An Interim Review of the Health Information Systems Programme—University of Oslo—with Recommendations for Future Action

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PATH would like to thank the many individuals that shared their insights and experiences through surveys and interviews. A full list of names is available in Appendix 6: Trips for in-person data collection.

The report is the product of its authors and the responsibility for the accuracy of data included in this report rests with the authors. The findings, interpretations, and conclusions presented in this report do not necessarily reflect the views of the Norwegian Agency for Development Cooperation (Norad), the Bill & Melinda Gates Foundation (BMGF), or the University of Oslo (UiO).

Cover photo description: In Sinafala village, Zambia, data collector Odinga Chitonka, collects malaria data on his mobile phone, which is then uploaded to DHIS 2.

Photo credit: PATH/Gabe Bienczycki.

September 15, 2016 report updates:

- Updated Figure 14 - UiO reported funding by partner, 2010–2016 (USD)
- Updated Table 5 – UiO reported 2016 expected income and expected outcome (USD)
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The Norwegian Agency for Development Cooperation (Norad) and the Bill & Melinda Gates Foundation (BMGF) engaged PATH to conduct a strategic review of the Health Information Systems Programme (HISP) at the University of Oslo (UiO). Norad also engaged PATH to conduct an external assessment of HISP in 2011.

While the main activity of the HISP network began as development of the District Health Information System (DHIS) software for collecting and aggregating health statistics, HISP is more than a software development project; it consists of three inter-related activities: software development, implementation support, and research and innovation. The web-based version of DHIS, DHIS 2, has evolved into the leading open-source, web-based solution for aggregate health data and is in use in more than 50 countries.

Norad, in consultation with partners, defined the initial objectives for the evaluation. BMGF contributed more detailed supplemental questions and financing to the evaluation scope. The primary focus of this review was to assess the role, capacities, challenges, and opportunities facing UiO and make recommendations on how its role might be enhanced to support the increasing demands for development and deployment support.

To assess and inform recommendations, PATH used multiple methods to gather data and opinions, including: conducting a series of stakeholder interviews; administering an online survey; collecting program data from UiO; and facilitating an in-person focus group discussion with UiO, Norad, and BMGF. The assessment was conducted between December 2015 and June 2016.

General Findings

Software development: DHIS 2 has evolved into a well-established software platform supported by a professional team of core staff at UiO. Since 2011, growth of the core team through the hiring of staff and centralization of software development at UiO transformed the product management of DHIS 2. The platform evolved beyond its original support for aggregate district health data to also include tracking patients and events and expanded visualization and reporting capabilities. In addition, the growing monitoring and evaluation (M&E) use case for nongovernmental organization (NGO) and donor programs has brought increased funding to DHIS 2 software development; however, country users are concerned donor requirements are driving the product roadmap at the expense of country needs. Stakeholders have a very positive view of DHIS 2 and the HISP UiO team, but would like a better understanding of DHIS 2 strategy, roadmap, and product management processes.

Implementation support: UiO plays a central role in building capacity to use DHIS 2 and nurturing a community of learning and experience sharing around the platform. The open-source model, in combination with a network of country-based development and implementation groups (HISP nodes), has greatly contributed to the success of DHIS 2 uptake. The emerging regional approach has had significant impact on the scale-up of country adoption. Peer learning networks are valuable for sharing and learning from successes and building country capacity, and will be essential for the continued success of DHIS 2. The HISP nodes are a powerful network for amplifying capacity building and extending the overall HISP team to countries and regions; however, the network could be better utilized by clarifying roles.
**Research and innovation:** HISP has strong support from UiO and the Department of Informatics, and there are many advantages to HISP being housed in a university setting. HISP students contribute substantially to active implementation research and continuous improvement to HISP approaches and DHIS 2 software. The continued engagement of UiO (researchers, students, and development team members) in country implementations advances the body of knowledge in global health informatics and provides a critical feedback loop to software development. Decreased funding for research and scholarships has put innovation at risk.

**University of Oslo program management and capacity:** While UiO program management and capacity has grown significantly over the past five years, more can continue to be done to further develop organizational maturity with sustainable processes, product management systems, and long-term human resource capacity. There is a clear message from stakeholders for UiO to increase software development quality and capacity. In addition, questions were raised about the potential value of moving DHIS 2 support out of the UiO setting into a separate organization to focus on software development. However, UiO’s multipronged HISP approach to coalescing software development with implementation support, capacity building, and research is critical to DHIS 2 success, so we believe increasing software development capacity is best achieved within the current UiO HISP model.

**Funding landscape:** The funding landscape for DHIS 2 changed significantly since 2011. Norad; the Global Fund to Fight AIDS, Tuberculosis, and Malaria (the Global Fund); and the President’s Emergency Plan for AIDS Relief (PEPFAR) coordinated investment to support core program management, platform development, and in-country implementation support. However, funding has become more fragmented across donors and partners and is increasingly tied to NGO-specific requirements. Flexible funding to support the development of the core software platform was a major contributor to the development of DHIS 2. While HISP’s annual funding more than doubled since 2011, a majority of this funding is set to expire in 2016. There is also a gap in funding for ongoing in-country support following implementation.

**Summary of Recommendations**

<table>
<thead>
<tr>
<th>Software Development</th>
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<tbody>
<tr>
<td>✓ Increase communications of the HISP strategy, DHIS 2 software strategy, UiO capacity and management structure, and DHIS 2 roadmap and governance processes to increase awareness.</td>
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<tr>
<td>✓ Define clear boundaries for DHIS 2 product strategy that would alleviate scope creep and the concern of trying to “be all things.”</td>
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<td>✓ Establish an external advisory board, representing various stakeholder roles including country and NGO users, donors, developers, and implementers, which can provide input and guidance on changes to strategy.</td>
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<td>✓ Increase community input, visibility, and usability of the DHIS 2 product roadmap.</td>
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<td>✓ Engage an external technical review of the platform and code base.</td>
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<td>✓ Improve the quality of releases by increasing release testing, improving the stability of application programming interfaces (APIs) and integration points, and supporting a simplified release path.</td>
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## Implementation Support

- Build a network of implementing partners by developing a certification program for implementers.
- Develop “preconfigured” templates for common deployment use cases and standard sets of indicators and dashboards to decrease the time, effort, and variation in implementations.
- Develop a guidance package or toolkit on how to implement DHIS 2.
- Establish DHIS 2 country teams to provide ongoing support and maintenance across any DHIS 2 in-country installations.
- Strengthen training classes and resources and distribute training responsibilities to nodes and partners to address training needs.
- Clarify the definition and roles of the HISP network and nodes.
- Strengthen the DHIS 2 community of practice.

## Research and Innovation

- Maintain a focus on research and continue to make HISP work known through academic publications.

## University of Oslo Program Management and Capacity

- Increase software development quality and capacity balanced with the other components of the HISP program that have made it successful.
- Increase UiO staffing in a prioritized, incremental approach.

## Funding Landscape

- Coordinate donor investments to ensure funding reaches the appropriate components of HISP.
- Coordinate and pool funding for in-country ongoing support needs.
BACKGROUND

Introduction

The Health Information Systems Programme (HISP) was initiated in South Africa in 1994 as a collaborative research project between the University of Oslo (UiO) and the University of the Western Cape. Masters and PhD students from 22 countries study topics related to the development and use of information and communications technology (ICT) based on health management information systems (HMIS). Their research supports the development of the District Health Information System (DHIS) software program. The web-based version, DHIS 2, was developed by the UiO Department of Informatics in 2005 and is a free and open-source platform designed to provide a backbone for national HMIS at national and sub-national levels.

The main activity of the HISP network has been the development of the DHIS software for collecting and aggregating health statistics. However, it is critical to recognize that HISP is much more than a software development project; it is an action research program responsible for shaping the culture of information use through training of local technologists, decision-makers, and health managers, as well as contributing to the global body of knowledge through academic research and dissemination.

HISP consists of three inter-related activities (see Figure 1):

- **Software Development** - Driving the development, maintenance, and dissemination of an evolving suite of ICT tools under the DHIS 2 package.
- **Implementation Support** - Supporting country deployments through regional workshops and academies and leveraging the HISP network and community of practice (CoP) to build capacity for DHIS 2 deployments and provide a feedback loop to software development.
- **Research and Innovation** - Leading action based research to investigate and design solutions to problems encountered in national HMIS systems using ICT tools.
**FIGURE 1. HISP REPRESENTATION**

**HISP**

HISP is a global network established, managed, and coordinated by the Department of Informatics at the University of Oslo.

- SOFTWARE DEVELOPMENT
  - DHIS 2 strategy
  - DHIS 2 development roadmap
  - DHIS 2 quarterly releases

- IN-COUNTRY IMPLEMENTATION SUPPORT
  - Implementation support
  - Capacity building through academies and training
  - Network of HISP nodes and community of practice

- RESEARCH AND INNOVATION
  - PhD students
  - Masters programs
  - Action research

**HISP progress update**

Since the last assessment report prepared by PATH in 2011, HISP has made great strides. Demand for DHIS 2 software by countries has significantly increased, funding more than doubled, and UiO staffing has grown by more than five times the 2011 total. DHIS 2 has evolved in its core capacity beyond its original support for aggregate district health data to include tracking patients and events.

UiO has leveraged a relatively modest budget to build a program with significant research credentials as well as capacity-building in support of deployment and use of DHIS 2 in over 50 countries. DHIS 2 is emerging as the core software on which to build national HMIS and to-date has been selected by 21 countries and seven Indian states for this purpose. A version of DHIS 2, called DATIM (Data for Accountability, Transparency and Impact), is also being used by the President’s Emergency Plan for AIDS Relief (PEPFAR) for managing data reporting in 58 country programs.

Technical support from UiO is in high demand as health leaders in many countries are interested in DHIS 2 as a means to developing national HMIS systems that provide decentralized, timely, and high quality information for domestic use and routine decision-making, as opposed to expensive parallel efforts including surveys and specific data collection designed to meet the needs of external partners. Furthermore, development partners are increasingly recognizing the opportunities DHIS 2 deployment offers as a robust configurable software platform and its potential for developing local capacity, contributing towards the construction of sustainable platforms, and the opportunity for coordinating financing and support by multiple partners.

Following the recommendations of the 2011 HISP evaluation report, Norad started core funding to UiO to establish a core development team and professionalize support for the DHIS 2 platform. Later, from mid-2013, Norad partnered with PEPFAR and the Global Fund to Fight AIDS, Tuberculosis and Malaria.
(the Global Fund) to establish a 3-donor effort to strengthen DHIS 2 in countries. From 2015 there have been attempts to broaden this group of cooperating partners to promote alignment of investments among the Bill & Melinda Gates Foundation (BMGF), the United States Centers for Disease Control and Prevention (CDC), Gavi (the Vaccine Alliance), the United Nations Children's Emergency Fund (UNICEF), the United States Agency for International Development (USAID), the World Health Organization (WHO) and potentially, the World Bank. The interest and alignment of these major partners would ensure significant strategic intent and could propel significant synergies in health management information system (HMIS) investments.

The success of HISP and DHIS 2 is a result of several major factors - the changing ICT context in countries, expanded use cases, and HISP’s comprehensive combination approach to for ensuring country success.

**Changing country context**

The first offshore fiber-optic lines for Africa had only recently gone live in 2011, and few countries had fiber backbones supporting broadband connections to the districts. Successful digital health applications either existed only at the national level, or relied only on low-bandwidth mobile phone network technologies such as short message service, unstructured supplementary service data, and interactive phone-based voice response (much like customer support phone trees). Since 2011, broadband access has grown exponentially while prices for both connections and devices such as smartphones and tablets have dropped commensurately.

Five years ago, the broadest deployment of DHIS 2 to the district level was in Sierra Leone, supported by the Health Metrics Network’s investments. Separate instances of DHIS 2 were installed in every district and the data was aggregated by email or physical conveyance of thumb drives. Most countries using DHIS 2 were still bringing paper to the national level and entering it there. In 2016, the model has completely changed and the power of DHIS 2 as web-based software was unleashed. In most countries implementing DHIS 2, district-level health workers directly access the national system, entering data at the district level and doing data analysis. Emerging mobile tools are supporting direct entry of data from facilities and even community health workers. New interoperability capacities in DHIS 2 are supporting direct contribution of health indicator data from existing health information systems (HIS).

These developments greatly reduce the cost of nationwide district-level investments. Separate instances of DHIS 2 no longer need to be installed in every district, as a single instance of DHIS 2 can serve the entire national health indicator reporting system. As broadband connections, mobile tools, and DHIS 2 applications continue to increase, the reach of DHIS 2 will grow as well, both to new countries and more deeply into the districts, facilities, and communities of existing countries.

**Expanded use cases**

Nongovernmental organizations (NGOs) and donors have expanded use cases for DHIS 2 well beyond country health data reporting to include:

- NGO-wide and project-specific M&E systems.
- Program monitoring systems such as PEPFAR’s DHIS 2-derivative DATIM system for monitoring all PEPFAR country activities.
- Longitudinal patient care using the DHIS 2 patient tracker is supporting stronger source data for health indicators, and enabling the use of DHIS 2 for shared health records and domain-specific
registries such as family planning, antenatal care, deliveries, and under-five care including immunization.

- Disease surveillance applications using the DHIS 2 event tracker are supporting global programs around the world such as the CDC’s Global Health Security Agenda, and country-specific implementations are supporting digitally-enabled case management and disease elimination programs.

**HISP multipronged approach to software development**

Where many open-source digital health programs have focused on software alone, UiO-led interventions include strong research, capacity building, and community of practice activities. By coordinating these different interventions into a comprehensive approach, UiO has created a model for success for digital health global goods. Through participating actively in a range of implementation projects, UiO has developed highly relevant software and established an implementation approach that has shown to be successful and sustainable.

The success of the software development method and the spread of the DHIS 2 platform is highly contingent on deep involvement from the core development team in local implementations. This is in line with a participatory design approach where developers and users sit closely together to conceive well-functioning solutions to real problems.

As shown in Figure 2, the DHIS 2 software development and implementation projects have largely been action research based, in the sense that new functionality is tested out in small scale on the ground before being scaled up and if successful taken back and implemented in the DHIS 2 core platform. In parallel, important implementation experiences are published in the academic literature and shared at events such as DHIS 2 training academies. HISP generates high quality research outputs through PhD students, many of whom return to their home country to lecture at universities, support local companies and support and give advice to Ministries of Health, donors and NGOs. Thus, they become key actors in the establishment of local capacity to support the strengthening of health information systems.
Purpose of this report

A number of questions, challenges, and opportunities have arisen in response to the increased demand for DHIS 2 support. Deploying the DHIS 2 platform does not necessarily ensure delivery of more and better health information. Recent deployments indicate the potential for significant learning in terms of architecture, data quality, and data use.

There is a need for UiO to:

- Secure core financing.
- Support the continued scale-up of DHIS 2 deployments by focusing UiO capacity and strengths in the areas of greatest value add.
- Facilitate and leverage the DHIS 2 community of practice to share best practices and increase in-country capacity.

The purpose of this review was to independently collect feedback from multiple stakeholder groups to assess and inform recommendations for UiO to grow their capacity and pursue resources for continued support and expansion of DHIS 2.

Scope

Norad and BMGF each contributed funding towards the scope of work for the research and development of this review. The time period for the collection of stakeholder feedback, assessment, and
development and documentation of recommendations was conducted between December 2015 and June 2016.

The potential depth of topics covering HISP, the DHIS 2 platform, deployments, and funding is far reaching. The scope for this assessment was not exhaustive due to limited time and resources and did not include a literature review, nor an assessment of implementation success and best practices. Stakeholders selected for interviews and surveys were primarily implementing partners, developers, and donors. Several country representatives were included, but as the numbers were small, country feedback is not adequately represented. Questions relating to the efficiency and effectiveness of country-based implementations were left to a potential Phase II of research to be further discussed among partner agencies. Topics for further research could include assessing best practices for DHIS 2 design, deployment project management, financing, building in-country capacity, and on-going maintenance support needs.

The primary focus of this current review was to assess the role, capacities, challenges, and opportunities facing UiO and to make recommendations how its role might be enhanced to support the increasing demands for development and deployment support.

Objectives

Norad, with consultation from partners, defined the following objectives for the evaluation:

1. Provide a holistic assessment of progress made to date, specifically:
   a. Scale up of DHIS 2.
   b. Core competencies of the HISP UiO team.
   c. Development of the capacities of the HISP network (operating environment).
2. In relation to the capacities required to enhance roll out and deployment of HISP at the country level, the review should seek to answer what is needed to successfully support national roll out in a large number of countries (e.g., national roll out in 50+ countries) from a quality and use perspective as well as a technical deployment and sustainable management perspectives.
3. Categorize the various opportunities open to HISP/DHIS 2 and make recommendations (given an appreciation of competencies and priorities) of where to focus.
4. Make recommendations for how to go forward institutionally (within UiO as well as in the broader HISP network). The review should make recommendations with regard to what institutional capacities need to be developed and what support functions and governance structures could be developed to promote enhanced functionality while retaining flexibility.
5. Identify what partnerships and financing (volume and form) are required to facilitate this model of growth and development.

BMGF contributed more detailed supplemental questions to the assessment scope and these were aligned to the objectives as shown in Appendix 1.
**Approach and Methodology**

**Approach**

PATH aligned assessment activities with the scope objectives and the supplemental questions, which can be found in Appendix 1. Where appropriate, the supplemental questions from BMGF are addressed in the body of the report in the corresponding section. To improve report readability and also to answer each of these questions specifically and completely, Appendix 2 contains these supplemental questions and answers.

**Methodology**

PATH used a combination of phone and in-person interviews and an online survey to collect information on stakeholder experiences and feedback regarding working with DHIS 2 and the UiO. The in-depth interview notes and survey responses were consolidated, summarized, and included in the findings section of this report. PATH also collected data from UiO on software development policies and procedures, deployment and training support, research outputs, staffing, and financing. In addition, a focus group discussion with UiO, Norad, and BMGF was held to review and discuss key findings.

**Phone and in-person interviews**

In-depth interviews were conducted with 31 individuals, or in some cases groups of individuals, to gather qualitative data. Interview participants are included in Appendix 3. PATH staff used a master interview guide, which was similar to the online survey questions, but allowed more time and flexibility for discussion and follow-up questions. The interview guide is included in Appendix 4.

A second interview guide of donor-specific supplemental questions was also used to fill in some knowledge gaps. This interview guide of donor-specific questions is included in Appendix 5.

PATH staff traveled to attend events to conduct some of the interviews in person. PATH was able to leverage travel for other projects to supplement the budgeted grant travel funds. The trips listed in Appendix 6 provided the opportunity for in-person information gathering.

**Survey**

In addition to interviews, an online semi-quantitative survey was emailed to 47 individuals to provide the opportunity for additional participants to provide input. A response rate of 43 percent was received including 15 complete surveys and five partially complete surveys, which is a typical response rate for an unsolicited email survey. Survey responses were anonymous and included responses across the stakeholder categories in Figure 3. The survey questionnaire, which was similar in content to the interview guide, is included in Appendix 7.
The survey responses indicate a high rate of responses from consultants, software developers, and implementers. This has to be taken into account in interpreting the responses, as it represents a specific subset of users with specific technical interests.
The findings and recommendation are organized into five main sections (see Figure 4).

1. Software Development

DHIS 2 has evolved into a well-established software platform supported by a professional team of core staff at UiO. The product has gained world-wide attention, is the most popular solution to collecting aggregate health data across a health system and is evolving new use cases on a continual basis.

DHIS 2 is not static, and a platform approach (see Figure 5) has resulted in expanded functionality through different levels of granularity of data. The original data model of aggregate indicators has been supplemented to include single events (case-based) and longitudinal records (tracked entity). These data models all feed into a common set of tools, such as pivot tables, maps, and a visualizer. An application (app) plug-in framework has been developed in order to mitigate the problem of centralized development by making it easier to build on to DHIS 2 without modifications to the core. Visualization and reporting capabilities have been expanded, and internal functionality is continuously advancing and changing.
The 2011 review drew attention to challenges in managing a global software product with a small team of academic software developers. It recommended both increased resources for software development and adoption of professional software management approaches. Through the hiring of professional staff and centralization of software development at UiO, there has been a transformation in the product management of DHIS 2. Changes implemented since 2011 have been successful and have allowed the platform to take on a greatly expanded global role.

**Product Strategy**

We used the term product strategy to define the overall vision for the DHIS 2 software and the approach and governance for technical development. UiO has defined guiding principles and a strategy for DHIS 2 within the broader HISP UiO Strategy 2014–2016.

UiO defined guiding principles for DHIS 2 software development:

1. Generic and reusable core features for a global user base, avoiding complexity
2. Rapid response to user needs – new release of the core platform every quarter
3. Innovation through in-depth involvement of the core team in country implementations
4. Adoption of community-developed standards for data exchange
5. Enabling local innovation and extensions based on open web-API and App Store
6. Transparency and online visibility (roadmap, bugs, releases)

An excerpt from the DHIS 2 strategy is included in Table 1.
**TABLE 1. EXCERPT FROM DHIS 2 SOFTWARE DEVELOPMENT STRATEGY**

| Key Focus Areas: | Maintain and advance DHIS 2 as a health information system  
| | - Develop functionality to meet emerging requirements  
| | - Keep at pace with emerging technological trends  
| | - Maintain code and improve code efficiency  
| | - Maintain architectural integrity  
| 1. Secure a strong and future oriented software core |  
| 2. Decentralize by promoting a community of application development partners around DHIS 2 | - Evolve DHIS 2 from an application to a platform  
| | - Promote a community of app developers working in areas that require special features/adaptations  
| | - Strengthen the web application program interfaces to allow other systems to access data more widely  
| Key Functional Focus Areas: | Move towards more relevant, timely, and appealing data for decision-makers  
| | - Improve data visualization  
| | - Utilize social-media features extensively  
| | - Offer information through multiple channels (message boards, email, short message service [SMS], etc.)  
| 1. Reach out to decision-makers with improved data | Enable data collection and basic data use at the lowest level of the health system  
| | - Offer robust and simple applications connected to a stable national backbone  
| | - Support all devices at hand (personal computers, tablets, smartphones, low-end phones, etc.)  
| | - Offer automated messages (SMS) to communities and clients of health programs  
| 2. Reach out to the facility and community levels through mobile devices | Support key registering data underpinning mother and child health in the domains of:  
| | - Management of the logistics of essential commodities  
| | - Case-based data on vital events such as births and maternal and neonatal deaths  
| | - Tracking of individuals over time as part of longitudinal health programs  
| 3. Support basic health management information system registry needs related to logistics, vital events, and tracking | Make data available to other applications by implementing the community-developed Open Health Information Exchange (OpenHIE) standards.  
| 4. Support data exchange with other applications | Implement security measures in line with global standards (e.g., US and EU) on patient security and privacy. This work will be carried out in close collaboration with expert partners who have extensive experience in this domain, for example, the Norwegian Institute of Public Health and Population Services International (PSI).  
| 5. Secure the privacy of beneficiaries by securing patient-related information |  

Despite the existence of the detailed HISP UiO Strategy 2014–2016, the findings from stakeholder surveys and interviews indicate a lack of awareness of the strategy or confusion about the strategy.
The following are examples of feedback and findings related to the DHIS 2 software development strategy:

- Stakeholders are confused about the DHIS product strategy. Stakeholders expressed concern that there is no clear strategy guiding the product development and perceive a lack of transparency around the direction of the product.
- There is not a clear understanding among stakeholders about what open-source means in terms of software development and how stakeholders are involved in guiding the product’s evolution. There is a perception that the HISP network functions as a “closed community” despite the open-source label.
- Another clear finding is that stakeholders are concerned that there has been a “drift” from the core functionality and strengths of the platform in an attempt to meet a variety of user needs. A number of stakeholders expressed the concern that DHIS 2 is trying to become “all things to everyone.” There is not a clear understanding of how new modules fit with the core product. There is concern of “scope creep” as additional features are layered on to the core product, resulting in an unwieldy product.
- There was mixed feedback on new components for Tracker and Events data, some indicating the new functionality was valuable in extending the use of DHIS 2 and some indicating the shift away from core aggregate data was a concern because it also shifts development resources from the core aggregate functionality. Stakeholders also noted a concern that new modules could “compete” with other software solutions; the most common example given was the questions of if the Tracker functionality driving DHIS 2 towards becoming or competing with an electronic health record (EHR).

> Focus should be on aggregate information and the dashboarding side. It doesn’t fit in product strategy to add business intelligence (BI) tools into the core... it should be external integration. Look at the Salesforce model... [INTERVIEW COMMENT]

> Would rather see DHIS 2 Tracker divorced from the main and have its own development track. The needs of the disaggregated data are different. Tracker will have a lot of churn from the main software (or the aggregate warehouse...) [INTERVIEW COMMENT]

> HISP should look at the core services and where it wants to expand to. HMIS and GIS [geographical information systems] are the tool to go to. [What is] confusing is patient tracker and comparing with [OpenMRS, OpenSRP]... As HIS gets more mature and domains more defined, the scope creep, particularly in patient records, is confusing. [INTERVIEW COMMENT]

- Users had positive comments about the strategy of using application program interfaces (APIs), standard integration points, the promotion of developing apps, and the use of the App store to support customization. However, they also noted more work is needed to strengthen and stabilize the integration layer (see more in Product Roadmap Findings).
• The use case for NGOs and donors deploying DHIS 2 as a platform for measurement and evaluation (M&E) is relatively new, compared to country deployments, and brings both opportunities and challenges.
  o Opportunities:
    ▪ Increased source of funding for core development from NGO and donor program deployments.
    ▪ New enhancements/functionality are being added to the base/core software that will benefit all users.
    ▪ New user community that can drive best practices forward.
    ▪ NGO and donor deployments in country can influence and increase DHIS 2 local support.
  o Challenges:
    ▪ Concern that DHIS 2 development resources are consumed by NGO and donor program-funded requests, at the expense of country requests.
    ▪ Concern with the proliferation of multiple instances of DHIS 2 running in-country (i.e., national instance and one or more NGO program instances) and the need to have a comprehensive country-owned understanding of their HMIS ecosystem and data.
    ▪ Concern that NGO and donor-specific development requests, while designed to be generic and benefit all users, may not actually achieve that goal if country users are not aware of new development enhancements nor have the resources to take advantage of them (e.g., would require planning, updating processes, new training, etc. to implement using a new function or feature).

**Product Roadmap**
A software product roadmap is a tactical plan, generally used to plan and communicate the schedule for the development of software features.

The following are findings and feedback related to the DHIS 2 roadmap and software development:

• The UiO maintains a DHIS 2 roadmap, available on the DHIS 2.org website, that shows what features and projects are planned for the next three releases. Comments from survey and interviewee participants mentioned the need for a roadmap, so users may be unaware of the available roadmap, or the roadmap is not meeting stakeholders’ needs (e.g., it may be too technical for all stakeholders).

• Several stakeholder participants mentioned confusion and frustration about how requested functionalities and improvements are prioritized. There is a desire to see more transparency in how the roadmap is developed and the process used to prioritize and schedule development requests. Stakeholders perceive that new features and functionality are driven by funding, which leads to concern that country needs are not being addressed in favor of NGO and donor program needs. UiO does have a process for prioritizing enhancement requests based on an assessment of impact versus level of effort and benefit versus complexity, importance, participation of requesting organization, and funding. For more detail on the DHIS 2 enhancement prioritization process, please see Appendix 2, supplemental question C3.
- Stakeholders were asked in the survey to prioritize DHIS 2 enhancements/focus areas. The results (provided in Figure 6) show most enhancements were ranked as both high priorities and low priorities. This seems to indicate there is not a cross-cutting agreement on which focus areas are the highest priority and it is assumed different stakeholders have their own priorities depending on their roles and use cases.

FIGURE 6. SURVEY RESPONSE: DHIS 2 ENHANCEMENT PRIORITIES

- There is not a clear understanding across stakeholders on what an open-source development model looks like and how UiO manages development resources and the development process.
- There is a concern that the DHIS 2 code base has become complex and fractured over time as more and more features and functionality are incrementally added to a maturing system. UiO does look to simplify code as new features are added; however, this is an incremental approach. Stakeholders suggested that a technical redesign or refactoring would help to clean up the code base. Refactoring is the process of restructuring existing computer source code, without
changing its external behavior, in order to improve its internal structure, making the code cleaner and simpler.

**Release Management**

Release management includes the tactical management and processes of how DHIS 2 enhancements are packaged and made available in product releases.

The following are findings and feedback from survey and interviewee stakeholders related to DHIS 2 releases:

- DHIS 2 maintains a quarterly release cycle. This is generally regarded as positive and facilitates rapid dissemination of new functionality.
- It is apparent that users are challenged with keeping up with the quarterly release cycle as they must balance the effort and risk of installing new releases with falling behind in versions and support.
- As deployments reach scale and use becomes more stable, users will have a desire to minimize the expense and risk of installing new releases as they will have less need for new functionality.
  
  There were several suggestions from users that a minimized release upgrade path would be desirable for mature deployments.

  
  _Maybe it’s a good idea to distinguish bi-annual major releases (which might contain technology breaks with a migration path) and trimester minor releases (which only contain bug-fixes and new features which don’t require a migration path) [INTERVIEW COMMENT]_

- Users reported both that the quality of releases was good and also that quality needs to be improved. It was noted that UiO is responsive and makes fixes quickly; however, users tend to wait until patches are released and stability is better before installing new releases. Quality of releases is increasingly critical as the install base of DHIS 2 users has increased. In addition, DHIS 2 is increasingly part of a larger country digital ecosystem. A bug found in DHIS 2 may now have ramifications across multiple other systems, which may not have active developers and support to adapt to unplanned DHIS 2 bugs or changes.

  _“Testing—I will prefer less features, and know that every release can be trusted as a fully working version, bug free (or at least almost bug free).” [SURVEY RESPONSE]_

- Several users strongly voiced recommendations to improve the stability of APIs and integration points in the releases, suggesting that they must be versioned and cannot change with each release because it causes re-work on the non-DHIS 2 side of any integrations. This causes increases and unplanned expenses for users to install and test releases.
- Some concerns were raised about when functionality or features are changed or removed. Users felt there is a need for more advanced planning and communication about if and when functionality will be removed.
Several users suggested a need for UiO to have an issue tracker and expressed frustration with not being able to easily track the status of an issue and related fix and resolution. UiO does track issues, so there may be a gap in the awareness, availability, or usability of this information.

**Software Development Recommendations**

**Product Strategy Recommendations**

**Recommendation:** Address the disconnect between UiO DHIS 2 product strategy and stakeholders’ awareness and perceptions of that strategy. The disconnect could be the result of one or more of the following reasons:

- Stakeholders are unaware of the existence of a product strategy.
- Stakeholders disagree on the product strategy.
- There is a disconnect between the product strategy and actual product development execution.
- There is a disconnect between the product development execution and stakeholder perceptions of product development.

We suspect a large part of the disconnect is due to the latter, specifically that UiO has made relatively recent changes to documenting the DHIS 2 strategy that has largely not been seen and understood by the many stakeholders involved in the development, deployment, or use of DHIS 2.

**Recommendation:** Develop a communications plan to increase awareness of the HISP strategy, DHIS 2 software strategy, UiO capacity and management structure, and DHIS 2 roadmap and governance processes. The DHIS 2 website has most of this information available, but is focused primarily towards technical implementers, so perhaps could be expanded to meet the broader information needs of other stakeholder groups.

**Recommendation:** The DHIS 2 product strategy should define clear boundaries for product goals and objectives that would alleviate scope creep and the concern of trying to “be all things.” This could include identifying priority use cases, such as immunization and disease surveillance and identifying what DHIS 2 is not focused on.

**Recommendation:** Establish an external advisory board, representing various stakeholder roles including country and NGO users, donors, developers, and implementers, which can provide input and guidance on changes to strategy. Any new major product components or changes to strategy should be reviewed by the advisory board.

**Product Roadmap Recommendations**

**Recommendation:** The DHIS 2 product roadmap should be more visible, (i.e., improving how users find it, understand it, and can use it). This may include more documentation on enhancement features and more transparency about the process for prioritizing and scheduling enhancements. Concerns about which development projects and focus areas to focus on may be alleviated by a more transparent view of the process.

**Recommendation:** Increase engagement with the user community as input to the product roadmap. This could include online voting on priorities or other engagement models to ensure users, especially country users, feel like they have a voice in product priorities.
Recommendation: Engage an external technical review of the platform and code base. This review would provide feedback on the strengths and weaknesses of the technical architecture and guidance on when/if the code could benefit from a refactoring to clean up and simplify the internal structure.

Release Management Recommendations

Recommendation: Increase the amount and quality of release testing. In addition to the testing for each individual change, there should be full regression testing of a packaged release to ensure it does not cause unintended breaks or changes. Installed users also must test releases in their specific configuration and ecosystem of integrated systems. This should not be a direct function/responsibility of the UiO team, but any tools and techniques to help users in how to improve their own release testing would be well received.

Recommendation: Improve the stability of APIs and integration points in the releases. APIs and integration points should be versioned so that any time there is a change to an API or integration point, it does not require a change to the other side of the integration point unless the user is planning to take advantage of those changes.

Recommendation: Support a simplified release path for stable/mature deployments, such as an annual release with optional quarterly patch releases that are combined into the yearly release. There should be clear product guidance on how current users need to stay on releases to receive core product support and a viable upgrade path.

2. Implementation Support

DHIS 2 is in use in over 50 countries (see Figure 7) compared to less than 20 countries in 2011, which represents a greater than 160 percent increase. This widespread use was noted by survey respondents as an important factor in what makes DHIS 2 compelling (see Figure 8). The software is part of routine reporting and is the national HMIS in 21 countries. Some country rollouts have been swift, likely as a result of increased resources available for deployment and support. DHIS 2 has also been deployed at a large scale by PEPFAR (58 countries were reporting through DATIM as of June 2015), as well as the increasing deployments by NGO and donors.
DHIS 2 has scaled within countries as broadband connections have reduced the cost and difficulty of access. Nigeria alone has more than 70 million data values in DHIS 2, adding more than two million data values every month from 22,000 registered users. Kenya similarly has 11,000 registered users and is adding more than 1.5 million data values every month. DATIM has 9,000 registered users across the 58 countries where it is deployed. These examples show the success of the HISP implementation support approach.
The open-source software model of DHIS 2 is at the heart of the software’s success. Open-source, in contrast with more proprietary software models, emphasizes the collective ownership of every user and implementer, not just UiO. Open-source approaches foster community, collaboration, and easy uptake and customization by other individuals and organizations. This lowers dependency on the core software development team; it is not necessary that they conduct every implementation, instead they are able to engage and support implementations led by others.

This model is supported by several key approaches, including a network of country-based DHIS 2 development and implementation groups (currently known as HISP nodes), a successful series of DHIS 2 academies that gather implementers and users together for training, and engagement with existing regional peer learning networks.

The emerging regional approach has arguably had the most impact on country adoption over the last five years. The proliferation of DHIS 2 in West Africa has largely been a result of UiO’s continual participation in and support of the West Africa Health Organization’s (WAHO’s) Health Information Systems (HIS) program and the HISP West Africa and HISP Nigeria nodes which are organizing 2-3 annual DHIS 2 academies in both French and English. WAHO’s HIS program has routinely convened HIS leaders from all 15 of the Economic Community of West Africa States (ECOWAS) member countries to review and evaluate DHIS 2 and other national health information solution strategies. UiO has been an essential contributor to the dissemination of DHIS 2 at these events, capacity building of member countries, development of a regional strategy, and establishment of a regional DHIS 2 instance that captures core indicators from the countries for a comprehensive regional perspective. Similar approaches have been supported over the last five years by the Asia eHealth Information Network (AeHIN), and the East African Community’s (EAC) HIS program.

Countries are most willing to adopt new solutions based on reported success of other countries. Peer learning networks are an essential forum for sharing and learning from these successes, and UiO is a pioneering supporter of these networks in strengthening country capacity and the proliferation of successful solutions. This practice is essential for continued success of DHIS 2, further increasing country capacity.

**Implementation Support**

There has been a considerable increase in the number of full country deployments since 2011, and ministries of health are expressing keen interest in DHIS 2. In addition, the increasing number of NGO and donor program deployments is driving increased needs for implementation support. Evaluating quality and best practices of deployments was out of scope for this review, but we expect there is a wide variation in levels of success. We suspect there is a range of causes for deployments being less than successful and some are unrelated to the HISP or the DHIS 2 software, such as lack of sponsorship, data quality issues, and lack of adequate ongoing support. However, any unsuccessful deployments will fairly or unfairly reflect poorly on HISP and DHIS 2.

The following are findings and feedback from survey and interviewee stakeholders related to DHIS 2 implementations:

- Some respondents indicated that the technical aspects of implementation are generally easy, but that ensuring political support and ongoing project management is challenging.
Stakeholders agreed that knowledgeable implementation support resources are absolutely critical to the success of a DHIS 2 deployment. Because DHIS 2 is a configurable, generic platform that can address a variety of use cases without coding customization, expertise and experience are required during deployment to guide making the best decisions and design for system set-up and configuration.

Implementing users have difficulty locating and obtaining experienced individuals who can support configuration, resulting in the requests going directly to UiO for implementation support.

There are HISP nodes providing implementation services, UiO is providing implementation services, and private-sector independent organizations are providing training and implementation services. There is confusion about where and how to engage support and the potential for competition and lack of coordination between these entities.

Stakeholders indicated that every implementation “starts from scratch” and has to define their configuration, even when many use cases are standard or similar.

Stakeholders suggested that there could be more guidance available to help with implementation project planning including resource planning.

To continue to support high-quality implementations in a time of rapid expansion, UiO is focusing on scaling up the production of support material and implementation guidance to more efficiently share 20 years of collective HISP experience.

UiO has proposed the concept of establishing DHIS 2 country teams to help address the capacity gap of local resources to provide ongoing support for in-country deployments. This could address both the need for developing local resources for providing ongoing support as well as promoting a national coordinated view across multiple in-country DHIS 2 installations.
Training and Capacity Building

The topic of training can fall across many of these report sections as it relates to user training on product use and functionality, training for implementations and configuration, and academic training as part of the larger HISP academic research program. This section focuses primarily on DHIS 2 training academies.

The following are findings and feedback from survey and interviewee stakeholders related to DHIS 2 training:

- The DHIS 2 academies are generally viewed favorably, but there is a strong demand for more and better training. Suggestions were made that training should be more use-case specific and less generic. Suggestions were also made to improve learning tools and methods such as interactive module and online courses. UiO has recently updated the academy curriculums and added more advanced classes.
- It was pointed out that based on the increased number of NGO and donor program deployments, there are more NGO and donor users attending academies, in some cases taking up 80 percent of the available seats. This raised a potential concern that this could impact the access, availability, and funding for country users to attend needed academies. NGOs and donors should consider cross subsidizing training for country attendees to also attend.
- Stakeholders reported mixed responses with some indicating UiO should do more training on data governance and data use and some indicating UiO should focus more specifically on DHIS 2 use and leave broader topics of data use and analytics to other organizations.
- The academies serve a secondary purpose by creating and sustaining the network and user community. This informal network building has been essential to developing a community of practice that supports users to find one another to share solutions and support. While users often attend training during a deployment, it may be difficult (and expensive) to attend ongoing trainings in order to remain engaged with the user community. Therefore, there is a need for additional ways to support community building that would supplement and compliment the networking that happens in the academies.

HISP Network

The HISP network of nodes include in-country and regionally-based software developers and DHIS 2 implementers that are loosely affiliated with UiO. Generically, the term node refers to the actors or connection points in a network. The HISP network has developed organically without any formal structure.
The following are feedback and findings related to the HISP network:

- The HISP nodes are a powerful network for amplifying capacity building and extending the overall HISP team to countries and regions.
- The HISP network and nodes have evolved organically and informally. There is not a formal relationship between the nodes and UiO nor each other. Some nodes are doing core development work (India, Ireland, South Africa, United States, and Vietnam) and some are supporting implementations, training, and local customization (see Figure 9).

> “[As adoption at the enterprise level grows, HISP nodes] are largely not prepared to respond given the level of complexity. If they want to support this sector they need additional training… This quality issue is highly frustrating to NGO implementers who are told that DHIS 2 implementation is easy.” (SURVEY RESPONSE)

- There is a common confusion among stakeholders about what the nodes do and if and how to engage them. It is also unclear who can become a HISP node and a lack of transparency in that process.
“UiO should have a clear plan that emphasizes the role of regional nodes in supporting country HMIS.” [SURVEY RESPONSE]

- There is potential conflict and competition between the nodes, though there is also potential for cooperation. There is a history of tension between some of the HISP nodes and UiO, primarily due to lack of clarity in roles, stresses related to funding, communications challenges, and occasionally competing against each other for work.
- There are significant differences between nodes. The South Africa and India nodes are large and function quite differently from smaller nodes; these two nodes are natural regional implementation teams that are able to provide long-term stability and support.
- The nodes also vary in terms of their capacity. While technical knowledge and skill is high across nodes, managerial skills are consistently lacking.
- HISP nodes can be long-term entities that serve to strengthen country capacity, but they need to be sustainable to retain talent and knowledge. There is not a clear model for success—it is unclear what funding and infrastructure is needed to create a functional HISP node.

Is there a common definition of how the network is defined? Who is in, and who is not in? Does Oslo/UiO see itself as a key member of the HISP network, or an independent actor that supports all stakeholders using the DHIS 2 equally (irrespective whether they are HISP nodes or are NGOs and private companies)? [INTERVIEW COMMENT]

“No one understands what the HISP networks are. They seem to be loosely vetted independent agencies that have vague connections with UiO. There is no formal certification of these agencies and capacity across them varies widely. If UiO is supporting them, it is not clearly communicated to the user community.” [SURVEY RESPONSE]

**Community of Practice**

The DHIS 2 community of practice (CoP) is a user community of individuals open to anyone interested in DHIS 2. This differs from the HISP nodes that are loosely defined organizations with staff involved in development and/or deployment support.

The following are findings and feedback related to the DHIS 2 CoP:

- This community has grown organically primarily through the academies.
- There is a DHIS 2 “experts” list available on the website. It is not clear to stakeholders how to be designated as an expert.
- The user community is a valuable resource that could be better utilized to harness even greater potential benefits. The CoP can provide feedback to UiO on what is working well and what is not and could be used to provide input or voting on roadmap priorities.
Implementation Support Recommendations

Recommendation: Focus on training and building a network of implementing partners, rather than providing primary implementation support, which is in alignment with UiO’s most recent strategy. Due to the limited number of UiO resources and the increasing demand for implementation support, UiO can have the greatest impact to quality implementations by focusing on tools, training, and processes that support the development of high-quality and consistent implementation resources. This could include development and strengthening of training material, training the implementers, and documenting and sharing best practices. The HISP approach relies on learning from implementations as the link and feedback mechanism to informing DHIS 2 software development strategy and roadmap planning, so it is important for UiO staff to be involved in some implementations.

Recommendation: Develop a certification program for training implementers. Organizations or individuals that have received training and acquired a UiO-designated set of qualifications could use the designation of “DHIS 2 certified implementers” as an accreditation. For consideration, in some models there is a fee structure associated with being a premier implementing partner.

Recommendation: Develop “preconfigured” templates or starter sets for common deployment use cases and standard sets of indicators and dashboards to decrease the time, effort, and variation in implementations. For example, the World Health Organization’s Global Reference List of 100 Core Health Indicators could be made available. UiO has already begun some work on developing starter packages. Development of these preconfigured starter sets could be done by UiO or by other partners as long as the templates are available as public goods.

Recommendation: Develop a guidance package or toolkit on how to implement DHIS 2. This should include recommended guidance on project planning, budgeting, what kind of staff and skills are needed, planning for infrastructure (e.g., hardware, software, storage, back-up, etc.) on-going maintenance and support needs.

Recommendation: Establish DHIS 2 country teams to provide ongoing support and maintenance across any DHIS 2 in-country installations. This could include the following:

- Consider UiO role as the secretariat for DHIS 2 country teams, providing guidance on best practices, identifying country team member candidates, and building and maintaining capacity.
- Leverage in-demand resources and help ensure NGO and donor in-country deployments compliment and not duplicate the national deployment by encouraging common standards and data sharing.
- Core activities for the country team would include:
  - DHIS 2 implementation activities such as interacting with users, designing the database, defining and harmonizing indicators, designing reports, and developing relevant dashboards.
  - DHIS 2 ongoing maintenance activities, such as maintaining good design, server hosting, installing software upgrades, performing database cleanups, and integrating with other systems.
  - DHIS 2 capacity building and training.
- The DHIS 2 country team should be competent in the following skills:
  - DHIS 2 design and technology.
DHIS 2 architecture and metadata, including interoperability.
- DHIS 2 implementation “best practices,” including interacting with users and stakeholders for harmonization of forms and indicators.
- Data use and design of relevant dashboards and reports.

- Address funding models for DHIS 2 country teams, acknowledging and accommodating local flexibility as to where the country team is located (e.g., at the ministry of health, local university, HISP node, local partner, NGO, etc.) and challenges with disparities in salaries. Consider pooled funding from NGOs and donors with in-country deployments.

**Training Recommendations**

**Recommendation: Strengthen training classes and resources.** Training classes and tools can be updated to leverage learning management tools (such as Moodle) to create online and interactive courses, which could be available in multiple languages. Class topics can be tailored to be specific to typical health use cases. It should be noted that the training needs of NGOs and donors may be different than in-country deployments as they may have less need to focus on capacity building. Training materials or courses should be available to address specific needs of different stakeholder roles, for example:

- Deployment planning
- DHIS 2 configuration
- Sysadmin and technical support
- Application development
- DHIS 2 features and functionality
- User training

**Recommendation: Distribute training responsibilities to nodes and partners to address training needs.** There are some areas that may be best suited for UiO to focus on, such as training on new DHIS 2 features and functions, or where UiO can provide the best opportunity for a multiplier effect by focusing on content, materials, and tools for training other trainers. There are other organizations that can take on training roles and should be utilized to extend the overall knowledge and tools available to meet increasing training needs.

**HISP Network Recommendations**

**Recommendation: Clarify the definition and roles of the HISP nodes.** It may be helpful to define what the nodes are and are not. This could involve the following initiatives:

- Consider redefining what a HISP node is (or is not) in relation to country support teams and the CoP.
- Define qualifications and a transparent process for becoming a HISP node.
- Develop and put in place memorandums of understanding to define roles, communication, and cooperation between nodes and with UiO when they are working together.
- Strengthen how the nodes are used to support in-country or regional training, deployments, and ongoing support.
- Strengthen the partnership and cooperation between nodes through a board or coordinating body (which does not need to be UiO led).
- Support the development of managerial skills within the nodes to operate sustainable teams (which does not need to be UiO led).
• Evaluate and recommend a strategy for a funding model to sustain the nodes (e.g., pooled funding, centralized funding, or decentralized funding).

Community of Practice Recommendations

Recommendation: Strengthen the DHIS 2 community of practice. This could involve the following initiatives:

• Provide active support for community management activities to strengthen networking and knowledge management.
• Develop and maintain the “experts list” with a transparent process and qualifications for becoming a designated expert, including relevant areas of expertise, and how to engage with them. Draw on examples from other open-source communities, for example, community members could be recognized with different “levels” of contributions.
• Facilitate more topic-specific community subgroups, such as by use case (e.g., global health security) or by functional topics (e.g., using DHIS 2 Tracker).

3. Research and Innovation

HISP is focused on enabling and supporting countries in strengthening their health systems and their capacity to govern their health information systems (HIS) in a sustainable way to improve the management and delivery of health services. Since 1994, researchers and students (Masters and PhD) have worked closely with users in developing countries to strengthen HIS.

At UiO, the DHIS 2 activities form a living lab, where research, innovation, and software development are closely linked. Based on interaction with users (including ministries, health workers, donors, iNGOs (international NGOs), exploration of new use cases (e.g., disease surveillance), and experimentation with new functionality and technologies (e.g., cloud and smartphones), research activities generate a steady stream of ideas, insights, innovations, and knowledge to the software development team.

One of the major highlights of the 2011 HISP assessment report was the power of DHIS 2’s home in a university. HISP did not begin as a major provider of essential global health software, but instead as a program for establishing health informatics masters programs at African universities, tied to a global PhD program based at UiO. The power of this approach for building health informatics leadership capacity in countries has been a foundation of success for the HISP approach and the DHIS 2 software. While funding for the expansion and support of the local university master’s program has declined substantially over the last five years, the PhD program has grown, currently supporting 17 PhD students.

These students contribute substantially to active implementation research and continuous improvement to HISP approaches and DHIS 2 software. The continued engagement of UiO and its researchers and students in country implementations has continued to advance the body of knowledge in global health informatics and successful approaches. Where traditional donor and NGO models have advanced the grey literature and often proprietary models of international development, UiO has contributed more than twenty peer-reviewed books, articles and presented papers to the growing body of knowledge in this area every year since 2010.

The following are findings and feedback related to HISP academic research:
HISP has strong support from UiO and the Department of Informatics, and there are many advantages to HISP being housed in a university setting. Significantly, 42 PhDs have been granted by UiO to students working in health informatics under HISP since the inception of the HISP project, of which 19 have been since 2010. This demonstrates success in the Action Research program pioneered by HISP and the global approach that has been taken for training.

UiO has supported international master’s degree programs in HMIS at UiO and the establishment of master’s degree programs within targeted countries (i.e., Ethiopia, Malawi, Mozambique, South Africa, Sri Lanka, and Tanzania). These programs have graduated 300 students contributing significantly to building in-country capacity.

There has been a decrease in funding for research and scholarships (see Figure 10), which not only puts research and innovation at risk, but also inhibits innovations in the continuous development of the platform and capacity around it.

**“UiO-trained resources are returning home to contribute to HIS strengthening. However, UiO needs to train more people especially at Master level in francophone countries. This training should cover both HIS and software development.”** [SURVEY RESPONSE ]

**“The local offices or developers in some cases are given too much responsibility and insufficient mentorship right after graduating—there needs to be an apprenticeship model, like what South Africa tries to do in some places.”** [SURVEY RESPONSE ]

**FIGURE 10. HISP REPORTED DECLINE IN RESEARCH FUNDING OVER TIME 2010–2015 WITH 2016 PROJECTION, (NOK) **

1 NOK is Norwegian Krone. For reference, 1 NOK = approximately .12 US Dollar
• HISP continues to publish academic works in health informatics conferences and journals at a substantial rate. Topics of publications include health systems architecture, eLearning systems, and health informatics. As
• Figure 11 shows, the rate of publication has remained steady over the last six years. Jørn Braa and Sundeep Sahay published a book, *Integrated Health Information Architecture: Power to the Users* (Matrix Press, New Delhi, 2012), which provides a substantial background on the theory of HIS and is a recognized contribution to health informatics.

**FIGURE 11. NUMBER OF HISP PUBLICATIONS, 2010—2015**

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**Academic Research Recommendations**

**Recommendation:** Maintain a focus on research and continue to make HISP work known through academic publications. There may be opportunities for research and funding through broader collaborations with computer science (for instance, studies of software engineering and open-source software). There are many examples around the world of NGOs that are successfully embedded within universities. These may provide models to inform the development of HISP inside UiO, and identify possible adjustments inside the academic structure.

4. **University of Oslo Program Management and Capacity**

The rapidly growing use of DHIS 2 around the world has led to an equally rapid increase in the demand for DHIS 2 expertise to provide technical support and guidance to implementations.
UiO plays a central role in not only developing a generic platform, but also building capacity to use the platform, to support and nurture a community of learning and experience sharing around the platform. This work is organised in different ways:

1. Provide generic support documentation and training material that anyone can utilize.
2. Host DHIS 2 academies that are open to anyone and focus on training in the use of the platform and sharing experiences with other organizations/countries implementing DHIS 2.
3. Develop formal partnerships around implementation projects where UiO and implementation partners work together to support a country or organization. Mutual learning between partners takes place through “learning-by-doing-together.”
4. Provide financial support and training to local/regional partners to build capacity to support country implementations, and to help UiO developers to gather requirements, test new features, provide feedback, and facilitate local innovations that can be incorporated into the generic platform and made available to all countries.

The HISP team at UiO has had a strong focus on recruiting developers to the core software development team in 2015 (see Table 2). The team at UiO consists of senior and junior academic staff, programmers, developers, technical writers, project coordinators, and students. PhD students are typically involved in development and implementation activities, but are not included in this table.

**TABLE 2. UIO REPORTED NUMBER OF HISP UIO STAFF AT 50% OR MORE ALLOCATION, 2010–2015**

<table>
<thead>
<tr>
<th>HISP UiO role</th>
<th>Total staff on DHIS 2 activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>Software Developers</td>
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</tr>
<tr>
<td>Implementers</td>
<td>1</td>
</tr>
<tr>
<td>Academy</td>
<td></td>
</tr>
<tr>
<td>Professors</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

Current UiO staff in 2016 is shown in Table 3 and includes a complete view of software development staff along with implementation support staff, research staff including students, and project administration and management staff.
University of Oslo Key Strengths

The following are findings and feedback on strengths of the UiO team:

- The UiO team is a strong advocate to ministries of health to strengthen management capacity and support HMIS development. Students from UiO provide critical technical resources when programs are getting off the ground. UiO is often credited for technical assistance and customization by country partners and is a key contributor to the HIS body of knowledge and human resources.
- The DHIS 2 product has gained world-wide traction as the most-used solution for aggregate health data, in large part due to the “care and feeding” of HISP by the UiO.
- Survey and interview respondents consistently expressed strong positive feelings about the DHIS 2 software and want to see continued success for DHIS 2 and HISP.
- The UiO team is viewed as “super-heroes” in terms of a small team creating the kind of success they have.
- UiO has made great strides since the last assessment review (2011) towards professionalizing the product management for DHIS 2 and increasing development capacity.

### TABLE 3. UIO REPORTED NUMBER OF HISP UIO STAFF, 2016

<table>
<thead>
<tr>
<th>HISP UiO Staff Summary</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software Developer Staff</strong></td>
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</tr>
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</tr>
<tr>
<td><strong>Total</strong></td>
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</tr>
<tr>
<td><strong>Implementation Support Staff</strong></td>
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<td>Implementation Support Staff Based at UiO</td>
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<tr>
<td>Regional Implementers</td>
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<tr>
<td>Technical Writers</td>
<td>2</td>
</tr>
<tr>
<td>Academy Administrators</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
</tr>
<tr>
<td><strong>Research and Innovation Staff</strong></td>
<td></td>
</tr>
<tr>
<td>Professors</td>
<td>5</td>
</tr>
<tr>
<td>PhD Students</td>
<td>17</td>
</tr>
<tr>
<td>Researchers</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>Project Administration and Management Staff</strong></td>
<td></td>
</tr>
<tr>
<td>Project Coordinators</td>
<td>2</td>
</tr>
<tr>
<td>Financial Administrators</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>HISP UiO Total Staff</strong></td>
<td>58.5</td>
</tr>
</tbody>
</table>

University of Oslo Key Strengths

The following are findings and feedback on strengths of the UiO team:

- The UiO team is a strong advocate to ministries of health to strengthen management capacity and support HMIS development. Students from UiO provide critical technical resources when programs are getting off the ground. UiO is often credited for technical assistance and customization by country partners and is a key contributor to the HIS body of knowledge and human resources.
- The DHIS 2 product has gained world-wide traction as the most-used solution for aggregate health data, in large part due to the “care and feeding” of HISP by the UiO.
- Survey and interview respondents consistently expressed strong positive feelings about the DHIS 2 software and want to see continued success for DHIS 2 and HISP.
- The UiO team is viewed as “super-heroes” in terms of a small team creating the kind of success they have.
- UiO has made great strides since the last assessment review (2011) towards professionalizing the product management for DHIS 2 and increasing development capacity.
University of Oslo Key Challenges

The following are findings and feedback on perceived challenges for the UiO team:

- There is concern from many DHIS 2 stakeholders about the success of the UiO team being reliant on a few key individuals. The organization has made progress to develop a management structure that spreads responsibilities from one key founder to four to five key leaders, but the risk is still there that losing one of these key people would critically impact the team. This sentiment was expressed fairly consistently across stakeholders.
- The organization is at a key point of needing to increase capacity and also move from “start-up” mode to a more stable and mature organization with sustainable processes that will live beyond the initial key founders. There is a challenge in maintaining the action research and innovation
traits that have enabled HISP success with the critical need for stability and a sustained focus on software quality.

So many organizations are pulling Oslo in different directions. [INTERVIEW COMMENT]

- Stakeholders often are not aware of the progress that has been made by UiO in developing and maturing the organizational structure and roadmap planning, suggestive of a need for better communication.
- There was mixed feedback from stakeholders on whether UiO should do more or less to promote a data-use culture (see Figure 12 responses). Some participants indicated this should be a role that other organizations can more effectively take on and some wish UiO could do more.
- There is a risk of backlash and criticism of DHIS 2 and the HISP program for any less-than-successful implementations. DHIS 2 software and deployments are judged unfairly by the quality of the data, which UiO cannot be accountable for. With the increased number of DHIS 2 deployments and implementations being supported by an increasing number of partners (with more variability in experience and quality), there is less direct influence UiO can have in ensuring each deployment success.

DHIS 2 can be seen as a silver bullet solution, but it’s not. It’s a platform that must be configured for specific use. [INTERVIEW COMMENT]

University of Oslo Capacity Recommendations

Recommendation: There is a clear message from stakeholders for UiO to increase software development quality and capacity. However, UiO must balance increased demands for development capacity and quality with the other components of the HISP program that have made it successful. The feedback from survey respondents (see Figure 1) and interviewees was consistent about the need for increased software development quality and capacity.
The top three core strengths of the HISP UiO program should be (select three)

Software development quality
Capacity and resource availability for software development
Capacity building of implementation and support resources
DHIS2 strategy for future product plans
Implementation support quality
Governance model for HISP network and DHIS 2 development
Resource availability for implementation support
Promoting a data use culture

Recommendation: Increase UiO staffing in a prioritized incremental approach.

Ideal scenario staff numbers
UiO has proposed increasing staff numbers (see Table 4) in order to increase capacity across all components including software development, implementation support, research and innovation, and project administration and management.

**TABLE 4. UiO PROPOSED IDEAL STAFFING SCENARIO**

<table>
<thead>
<tr>
<th>HISP UiO Staff Summary</th>
<th>Current baseline staff</th>
<th>Ideal scenario staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software Developer Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software Developers</td>
<td>17.5</td>
<td>30</td>
</tr>
<tr>
<td>Business Analysts</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Architects</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Testers</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17.5</strong></td>
<td><strong>38</strong></td>
</tr>
<tr>
<td><strong>Implementation Support Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation support staff based at UiO</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Regional Implementers</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Technical Writers</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Training Coordinators</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Academy Administrators</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>
Ideal scenario staff roles

UiO’s proposed staff functions would cover the following:

- **Increasing software development quality and capacity:** There is a need to scale the current software developer team to meet the demand from the increasing number of countries, capturing these requirements and assuring quality based on a solid architecture and a rigorous testing regime to assure stable releases and upgrades. The majority of developers are located at the UiO, while others are a part of the global team that work under the DHIS 2 development lead. This would be supported by:
  - **Software developers:** Design and develop software, write technical documentation and developer guides, participate as trainers in DHIS 2 academies for external developers. This includes the lead developers.
  - **Business analysts:** Capture, document, and prioritize user requirements.
  - **Architects:** Maintain the internal DHIS 2 software architecture, develop and document web application program interface (API) and user/developer guides, support the integration with other relevant software platforms.
  - **Testers:** Maintain a rigorous test regime.

- **Extending implementation support to meet increasing demands:** While DHIS 2 now is implemented in 50+ countries, the capacity at UiO to support implementers out in the field has not developed accordingly. To meet the increasing demand for support to countries, UiO needs to 1) consolidate and disseminate collective knowledge from 20 years of experience currently dispersed throughout the global HISP network, 2) strengthen regional capacity-building programs, and 3) facilitate—not lead—country support through a strong network of regional partners/training centers, and by facilitating country support teams and their training through certification. UiO needs to maintain (and even broaden) the long-term, deep engagement with a handful of implementations in order to continue the successful well-grounded platform innovation process.

  - This would be supported by:
    - **Implementation supporters based at UiO:** Consolidate and streamline guides and training material; facilitate sharing of use cases and best practices; provide trainers for expert level courses; mentor regional partners; take part in innovation projects in the field; and communicate requirements. Develop shared/standardized
configuration/metadata packages, provide patient data security guidance, engage in community interaction, participate in global initiatives, perform role of project management/lead on various globally coordinated projects, and coordinate and mentor DHIS 2 country teams.

- **Regional implementers**: Independent implementation supporters on sub-contracts work in country on a virtual team together with UiO-based staff.
- **Technical writers**: Professional writers support all the documentation needs of the implementation support platform.
- **Training coordinators**: Provide expert advice and inputs to the academy program; develop training materials, online learning platform, and certification process; develop and maintain long-term training strategy; run a certification program for DHIS 2 academies/expertise for trainers, participants, and country support teams; and develop trainer-of-trainers program for regional DHIS 2 training.
- **Academy administrators**: Provide all logistical support to hosting of DHIS 2 academies and related events. Mentor regional training partners. Develop targeted themed trainings and levels.

**Increasing research for innovation and long-term capacity building**: HISP and DHIS 2 grew out of research and innovation at UiO and across their partner universities in the south. As an action research project, research has put HISP UiO at the forefront of IT innovation and supports extensive experimentation and knowledge sharing. Further, researchers have played a central role in the implementation of DHIS 2 and the knowledge generation around these processes. Due to lack of funds for PhD scholarships, the number of active PhD students declines dramatically. In addition there is very limited involvement with building up master’s programs in health informatics in the south. There is need for these students in order to feed the pipeline for further development and to enhance country level implementation capacity.

- **Professors**: Action research related to implementation projects, exploration of new use cases, and experimentation with new functionality and technologies; develop and teach joint curricula with universities in the south; supervise master’s program and PhD students.
- **Researchers**: Action researchers.
- **PhD students**: Action research and participate in software platform development and implementation projects in home country.

**Strengthening project administration and management**: To support the transition from a relatively small activist-driven team where everyone does everything to a medium size organization dealing with a range of partners and funders at a professional level, UiO needs to further staff up the administrative support team with project coordinators and administrators. This would be supported by:

- **Project manager**: Manage projects.
- **Project coordinators**: Coordinate projects, budgeting, reporting, resource allocation, and planning.
- **Financial administrators**: Contracts, subcontracting, finances, and budgeting.

**Ideal scenario staff assumptions next steps**

At the time of this report, it was not possible to fully evaluate UiO’s ideal scenario staffing proposal without a clear understanding of future demand and resource levels. However, assuming the current growth trend continues, some initial recommendations on next steps may be made.
Based on the overall recommendations in this report and the strong demand from stakeholders for increased software development quality and capacity, the current UiO staff numbers can be assumed to represent a baseline level of support required. If demand and resources continue to increase, we recommend a phased approach to adding staff to effectively onboard and manage expanded capacity.

Factoring in the input collected during this assessment and UiO’s current staff, we recommend the following prioritization for adding staff and capacity:

- **Software development:**
  1. Add testers
  2. Add business analysts and architects
  3. Phase in additional software developers

- **Implementation support:**
  1. Add technical writers, a training coordinator, and academy administrators
  2. Phase in implementation support staff at UiO and regional implementers

- **Research and innovation:**
  - Add faculty and students, as warranted by available funding

- **Project administration and management:**
  - Add financial administrator and project managers

### 5. Funding Landscape

The funding landscape for DHIS 2 has shifted in the past five years. Following the 2011 HISP assessment report, Norad, the Global Fund, and PEPFAR entered into an informal relationship to coordinate funding and leverage investments in DHIS 2. Through this agreement, Norad continued to support UiO’s core funding, including the management team, development of the platform, and some in-country implementation support, the Global Fund supported in-country implementations, and PEPFAR supported targeted reporting needs (and eventually complemented Norad’s support of core staff).

HISP funding is quite complex and has a long history of balancing incremental donor needs and incremental requirements with product development, market development activities, and academic goals. See Figure 1 for historical funding by partner.
Current funding, with funding end dates, is included in Table 5. (Note: Norad and PEPFAR funding is allocated to core software development; funding from the Global Fund and UNICEF is designated for country implementations and does not contribute to the core.)

**TABLE 5. UIO REPORTED 2016 EXPECTED INCOME AND EXPECTED OUTCOME (USD)**

<table>
<thead>
<tr>
<th>Expected Income</th>
<th>Expected Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2016 Funding Source</strong></td>
<td><strong>Funding (USD)</strong></td>
</tr>
<tr>
<td>PEPFAR MEASURE</td>
<td>2,355,065</td>
</tr>
<tr>
<td>Norad</td>
<td>866,977</td>
</tr>
<tr>
<td>Norad Research</td>
<td>355,590</td>
</tr>
<tr>
<td>The Global Fund</td>
<td>1,275,000</td>
</tr>
<tr>
<td>PEPFAR OpenHIE</td>
<td>818,455</td>
</tr>
<tr>
<td>UNICEF</td>
<td>666,667¹</td>
</tr>
<tr>
<td>PATH²</td>
<td>440,232</td>
</tr>
<tr>
<td>CDC Ebola</td>
<td>322,918</td>
</tr>
<tr>
<td>Norwegian Education Grant</td>
<td>208,955</td>
</tr>
<tr>
<td>Research Council of Norway</td>
<td>80,036</td>
</tr>
<tr>
<td>Other</td>
<td>487,042</td>
</tr>
<tr>
<td><strong>Total external funding</strong></td>
<td>$7,876,937</td>
</tr>
<tr>
<td><strong>UIO contribution</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total funding</strong></td>
<td>$9,125,543</td>
</tr>
</tbody>
</table>

1 Research Council of Norway (NFR)
2 PATH funding is to adapt DHIS 2 patient tracker to serve as Zambia’s national immunization registry.
3 No new Norwegian Quota PhD scholarships ($90,000) after 2016.
The following are findings and feedback related to HISP funding:

- Since 2011, funding has increased by including a larger range of financing partners – with attendant problems in fragmentation of objectives, finances, and reporting.
- There has been a shift from donor funding for country use cases towards funding tied to NGOs and donor programs with specific product development deliverables.
- DHIS 2 has been significantly expanded as a result of PEPFAR funding, which has provided sufficient resources to expand UiO development capacity (beyond core Norad support). Of critical importance was PEPFAR's decision that its funding and requirements would be directed to the core DHIS 2 platform (versus being PEPFAR-specific).
- This new funding landscape has both positive and potential negative consequences. Development capacity is increased, but there is a perception among country users that funding sources such as PEPFAR are driving the product roadmap and diverting resources away from improving the core product and country requested features that are not a priority for funders.
- Donors do not have a clear understanding of DHIS 2 strategy and roadmap so have challenges aligning funding. At the same time, opportunistic financing makes it difficult for UiO to define and follow a strategic path as different donors finance different requirements which may not contribute to an overall development plan.
- While the increase in NGO and donor program funding is currently contributing significantly to the funding available for DHIS 2 core development, it is likely this level of funding will decrease after the required functionality is delivered and those program-specific implementations have reached a steady state. The needs for new functionality tend go down and investments will shift from development to ongoing support and maintenance.
- There is a perceived lack of transparency around what donor funds are being received by UiO.
- The fragmentation of funding requires greater administration and oversight by UiO to manage multiple contracts and deliverables.
- Stakeholders expressed a concern that donors will fund country implementations but are less interested in contributing to development and maintenance of the global core platform.

One of the big challenges with funding is that donors pay for on-the-ground deployment and no one wants to pay for central infrastructure. [INTERVIEW COMMENT]

- There is a common gap in funding for the ongoing maintenance support required in-country following implementation. There are needs for ongoing technical support including maintaining servers and databases, installing new releases, and continued support for user training and promotion of data use.
- Funding for core support to UiO is not long term and many contracts are ending in the near future leading to a major financial challenge for maintaining current capacity and developing new capacity.
- There are significant challenges financing the research component of activities, which is required to drive success and to sustain maintenance of the program in a university setting.
**Funding Recommendations**

**Recommendation:** Donor investments should be coordinated to ensure funding reaches the appropriate components of HISP, including core DHIS 2 development, country deployments, and research and capacity development. The Health Data Collaborative (HDC) may be a suitable vehicle for facilitating coordination. The Facility and Community Data working group of the HDC is developing a plan for DHIS 2 investment across partners and would encourage countries to have a coordinated project plan for investments at a country level as well.

While difficult to fully cost at this point, UiO has provided a ballpark estimate (see Table 6) of funding that would be needed to accommodate the ideal scenario staffing (see Table 4) as outlined in the above section.

**TABLE 6. UIO ESTIMATED FUNDING NEEDED FOR THE IDEAL SCENARIO STAFFING**

<table>
<thead>
<tr>
<th></th>
<th>Year 2016 funding (US$)</th>
<th>Ideal scenario funding (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total external funding</td>
<td>7,876,937</td>
<td>16,300,000</td>
</tr>
<tr>
<td>UiO contribution</td>
<td>1,248,606</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Total funding</td>
<td>9,125,543</td>
<td>18,800,000</td>
</tr>
</tbody>
</table>

We recommend the following actions to further assess and plan future funding and staffing needs:

- Divide the total ideal scenario investment into the HISP components of software development, implementation support, and research and innovation.
- Further divide the software development component into a “sustainment” budget and a demand-driven “enhancements” budget.
  - The DHIS 2 sustainment budget would represent the minimum funding needed to keep the DHIS 2 core platform viable. This would include regular maintenance and fixes, regular product releases, and may also include a set budget for routine enhancements to keep the platform viable and meeting country needs. Ideally, donors would align flexible and unrestricted funding to maintain long-term support for the sustainment of the DHIS 2 global good.
  - The enhancements budget would be demand-driven (i.e., based on funding provided by partners for new requirements or use cases). The budget would increase or decrease depending on donor needs and available funding sources.
- Assess partner and donor projected funding to determine the funding gap to be closed by year. This should align with a phased staffing projection to better understand the ramp-up time required.

**Recommendation:** Funding for in-country ongoing support needs should be coordinated and pooled. A pooled funding model should be considered to support in-country ongoing DHIS 2 support needs through DHIS 2 country teams (this is a topic for additional assessment in a potential Phase II scope of research). Within a country, there may be a national instance of DHIS 2 as well as one or more NGO or donor-led instances. Because technical support (data centers/services) and DHIS 2 experienced support resources are scarce, these should be pooled and leveraged across DHIS 2 instances (as well as other HIS...
systems) to provide support. NGOs and donors could potentially contribute a larger share for technical support as a demonstration of support for the country instance and in order to build capacity by supporting technical trainings in-country. Plans to implement DHIS 2 should include establishing a country support team that can sustain the support of the HIS both during and after the initial implementation phase. Country teams would make an important shift from intermittent technical assistance missions to a continuous onsite support function, which is necessary for a country to successfully build and maintain a national HIS.
To bound scope for this assessment, the focus was purposely targeted at reviewing the role, capacities, challenges, and opportunities facing UiO and to make recommendations on how its role might be enhanced to support the increasing demands for development and deployment support.

Questions relating to the efficiency and effectiveness of country-based implementations were left to a potential Phase II scope of research to be further discussed among partner agencies. Topics for further research could include: assessing best practices for DHIS 2 implementation design, deployment project management, country-level financing, building in-country capacity, and ongoing maintenance support needs.

As an immediate next step, Norad is convening a discussion with UiO and key donor representatives in June of 2016 to review report findings, plan any future review of country implementations, and discuss opportunities for coordinating donor investments.
## APPENDIX 1: ASSESSMENT OBJECTIVES AND ACTIVITIES

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Supplemental Questions</th>
<th>Assessment Activities</th>
</tr>
</thead>
</table>
| **Objective 1:** Assess progress made to date. | A. Which conclusions/recommendations from the 2011 review remain the same and which are different? Specifically: 
1) Is the competitive positioning of the DHIS 2 product the same, or have other products shifted? 
2) Does it still make sense for DHIS 2 to pursue being a “national data warehouse” as recommended in 2011 (pg. 23) and assumed in the evaluation of various expansion opportunities? What alternative models exist that rely more heavily on interoperability and working with other available products? 
B. Where does DHIS 2 currently and normatively sit within the visionary ICT framework that’s been adopted by the Asia eHealth Information Network (AeHIN)? | • Develop a written survey for countries and development partners to obtain feedback on overall HISP progress. 
• Review and assess: 
  o Scale-up of DHIS 2 
  o Core competencies the HISP UIO team 
  o Development of the capacities of the HISP network 
• Document achievements, milestones, critiques, and impact. |
| **Objective 2:** Assess capacities required to enhance support for national roll out in a large number of countries. | • Interview key stakeholders within countries and development partners for feedback on implementation support and services. 
• Assess quality and use perspective as well as a technical deployment and sustainable management perspective. 
• Make recommendations on capacities needed to scale up implementation support and which are strategic for HISP to retain and which could be provided by partner organizations. | |
| **Objective 3:** Categorize the various opportunities open to HISP/ DHIS 2 and make recommendations on where to focus. | C. Does University of Oslo have the software development capacity to meet the global demand for DHIS 2 growth? 
1) How many full-time developers are currently on staff? How many part-time? How frequently does staff change? 
2) Are there any other developers/ organizations that actively contribute to the DHIS 2 code base? 
3) How are core feature requests submitted? How are software feature efforts costed and prioritized? 
4) What percentage of development time is spent on implementing new features versus supporting existing deployments? 
5) How large is the current backlog of DHIS 2 feature requests from the global community? 
6) What are the options for increasing the development capacity for DHIS 2? | • Interview key stakeholders within countries and development partners for feedback on development priorities. 
• Make recommendations on strategic areas to focus on. |
<table>
<thead>
<tr>
<th>Objectives</th>
<th>Supplemental Questions</th>
<th>Assessment Activities</th>
</tr>
</thead>
</table>
| 7) How much funding is currently available to support the core DHIS 2 development effort (and for how long)?<br>8) As demand for patient-level data increases, how does DHIS 2 further expand patient-level capacity and/or interoperability with patient-level systems? Which is a better area of focus moving forward: further expanding patient-level capabilities in DHIS 2 or increasing interoperability and associated support with other patient-level systems?<br>9) Are there features/products that would make sense to shift to other partners due to either capacity or expertise?<br>10) What balance do you expect to maintain between development of the platform and supporting country implementations?<br>D. How is the DHIS 2 code base managed?<br>1) Are countries encouraged to establish their own fork of the code when deploying DHIS 2? Or are deployments typically done in a way that can easily receive future updates of core functionality?<br>2) How much DHIS 2 code fragmentation currently exists in the global community?<br>3) What ramifications does this have on adoption and maintenance? | **Objective 4:**<br>Make recommendations for how HISP should move forward.<br>E. How do updates to positioning, expansion opportunities, and critical success factors inform strategic recommendations for DHIS 2 expansion in the Norad evaluation?  • Assess what institutional capacities need to be developed and what support functions and governance structures could be developed to promote enhanced functionality while retaining flexibility.<br>• Synthesize results from surveys and interviews.<br>• Finalize recommendations into an actionable roadmap.<br>• Present assessment and roadmap to Norad.<br><br>**Objective 5:**<br>Assess partnership and financing models.<br>• Conduct development partner survey and interviews.<br>• Assess and recommend partnership and financing models.
A. Which conclusions/recommendations from the 2011 review remain the same, and which are different? Specifically:

1) Is the competitive positioning of the DHIS 2 product the same, or have other products shifted?

In the 2011 Health Information Systems Programme (HISP) assessment report, the District Health Information System (DHIS) (this was prior to DHIS version 2) was compared to OpenMRS and iHRIS in terms of business model, offerings, and development approach. These systems are leaders in their domains and are often deployed together with some level of integration.

Table 2A. Comparison of widely deployed software tools (from 2011 assessment report)

<table>
<thead>
<tr>
<th>Organization or Product</th>
<th>HISP</th>
<th>OpenMRS</th>
<th>iHRIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core product;</td>
<td>DHIS software for aggregation, analysis,</td>
<td>Open-source medical record system.</td>
<td>Integrated Human Resource Information System.</td>
</tr>
<tr>
<td>What solution does it</td>
<td>and reporting of health indicators.</td>
<td></td>
<td>Human resource management tools for health</td>
</tr>
<tr>
<td>provide and who are</td>
<td></td>
<td></td>
<td>managers.</td>
</tr>
<tr>
<td>the target users?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The conclusion from the 2011 report was that OpenMRS and iHRIS provide opportunities for alignment with software platforms that share similar philosophies, business models, and deployment priorities with DHIS. The recommendation was to explore options for increased interoperability between DHIS and other systems and identify if opportunities exist to synchronize deployment strategies to leverage joint resources in planning, training, and building local technical capacity.

It was noted at the time that, as DHIS was making plans to add patient-level tracking data, operational systems, such as OpenMRS, could expand their functionality into data aggregation and reporting, which could create competition or confusion in the potential overlapping space.

The interoperability landscape has evolved substantially since 2011. The DHIS 2 and iHRIS teams now routinely collaborate on interoperable deployments in countries, and together have implemented appropriate interoperability standards. A particular milestone was reached in Liberia in the spring of 2014 with a jointly-hosted multi-country DHIS 2–iHRIS interoperability academy. The joint academy included a technical connect-a-thon as well as a data-use focused component that discussed how data might be used from the combined systems. The standards and approaches discussed during that workshop played a pivotal role in the Ebola crisis later that year, and gave rise to the mHero health worker communication tool that leveraged the newly interoperable ecosystems. Meanwhile, the emergence of the OpenHIE community and interoperability
architecture has created new opportunities for connecting with other global health information systems. The University of Oslo (UiO) team has participated as the leaders of the OpenHIE health management information systems (HMIS) community and led the development of the Aggregate Data Exchange (ADX) standard now used to great effect by the President’s Emergency Plan for AIDS Relief (PEPFAR) Data for Accountability, Transparency and Impact (DATIM) system.

The DHIS 2 strategy must be able to meet the demand for both types of deployment scenarios:

- Meet deployment needs that include other complimentary domain systems such as openMRS and iHRIS by having a strong integration layer and the ability to “play well with others.”
- Meet deployment needs that are heavily invested in DHIS 2 as a core HMIS solution and rely on incremental functionality within DHIS 2 to meet additional use cases, such as patient-level tracker data.

2) Does it still make sense for DHIS 2 to pursue being a “national data warehouse” as recommended in 2011 (pg. 23) and assumed in the evaluation of various expansion opportunities? What alternative models exist that rely more heavily on interoperability and working with other available products?

The ability of the DHIS 2 platform to serve as a national data warehouse demonstrates the flexibility of the platform. Each country’s strategy for a national view of health data will vary based on its specific needs. In most cases there are many information systems in addition to DHIS 2 that are used to support various functions or domains of the overall health care system. A DHIS 2 data warehouse may meet national data warehouse and reporting needs, or may be a source system to a broader national data warehouse that combines data from many data sources, such as care delivery systems, patient record systems, patient and provider registries, and insurance or financial payment systems. The product strategy for DHIS 2 supports either approach.

B. Where does DHIS 2 currently and normatively sit within the visionary ICT framework that’s been adopted by the Asia eHealth Information Network?

The Asia eHealth Information Network (AeHIN) at its core is simply a learning network of its members. There are 13 AeHIN countries currently using DHIS 2 and they are organizing themselves, via AeHIN, to learn from each other.

Within the AeHIN network, there are now two main sub-networking groups: the Regional Enterprise Architecture Council for Health (REACH), which is made up of certified architects from ministries of health, and the Community of Interoperability Labs (COIL). COIL is composed of centers of excellence for interoperability in the member countries and focuses on topics for international initiatives such as DHIS 2, routine health information systems (RHIS), geographical information systems (GIS), and soon visualization (with Tableau). Architecturally, through the REACH council,
AeHIN is adopting OpenHIE as a recommended standard. DHIS 2 will be the recommended application for the HMIS component of OpenHIE.

C. *Does University of Oslo have the software development capacity to meet the global demand for DHIS 2 growth?*

1) **How many full-time developers are currently on staff? How many part-time? How frequently does staff change?**

Table 2B shows DHIS 2 software development staff numbers for 2010 - 2016. Developer staff turnover is very low. Only one person from the core team has left after completing a one-year contract.

Table 2B. UiO reported number of HISP UiO software development staff, 2010–2016

<table>
<thead>
<tr>
<th>HISP UiO Role</th>
<th>Total staff on DHIS 2 activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Developers</td>
<td>3</td>
</tr>
</tbody>
</table>

2) **Are there any other developers/organizations that actively contribute to the DHIS 2 code base?**

UiO manages all development to the DHIS 2 core code base. In addition to software development staff located at UiO, developers located remotely in some of the HISP nodes (primarily in the United States and Vietnam) are also doing core development work based on UiO’s direction. Other partners and development organizations are providing local customization typically not in the core code base but extending functionality through application programming interfaces (APIs) or integrated web applications (i.e., app development).

3) **How are core feature requests submitted? How are software feature efforts costed and prioritized?**

Feature requests are submitted through the DHIS 2 users’ mailing list.

The DHIS 2 core developer team receives a large amount of requests for features and improvements to the software. To guide prioritization, UiO uses a set of criteria when considering which features to include for the roadmap.

DHIS 2 feature request prioritization criteria:

1. Impact versus level of effort: The potential impact of a feature will be considered against the level of effort it will take to implement it. The impact is determined by how many users will be able to utilize it and the type of organization which will implement it. As an example, if the ministry of a large country plans to deploy a specific feature, it will be considered high impact. The level of effort refers to the amount of developer time it will take to implement the feature. If the impact is high relative to the required effort, the feature is more likely to be included.
2. Benefit versus complexity: The benefit of a feature will be considered against the complexity it will introduce in the source code. The benefit refers to how helpful or useful the feature will be to users. The complexity refers to how more complex the system source code will be after introducing the code which is required to implement the feature. If the benefit is high relative to the complexity, the feature is more likely to be included.

3. Importance: The importance of a feature refers to where it is on a scale between “critical” and “nice-to-have” for users of the system. If a feature is considered critical for the user’s ability to carry out its business through the system, then the feature is more likely to be included.

4. Participation, testing, and feedback: The level of participation in terms of testing and feedback from the organization requesting a feature impacts whether a feature will be included. Having the originator of a feature request contribute with active testing, constructive feedback, and rapid deployment is helpful for the development team in order to create a high-quality feature.

5. Partnerships and funding: Organizations that contribute with direct funding, or other types of partnerships, have a higher chance of getting feature requests prioritized. This is a result of the core team being able to bring on additional developer resources and hence increase the capacity to develop features.

4) What percentage of development time is spent on implementing new features vs supporting existing deployments?

Software developer staff time is dedicated to software development rather than direct support of existing deployments. The UiO team has separate staff supporting implementations. Current staff numbers are included in Table 2C.
5) **How large is the current backlog of DHIS 2 feature requests from the global community?**

There is a fairly large backlog of DHIS 2 feature requests. At current development-team capacity, it is estimated at approximately 18 months of development work to clear the backlog. However, it should be noted that most software products always have some level of feature request backlog, as it is not expected that all feature requests meet the criteria as being good for the core product, for example, because the request does not align with product strategy or has low impact or importance.

6) **What are the options for increasing the development capacity for DHIS 2?**

With increased funding, UiO could add additional developers to the staff to increase capacity. UiO has targeted an ideal scenario for future staffing that would increase software developers from 17.5 to 30 and add staff for business analysts, architects, and testers. The full staffing view of UiO current staff and ideal scenario staff is included in Table 2D.

---

**Table 2C. UiO reported 2016 HISP UiO staff**

<table>
<thead>
<tr>
<th>HISP UiO Staff Summary</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software Developer Staff</strong></td>
<td></td>
</tr>
<tr>
<td>Software Developers</td>
<td>17.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17.5</td>
</tr>
<tr>
<td><strong>Implementation Support Staff</strong></td>
<td></td>
</tr>
<tr>
<td>Implementation support staff based at UiO</td>
<td>5</td>
</tr>
<tr>
<td>Regional Implementers</td>
<td>5</td>
</tr>
<tr>
<td>Technical Writers</td>
<td>2</td>
</tr>
<tr>
<td>Academy Administrators</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
</tr>
<tr>
<td><strong>Research and Innovation Staff</strong></td>
<td></td>
</tr>
<tr>
<td>Professors</td>
<td>5</td>
</tr>
<tr>
<td>PhD students</td>
<td>17</td>
</tr>
<tr>
<td>Researchers</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>Project Administration and Management Staff</strong></td>
<td></td>
</tr>
<tr>
<td>Project Coordinators</td>
<td>2</td>
</tr>
<tr>
<td>Financial Administrators</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>HISP UiO Total Staff</strong></td>
<td>58.5</td>
</tr>
</tbody>
</table>

---
Table 2D. UiO reported current 2016 staff and targeted ideal scenario staffing

<table>
<thead>
<tr>
<th>HISP UiO Staff Summary</th>
<th>2016 staff</th>
<th>Ideal scenario staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software Developer Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software Developers</td>
<td>17.5</td>
<td>30</td>
</tr>
<tr>
<td>Business Analysts</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Architects</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Testers</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17.5</strong></td>
<td><strong>38</strong></td>
</tr>
<tr>
<td><strong>Implementation Support Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation support staff based at UiO</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Regional Implementers</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Technical Writers</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Training Coordinators</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Academy Administrators</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>27</strong></td>
</tr>
<tr>
<td><strong>Research and Innovation Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professors</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>PhD students</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>Researchers</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
<td><strong>42</strong></td>
</tr>
<tr>
<td><strong>Project Administration and Management Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Managers</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Project Coordinators</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Financial Administrators</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
<td><strong>7</strong></td>
</tr>
<tr>
<td><strong>HISP UiO Total Staff</strong></td>
<td><strong>58.5</strong></td>
<td><strong>114</strong></td>
</tr>
</tbody>
</table>

7) **How much funding is currently available to support core DHIS 2 development effort (and for how long)?**

Current funding, with funding end dates, is included in Table 2E. It should be noted that Norad and PEPFAR funding are allocated to core software development, and the Global Fund and UNICEF funding is designated for country implementations and not contributing to the core.
Table 2E. UiO reported 2016 expected income and expected outcome (USD)

<table>
<thead>
<tr>
<th>Expected Income</th>
<th>Expected Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2016 Funding Source</strong></td>
<td><strong>2016 Activity</strong></td>
</tr>
<tr>
<td><strong>Funding (USD)</strong></td>
<td><strong>Expense (USD)</strong></td>
</tr>
<tr>
<td><strong>Funding end date</strong></td>
<td></td>
</tr>
<tr>
<td>PEPFAR MEASURE</td>
<td><strong>Staff UiO</strong></td>
</tr>
<tr>
<td>2,355,065</td>
<td>Development</td>
</tr>
<tr>
<td>Sep 30, 2016</td>
<td>2,267,227</td>
</tr>
<tr>
<td>Norad</td>
<td>Research</td>
</tr>
<tr>
<td>866,977</td>
<td>1,248,606</td>
</tr>
<tr>
<td>Dec 31, 2016</td>
<td>Implementation</td>
</tr>
<tr>
<td>Norad Research</td>
<td>499,648</td>
</tr>
<tr>
<td>355,590</td>
<td>Administration</td>
</tr>
<tr>
<td>Dec 31, 2016</td>
<td>842,261</td>
</tr>
<tr>
<td>The Global Fund</td>
<td><strong>Implementation Costs</strong></td>
</tr>
<tr>
<td>1,275,000</td>
<td>Country Support</td>
</tr>
<tr>
<td>Dec 31, 2016</td>
<td>2,051,621</td>
</tr>
<tr>
<td>PEPFAR OpenHIE</td>
<td>Academies</td>
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<tr>
<td>818,455</td>
<td>718,310</td>
</tr>
<tr>
<td>Mar 31, 2017</td>
<td>Travel</td>
</tr>
<tr>
<td>UNICEF</td>
<td>366,197</td>
</tr>
<tr>
<td>666,667(^1)</td>
<td>Server Hosting</td>
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<tr>
<td>May 01, 2018</td>
<td>140,845</td>
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<tr>
<td>PATH(^2)</td>
<td>Equipment</td>
</tr>
<tr>
<td>440,232</td>
<td>129,577</td>
</tr>
<tr>
<td>Dec 31, 2016</td>
<td></td>
</tr>
<tr>
<td>CDC Ebola</td>
<td></td>
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<tr>
<td>322,918</td>
<td></td>
</tr>
<tr>
<td>Mar 31, 2017</td>
<td></td>
</tr>
<tr>
<td>Norwegian Education Grant</td>
<td></td>
</tr>
<tr>
<td>208,955</td>
<td></td>
</tr>
<tr>
<td>Dec 31, 2018(^3)</td>
<td></td>
</tr>
<tr>
<td>Research Council of Norway</td>
<td></td>
</tr>
<tr>
<td>80,036</td>
<td></td>
</tr>
<tr>
<td>Feb 28, 2019</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>487,042</td>
<td></td>
</tr>
<tr>
<td><strong>Total external funding</strong></td>
<td><strong>Total cost</strong></td>
</tr>
<tr>
<td><strong>$7,876,937</strong></td>
<td><strong>$8,264,292</strong></td>
</tr>
<tr>
<td>UiO contribution</td>
<td></td>
</tr>
<tr>
<td>1,248,606</td>
<td></td>
</tr>
<tr>
<td><strong>Total funding</strong></td>
<td></td>
</tr>
<tr>
<td><strong>$9,125,543</strong></td>
<td></td>
</tr>
</tbody>
</table>

1 Estimated budget.
2 PATH funding is to adapt DHIS 2 patient tracker to serve as Zambia’s national immunization registry.
3 No new Norwegian Quota PhD scholarships ($90,000) after 2016.

8) **As demand for patient level data increases, how does DHIS 2 further expand patient level capacity and/or interoperability with patient level systems? Which is a better focus moving forward: further expanding patient level capabilities in DHIS 2 or increasing interoperability and associated support with other patient level systems?**

Stakeholders interviewed for this assessment have differing views on this topic, wanting DHIS 2 to further expand patient-level capacity or wanting increased focus on interoperability with other patient-level systems. The reality of a generic and flexible platform that is meeting the needs of a diverse set of users is that the platform needs to support both deployment strategies. Having strong interface capabilities is critical to enabling development partners to extend core functionality by adding web applications and interfacing to other systems. DHIS 2 is often a core component of a national ecosystem of health information systems and needs to play well with other information systems. At the same time, there is a demand from countries that are heavily invested in DHIS 2 and do not have the funding or a sophisticated ecosystem of health information systems that are reliant on expanding functionality within DHIS 2 to meet their needs for tracking events and patient-level data, (e.g., for immunization registries and malaria case tracking).

The UiO team has indicated that the DHIS 2 strategy is not to become a full patient-level medical record system, however the patient tracker is anticipated by UiO as a good
solution for sharing information between facility-based medical records systems to support longitudinal patient care across facilities. Ongoing discussion with the OpenMRS community are exploring this model. A product strategy with clear boundaries will help define when extending functionality fits within the DHIS 2 core and when the feature requirements can best be met by other existing solutions.

9) **Are there features/products that would make sense to shift to other partners due to either capacity or expertise?**

UiO can maintain the highest level of quality of the core code base by managing the software development team working on core feature enhancements. Development partners can extend or customize DHIS 2 through web APIs, which enable tailoring the user interface and use the DHIS 2 data model to solve specific use-case requirements. Partners are encouraged to share web applications through the DHIS 2 App store so others can also use them.

10) **What balance do you expect to maintain between development of the platform and supporting country implementations?**

UiO has a strategy to maintain and increase focus on platform software development by increasing the staff of the software development team. To meet the increasing demand for support to country implementations, UiO can best extend its reach by providing training and supporting material to implementing partners. UiO would do this by 1) scaling up implementation guiding material; 2) strengthening regional capacity-building programs; and 3) facilitating, rather than leading, country support through a strong network of regional partners.

**D. How is the DHIS 2 code base managed?**

1) **Are countries encouraged to establish their own fork of the code when deploying DHIS 2? Or are deployments typically done in a way that can easily receive future updates of core functionality?**

Countries and other implementing organizations are strongly encouraged to avoid forking the system. Some of the core principles behind the rapid scaling of DHIS 2 include the ability to replicate the software across countries and the relatively small need for maintenance of custom/local modifications. This is made possible because most countries run the same distribution of DHIS 2, without modifications to the core platform. As a result of this, UiO encourages countries to use core, standard distribution of DHIS 2, and implement custom features through applications and the application framework, as well as external scripts/tools.

2) **How much DHIS 2 code fragmentation currently exists in the global community?**

The level of code fragmentation is generally low. Certain countries (e.g., Ethiopia) and projects (e.g., Palestine mother and child registry) have some fragmentation, but the level of fragmentation is quite low considering the number of DHIS 2 implementations. There is a clear trend of countries and nongovernmental organizations accommodating customization by building their own web applications integrated with the DHIS 2 core, rather than forking the core code base.
3) **What ramifications does this have on adoption and maintenance?**

The advantage of developing country- or organization-specific customization outside of the core code base through web applications and integration is that it makes it easier to install new DHIS 2 releases.

E. **How do updates to positioning, expansion opportunities and critical success factors inform strategic recommendations for DHIS 2 expansion in the Norad evaluation?**

The UiO HISP team is caught in a continuous balancing act between ensuring effective support for the DHIS 2 foundational core of an effective aggregate health data capture and reporting system, while at the same time fielding strong country, partner, and donor demand for additional functionality (e.g., patient tracking and event tracking).

This need for UiO to identify and strike a balance is not expected to change in the foreseeable future. DHIS 2′s strong general platform and highly flexible design means DHIS 2 can solve data needs from the longitudinal to the aggregate, independent of sector and independent of use case.

The sheer opportunity for DHIS 2 to be adapted to solve such a broad array of use cases inherently makes UiO a victim of its own success. It falls to UiO to set some boundaries on what DHIS 2 should do and what DHIS 2 should not do. To err too far on taking on all new opportunities will dilute UiO and DHIS 2 current focus and strength. To err too far the other way—setting too-heavy limits—will stifle innovation and affect UiO’s recognized strength for solving country problems.

We recommend UiO focus near-term expansion (for example, one to two years) on current data needs—aggregate health data, longitudinal patient data, and event tracking applied to prioritized use cases such as immunization disease surveillance, and others. This focus would help ensure strengthening of the current core platform, while not excessively limiting opportunities for innovation.

As further demands are made for additional use cases (financing, education, agriculture, environment, etc.), we encourage UiO to consider sharing those opportunities with partners. The great strength and success of UiO over the last five years has been how much it has been able to accomplish. The success of the next five years will be dependent on how much others are able to build on that foundation. Like Linux, Apache, and other open-source successes, creating a nurturing environment for broad, collaborative innovation on DHIS 2 will only strengthen and expand the DHIS 2 and HISP brand.
## Appendix 3: Interview Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Interview location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominic Atweam</td>
<td>Ghana Health Service</td>
<td>Dar es Salaam, Tanzania</td>
</tr>
<tr>
<td>Sean Blaschke</td>
<td>United Nations Children’s Emergency Fund (UNICEF)</td>
<td>phone</td>
</tr>
<tr>
<td>Jørn Braa</td>
<td>University of Oslo (UIO)</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Kristin Braa</td>
<td>UIO</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Daniel Bridges, Scott Russpatrick, Ben Winters</td>
<td>Akros</td>
<td>phone</td>
</tr>
<tr>
<td>Hannah Cooper, Tyler Smith</td>
<td>Cooper / Smith</td>
<td>phone</td>
</tr>
<tr>
<td>Austen Davis</td>
<td>Norwegian Agency for Development Cooperation</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Robert Eisses, Aaron Gladders, Gagan Diesh, Todd Smith, Justin Tilley</td>
<td>2Paths</td>
<td>phone</td>
</tr>
<tr>
<td>Mike Gehron</td>
<td>formerly, the President’s Emergency Plan for AIDS Relief</td>
<td>phone</td>
</tr>
<tr>
<td>David Hagan</td>
<td>SageHagan</td>
<td>phone</td>
</tr>
<tr>
<td>Arthur Heywood</td>
<td>HISP consultant, advisor to Ministry of Health Tanzania</td>
<td>phone</td>
</tr>
<tr>
<td>Ola Hodne Titlestad</td>
<td>UIO</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Matt Hulse</td>
<td>United States Agency for International Development (USAID)</td>
<td>phone</td>
</tr>
<tr>
<td>Dr. Honest Kimaro</td>
<td>HISP Tanzania and University of Dar es Salaam</td>
<td>Dar es Salaam, Tanzania</td>
</tr>
<tr>
<td>Carl Leitner</td>
<td>IntraHealth</td>
<td>phone</td>
</tr>
<tr>
<td>Theo Lippeveld</td>
<td>MEASURE Evaluation, John Snow International</td>
<td>Washington DC, United States</td>
</tr>
<tr>
<td>Isaac Lyatuu</td>
<td>HISP Tanzania and Ifakara Health Institute</td>
<td>Dar es Salaam, Tanzania</td>
</tr>
<tr>
<td>John Miller</td>
<td>PATH</td>
<td>phone</td>
</tr>
<tr>
<td>Kathryn O’Neill</td>
<td>World Health Organization (WHO)</td>
<td>phone</td>
</tr>
<tr>
<td>Lars Helge Øverland</td>
<td>UiO</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Lungi Okoko</td>
<td>USAID</td>
<td>phone</td>
</tr>
<tr>
<td>Ray Ransom</td>
<td>United States Centers for Disease Control and Prevention (CDC)</td>
<td>phone</td>
</tr>
<tr>
<td>Sundeep Sahay</td>
<td>UiO</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Wilfred Senyoni</td>
<td>HISP Tanzania and University of Dar es Salaam</td>
<td>phone</td>
</tr>
<tr>
<td>Dr. Vincent Shaw</td>
<td>HISP South Africa</td>
<td>phone</td>
</tr>
<tr>
<td>Knut Staring</td>
<td>UiO</td>
<td>Oslo, Norway</td>
</tr>
<tr>
<td>Steffen Tengesdal</td>
<td>BAO Systems</td>
<td>phone</td>
</tr>
<tr>
<td>Steven Uggowitzer</td>
<td>Entura Ventures</td>
<td>phone</td>
</tr>
<tr>
<td>Randy Wilson</td>
<td>Management Sciences for Health, Rwanda</td>
<td>phone</td>
</tr>
<tr>
<td>Tim Wood</td>
<td>Bill and Melinda Gates Foundation</td>
<td>phone</td>
</tr>
</tbody>
</table>
APPENDIX 4: INTERVIEW GUIDE

Project Background: The Norwegian Agency for Development Cooperation (Norad) represented by the Global Health Section, has awarded a short-term consultancy contract to PATH to help conduct an interim review of the Health Information Systems Programme (HISP)—University of Oslo (UiO)—with recommendations for future action. The feedback and recommendations from this review will assist Norad and the UiO in planning for future growth and development.

The purpose of this interview is to gather your opinions as a DHIS 2 stakeholder regarding HISP and UiO, to understand key issues you have faced in scaling DHIS 2, and to seek your suggestions on key areas to focus on for UiO. Please be assured that your opinions in no way will harm UiO. PATH is interviewing key stakeholders and all opinions will remain anonymous. Information that you provide will not be attributed directly to your organization but will be included anonymously in our final analysis. This analysis, including examples of global best practices, will be provided to all participants. We anticipate that this interview will take approximately 45 minutes. Thank you for making this research possible. Before we begin, do you have any questions I can answer?

Notes for Interviewer: Please note that all surveys will be conducted on a qualitative basis. In order to ensure consistency across surveys, questions have been standardized where possible. Please check if there are survey results from your interviewee before your interview so you can elaborate on questions and responses without repeating questions from the survey. After interviews are completed, please finalize your notes and post on the team SharePoint site.

Part I - Respondent’s characteristics

1. Which of the following best describes your organization?
   - US or European government agency
   - Private foundation
   - Ministry of health
   - University/academic institutions
   - Multilateral international organization (e.g., WHO, UNICEF)
   - Global health nongovernmental organization (e.g., World Vision)
   - Technology firm
   - Other, please specify _________________

   Interviewer notes:

2. Which of the following choice(s) describes your role/background?
   - US or European government/multilateral organization policy/decision-maker
   - Ministry of health (or equivalent government body) official
   - Consultant/researcher
   - Health technical officer
   - Technology officer
   - Software developer
   - Hardware developer
- Official of donor agencies
- Other, please specify _________________

Interview notes.

3. Please indicate to what extent you have done the following in the past three years:

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<th></th>
<th>To a great extent &gt;60%</th>
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<th>A small extent &lt;20%</th>
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<td>Researching DHIS 2 projects</td>
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</table>

4. During the past three years, which of the following geographical areas has your work with DHIS 2 been focused? (check all that apply and try and get a list)

- African Region
- Eastern Mediterranean Region
- European Region
- Region of the Americas
- South-East Asian Region
- Western Pacific Region

Interviewer Notes:

5. Have you been personally involved in deploying or using DHIS 2?
   If yes, please describe the project.
   Probe: country, software/hardware used, scale, partners involved.

6. Can you tell me more about your work with DHIS 2 and the relationship or structure of roles between the country, development partners, funders, UiO, HISP, and other stakeholders?
   Probe: What were the key reasons that you chose to work with HISP? Use the answer to this question to determine which of the following questions you focus on in the rest of the guide.

Part II - Perspectives on current DHIS 2 implementations (Questions for partners or countries doing implementations)

7. Please explain why you selected DHIS 2 versus other software platforms?
   Probe: Did you evaluate other software platforms?
8. What features made the DHIS 2 platform particularly compelling to your country/organization?

*Please prompt only if participant struggles with answer:*
- Stability
- Widespread use
- Funder support
- Local Implementer
- Others

*Please make sure this question is answered completely and consistently. It can then be used to make a table of key attributes and features.*

9. Which organizations did you work with to implement DHIS 2 in the field? Why did you choose them?

10. On a scale of 1 to 5 with 1 being relatively easy and 5 being relatively difficult, how hard was it to implement DHIS 2 in your project/country?

    *Probe: What worked well? What aspects did you struggle with in the immediate implementation and afterwards?*

11. What do you see as the key opportunities and challenges for DHIS 2 based on your experience?

12. In your opinion, what could UiO or donors do to take advantage of the opportunities and solve the challenges?

    *Probe: Any “low-hanging” fruit?*

13. What DHIS 2 projects have you seen/funded/read about that you think represent “best practices?”

    *Probe: What impressed you specifically about the project?*

14. What are the key dependencies which you feel block the development of DHIS 2 in the country or countries where you have worked?

15. To what extent do you think DHIS 2 challenges reflect a) a failure in the business model, b) a failure in the implementation support model, c) a challenge with the technology available and/or d) something else?

**Part III - DHIS 2 Roadmap**

16. Have you requested any features be added to the DHIS 2 platform?

    *Probe: If so, which ones? What are the priorities for your country/organization? Who did you make the request to? Did you contact UiO directly?*

17. What other functions or modules would you like to see added?

18. How do you feel about the quality of the DHIS 2 software?

    *Probe:*
    - Overall quality of software
    - Timeliness of new software releases
• Quality of new software releases
• Ease of installing and testing new software releases
• Comments:

Part IV – HISP and University of Oslo

19. How important is the contribution of the UiO to the continued sustainability of the HISP/DHIS 2 program in the country you are working?

20. What do you think the current strengths and weaknesses of the HISP UiO team are?
   Possible probes:
   • Software development quality.
   • DHIS 2 strategy for future product plans.
   • Capacity and resource availability for software development.
   • Implementation support quality.
   • Resource availability for implementation support.
   • Capacity building of implementation and support resources.
   • Governance model for HISP network and DHIS 2 development.
   • Promoting a data use culture.
   • Support for DHIS 2 training.
   • Training materials and documentation.
   • Support for research.
   • Support for higher education programs in health information systems and health informatics.
   • Promoting a network of DHIS 2 users that supports sharing of best-practices and products.
   • Building partnerships for sustainable funding models.
   • Other:

21. What do you think the core focus of the HISP UiO program SHOULD be?

22. Do you see opportunities for the HISP to increase effectiveness, address needs, ease implementation, and ensure sustainability?

23. In terms of financial and other resources, how much has UiO contributed to:
   • Development
   • Academic support (Graduate students)
   • Field Training
   • Research

24. Is the HISP UiO model of building capacity through research and training working?
   • Are UiO trained resources returning to countries and contributing to national HMIS programs?
   • Is it sufficient? Are more trained resources needed faster than UiO’s capacity to train?

25. Has support by UiO been seen to grow or wane?
   • How important is the contribution of the UiO to the continued sustainability of the HISP/DHIS 2 program?
   • Are there alternative ways University of Oslo could be contributing to support of HMIS?

Part V - Funder specific questions (for funders only)
26. As a funder, what convinced you to invest in DHIS 2? Do you believe that this investment has been successful?  
 Probe: Why was it successful or not? What were the key elements driving its success or failure?  
 Please note that flow wise this may be easier to probe at Question 3.

27. For your organization, what are the key determinants of success in a DHIS 2 implementation?  
 Probe: Have you or your project partners published anything you would like us to refer to?  
 Which implementers would you recommend that we speak with regarding DHIS 2?

28. If you personally had $100M and no restrictions to spend on improving DHIS 2 deployments or use globally, what work would you fund? How would you allocate it across the dependencies and challenges which you have highlighted?  
 Probe: What decision criteria is being used (e.g., impact, country specific, etc.)? Try and get to a % answer.

Conclusion

We are very thankful that you have provided this information to this project. Your time is valuable, and we appreciate your insights. If you have any additional questions or thoughts, please contact me before the end of February. Thank you.
APPENDIX 5: INTERVIEW GUIDE—ADDITIONAL DONOR SPECIFIC QUESTIONS

1. As a funder, what convinced you to invest in DHIS 2? Do you believe that this investment has been successful?
   Probe: Why was it successful or not? What were the key elements driving its success or failure?

2. What are your funding priorities with DHIS 2:
   a. academic and research,
   b. country implementations and support
   c. iNGO implementation
   d. software product development, specific functionality or general product support
   e. capacity development (in any/all of these areas)
   Probe: Are there areas you are not able/do not want to fund? What’s your view on the overall landscape of donor priorities with DHIS 2?

   If you are funding DHIS 2 development and support, are you funding specific enhancements for a specific project/program? Do you think they benefit the global good or are project/program specific?

3. What do you see as the strengths and challenges of the University of Oslo in developing and supporting DHIS 2?
   Probe: What do you think their key area to focus on should be and what things could be done by others?

4. If the DHIS 2 product development and support was spun out from the University of Oslo to an independent NGO, would that make it easier, harder or no different for your organization to fund?
   Probe: What advantages or disadvantages do you see to keeping the DHIS 2 product development housed at the University of Oslo long term?

5. What funding model could help coordinate getting the right resources to the right places (e.g., global good supporting product vs country specific implementation and support?)
   Probe: Could the Health Data Collaborative play a role? Is it covered under a current working group?

6. Do you have recommendations to sustain country-level funding and country level capacity?
   Probe: What role and value do you see from the HISP nodes in developing country capacity?

7. Some countries now have multiple instances of DHIS 2, for example at a national level and also used by one or more iNGOs. What would you think of the concept of pooling support resources in country?
   Probe: What organizational structure could play this role?

8. Any other general thoughts or suggestions on long term sustainable funding for DHIS 2?
# Appendix 6: Trips for in-person data collection

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<thead>
<tr>
<th>Location; Event</th>
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<th>PATH travelers</th>
<th>Funded by</th>
<th>HISP assessment work</th>
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<td>Dar es Salaam, Tanzania</td>
<td>December 7 to 10, 2015</td>
<td>Dykki Settle, Brian Taliesin, Kate Wilson</td>
<td>PATH</td>
<td>Conduct interviews with several HISP stakeholders that were attending PATH’s BID initiative meeting.</td>
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<tr>
<td>Oslo, Norway</td>
<td>January 28 to 29, 2016</td>
<td>Caren Althauser, Richard Anderson</td>
<td>Norad grant</td>
<td>HISP overview at UiO. Interviews with UiO staff.</td>
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<tr>
<td>Washington DC, United States; DHIS 2 for iNGOs Symposium 2016</td>
<td>February 22 to 23, 2016</td>
<td>Caren Althauser, Donna Medeiros</td>
<td>Norad grant and PATH</td>
<td>Information gathering on international non-governmental organization (iNGO) deployments. Conduct several formal and informal in-person interviews.</td>
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<tr>
<td>Dar es Salaam, Tanzania</td>
<td>February 19 to 25, 2016</td>
<td>Brian Taliesin</td>
<td>PATH</td>
<td>Conduct in-person interviews with HISP Tanzania, while in country for other project work.</td>
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<tr>
<td>Geneva, Switzerland; WHO primary health care stakeholder meeting</td>
<td>April 7 to 8, 2016</td>
<td>Caren Althauser</td>
<td>Bill &amp; Melinda Gates Foundation (BMGF) grant</td>
<td>Information gathering on DHIS 2 use for primary health indicators and the role of the Health Data Collaborative (HDC).</td>
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<tr>
<td>Oslo, Norway</td>
<td>May 18 to 19, 2016</td>
<td>Caren Althauser, Richard Anderson, Dykki Settle</td>
<td>BMGF grant and PATH</td>
<td>Gather feedback on draft report findings.</td>
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APPENDIX 7: ONLINE SURVEY QUESTIONNAIRE

The Norwegian Agency for Development Cooperation (Norad) is conducting an interim review of the Health Information Systems Programme (HISP) at the University of Oslo (UiO). The feedback and recommendations from this review will assist Norad and the University of Oslo in planning for future growth and development.

The purpose of this survey is to:
- gather your opinions as a DHIS 2 stakeholder regarding HISP and UiO,
- understand key issues you have faced in scaling DHIS 2,
- and seek your suggestions on key areas to focus on for UiO.

Please be assured that your opinions in no way will harm UiO. Information that you provide will not be attributed directly to you or your organization but may be included anonymously in our analysis. The final report will be available to all participants.

We anticipate that this survey will take approximately 30 minutes. Survey responses are due 29 January, 2016.

Thank you for making this research possible.

Part I - Respondent’s characteristics

1. If you would like a copy of the report when it is complete, please provide your email address. Your responses to the survey will remain anonymous.

2. Which of the following best describes your organization? (select one)
   - US or European government agency
   - Private foundation
   - Ministry of health
   - University/academic institutions
   - Multilateral international organization (e.g., WHO, UNICEF)
   - Global health nongovernmental organization (e.g., World Vision)
   - Technology firm
   - Other (please specify) ____________________

3. Which of the following choice(s) describes your role? (check all that apply)
   - Implementer
   - Ministry of health (or equivalent government body) official
   - Policy/decision-maker
   - Project manager
   - Consultant
   - Researcher
   - Software developer
   - Other (please specify) ____________________
4. Please indicate to what extent you have done the following in the past three years:

<table>
<thead>
<tr>
<th>Activity</th>
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<th>To a small extent &lt;20% of time</th>
<th>To some extent &lt;40% of time</th>
<th>To a moderate extent &lt;60% of time</th>
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<td>Developed software/hardware for projects using DHIS 2</td>
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<td>Deployed DHIS 2 projects in the field</td>
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<td>Researched DHIS 2-related projects</td>
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</table>

5. During the past three years, on which of the following geographical areas has your work with DHIS 2 been focused? (check all that apply)

- African Region
- Eastern Mediterranean Region
- European Region
- Region of the Americas
- South and East Asia Region
- Western Pacific Region
- Other (please specify) ____________________

7. Have you been involved in a DHIS 2 implementation or deployment?

- Yes
- No

<Logic: If no, skip to Part III>

Part II - Perspectives on current DHIS 2 implementations

7. Which organization(s) did you work with to implement DHIS 2 in the field? Why did you choose them?

8. On a scale of 1 to 5, with 1 being relatively easy and 5 being relatively difficult, how hard was it to implement DHIS 2 in your project/country?

- What worked well?
- What did you struggle with in the immediate implementation or afterwards?

Comments:

9. Is the deployment at scale for your project or country?

- Yes
• No

What are or were the challenges in reaching or trying to reach scale?

10. In your opinion, what could UiO or donors do to take advantage of the opportunities and solve the implementation challenges?

11. What DHIS 2 projects have you seen or read about that you think represent “best practices?” Why?

12. To what extent do you think DHIS 2 challenges reflect:

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<td>A challenge with the technology available</td>
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<td>Something else? (please specify)</td>
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Part III - DHIS 2 Roadmap

DHIS 2 faces a great demand for increased functionality and enhancements to the core software. Based on your experience in working with DHIS 2 and the needs of your country/program, please rate how you would prioritize the following functional areas for enhancements:

13. Please prioritize, in your opinion, the need for the following DHIS 2 enhancements: (1=low, 5=high)

• Development of specific modules for disease-specific programs.
• Development of national data warehouses based on DHIS 2, allowing integration of various country information and data sources.
• Integration of vaccination data into PHC reporting.
• Integration with other systems for management, (e.g., payroll, performance based rewards systems).
• Integration of supply and logistics information.
• Integration of HR information into HMIS reporting.
• Integration of aggregate facility-based data with facility survey data.
• Integration of community and outreach data into facility-based aggregate data reporting.
• Integration of surveillance systems into core HMIS systems.
• Integration of facility-based data into results-based financing (RBF) performance measurement and payment/incentive systems.
• Increase capabilities available through mobile devices.
• Development of the use of DHIS 2 as a district-based management system for non-health based social services (e.g., water and sanitation, education, agricultural, etc.).
• Development and use of patient-based care records.
• Increase privacy and security measures.
• Integration with analytics to promote data use (e.g., dashboards, scorecards, heat maps, etc.).
• Development and use of DHIS 2 as an enterprise level reporting tool.
• Other (please specify) ______________________

14. What other functions or modules would you like to see added?

15. How would you rate the quality of the DHIS 2 software? (1=low, 5=high)

• Overall quality of software
• Timeliness of new software releases
• Quality of new software releases
• Ease of installing and testing new software releases

Comments:

16. Have you requested any features be added to the DHIS 2 platform?

• Yes
• No

If yes:
• Which features?
• Who did you make the request to? Did you contact UiO directly?

17. What do you see as the key strengths of DHIS 2?

18. What do you see as the key opportunities and challenges for DHIS 2 based on your experience?

19. What features make the DHIS 2 platform particularly compelling to your country/organization? (check all that apply)

• Stability
• Widespread use
• Funder support
• Local Implementer
• Others (please specify) ______________________

Part IV – HISP and University of Oslo

20. How important is the contribution of UiO to the continued sustainability of the HISP/DHIS 2 program in the country you are working?

21. Please provide feedback, in your opinion, on the current quality of the HISP UiO team in the following support areas:

• Software development quality.
• DHIS 2 strategy for future product plans.
• Capacity and resource availability for software development.
• Implementation support quality.
• Resource availability for implementation support.
• Capacity building of implementation and support resources.
• Governance model for HISP network and DHIS 2 development.
• Promoting a data use culture.
• Support for DHIS 2 training.
• Training materials and documentation.
• Support for research.
• Support for higher education programs in health information systems and health informatics.
• Promoting a network of DHIS 2 users that supports sharing of best-practices and products.
• Building partnerships for sustainable funding models.
• Other (please specify) _______________

22. Please select what you think the top three core strengths of the HISP UiO program SHOULD be (regardless if they currently are or not): (select three choices)

• Software development quality.
• DHIS 2 strategy for future product plans.
• Capacity and resource availability for software development.
• Implementation support quality.
• Resource availability for implementation support.
• Capacity building of implementation and support resources.
• Governance model for HISP network and DHIS 2 development.
• Promoting a data use culture.
• Support for DHIS 2 training.
• Training materials and documentation.
• Support for research.
• Support for higher education programs in health information systems and health informatics.
• Promoting a network of DHIS 2 users that supports sharing of best-practices and products.
• Building partnerships for sustainable funding models.
• Other (please specify) or add comments

23. In terms of financial and other resources, how much has UiO contributed to:

• Software Development
• Academic support (graduate students)
• Field training
• Research
• Other (please specify) _______________
24. Is the HISP UiO model of building capacity through research and training working?
   - Are UiO trained resources returning to countries and contributing to national HMIS programs?
   - Is it sufficient? Are more trained resources needed faster than UiO’s capacity to train them?

25. In your opinion, has support by UiO been increasing or decreasing?
   - Increasing
   - Decreasing
   - No change
   - How important is the contribution of UiO to the continued sustainability of the HISP/DHIS 2 program?
   - Are there alternative ways UiO could be contributing to support of HMIS?

26. Is your organization a funder of DHIS 2 work?
   <Logic: If no, skip to Conclusion and Thank You>

Part V - Funder-specific questions

27. What is your in-country funding model focused on? (e.g., HMIS implementations, emergency response, program specific [e.g., HIV/AIDS], health system strengthening, etc.)

28. As a funder, what convinced you to invest in DHIS 2? Do you believe the investment has been successful?

29. For your organization, what are the key determinants of success in a DHIS 2 implementation?

30. If you personally had $100 million to spend on improving DHIS 2 deployments or use globally, with no restrictions, what work would you fund? How would you allocate it across the dependencies and challenges which you have highlighted?

Conclusion and Thank You

31. Is there anything else you’d like to tell us?

We are very thankful that you have provided your feedback to this project. Your time is valuable and we appreciate your insights.

If you have any additional questions or thoughts, please contact Caren Althauser at calthauser@path.org.
# Appendix 8: Selected Resources

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<td>DHIS² 2 newsletter archive and mailing list</td>
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1. Health Information Systems Programme
2. University of Oslo
3. District Health Information System
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⁴ Population Services International
⁵ President’s Emergency Plan for AIDS Relief
⁶ Data for Accountability, Transparency, and Impact