The Health Information Systems Programme

Final Report

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❊PATH
A catalyst for global health

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Acronyms and Abbreviations

Acronym	Definition
BEANISH	Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector
CBPP	commons-based peer production
CDC	Centers for Disease Control and Prevention
CHAI	Clinton Health Access Initiative
CHAT	Cultural Historical Activity Theory
CSSC	Christian Social Service Commission
DANIDA	Danish International Development Agency
DHIS	District Health Information System
ECOWAS	Economic Community of West African States
FOSS	free/open source software
GIS	geographic information systems
GLOBVAC	Programme for Global Health and Vaccination Research
HMIS	health management information systems
HMN	Health Metrics Network
HIS	health information systems
HISP	Health Information Systems Programme
IFI	Institute of Informatics
IHI	Ifakara Health Institute
IS	information systems
IT	information technology
JICA	Japan International Cooperative Agency
M&E	monitoring and evaluation
MCTS	Mother and Child Tracking System
MGD	Millennium Development Goals
MESI	Monitoring and Evaluation Strengthening Initiative
MOHSW	Ministry of Health and Social Welfare
MOU	memorandum of understanding
MSc	masters of science
MSH	Management Sciences for Health
nBits	name-based tracking
NHSRC	National Health Systems Resource Centre
NIPI	Norway India Partnership Initiative
NIMR	National Institute for Medical Research

Acronym	Definition
NOMA	Norad's Programme for Masters Studies
Norad	Norwegian Agency for Development Cooperation
NRHM	National Rural Health Mission
NUFU	Norwegian Programme for Development
OSS	open source software
PMTCT	prevention of mother-to-child transmission of HIV
RCN	Research Council of Norway
SCOT	Social Construction of Technology
SIU	Senter for internasjonalisering av høgre utdanning/Norwegian Centre for International Cooperation in Higher Education
STI	sexually transmitted infections
UAA	Addis Ababa University, Ethiopia
UDSM	University of Dar es Salaam
UEM	Eduardo Mondlane University
UIO	University of Oslo
UN	United Nations
USAID	United States Agency for International Development
UWC	University of Western Cape, Mozambique
VCT	voluntary counseling and testing
VERDIKT	Core Competence and Value Creation in Information and Communication Technologies
WAHO	West Africa Health Organization
WHO	World Health Organization

Executive Summary

Introduction

The Health Information Systems Programme (HISP) is a global project to strengthen public health systems by improving the collection and use of health indicators. The network of users has grown to include over 20 countries in Africa and Asia with over 1.3 billion people potentially covered by its services—making it one of the largest and most successful global health information system (HIS) initiatives in existence. The main activity of the HISP Network has been the development of the District Health Information System (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 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.

Findings

- **The achievements, impact and value created by HISP are unquestionably significant.** These can be measured along two axes: (1) the contribution to the global body of academic knowledge through the advancement of nearly 100 graduate students, and (2) the impact of in-country implementation and use—with nearly 20 active University of Oslo (UIO)/Norad-supported deployments of DHIS, potentially covering 1.3 billion people.
- **UIO is a strong advocate to the ministries of health to strengthen management capacity and support development of health management information systems (HMIS).** Students, faculty and staff from UIO provide critical technical resources for core software development and rapid in-country support for start-up.
- **Key ingredients for success were identified among the successful HISP deployments.** They include: local governance and ownership; HISP involvement in training and indicator selection; HISP staff embedded within the ministries of health; evolution to a service-based business model; ability to demonstrate that DHIS aligns with national goals; growing spheres of influence beyond country borders; and experienced management.
- **Agency funding of HISP is complicated and fragmented.** Four key findings emerged. (1) Approximately 130 million NOK have been spent on HISP. (2) Funding was nearly evenly split between development/deployment activities and academic capacity building. (3) Funding sources from within Norway are interwoven making attribution difficult. (4) Norwegian government funding is critical for core software development and is leveraged by other financial contributors for local deployment.
- **DHIS is at risk of losing momentum without clear management of the core product with regard to product development, messaging, and strategy.** Lack of clarity around distinct product requirements addressed by DHIS, the lack of a product road map for the next 36 months, as well as product divergence among regional nodes, increase the risk of fragmentation and loss of momentum.
- **HISP is at a critical point in its evolution and funding as it transitions from market seeding activities to management of a mature, scaled HMIS product.**

Conclusions

- **HISP is having a significant, worldwide impact.**
- **Masters and PhD students from UIO have had an important role in the development of DHIS v2 and in the introduction, deployment, and strengthening of DHIS in a wide range of countries.**
- **Software development resources are limited; and due to the success of the program there is a need to leverage enterprise-level service, product management, and development tools to meet the growing needs of partner countries.** Additional full-time developer resources are needed for maintenance and new features and to provide continuity of services beyond the average term of a masters student. **The flexibility of DHIS to be customized for local requirements has allowed the core software platform to meet the needs of partner countries.** One key need of the existing DHIS platform is expansion, integration o**r interoperability with other eHealth initiatives. Success in broader eHealth will require integrating other systems and working with partners, as well as building on a strong DHIS cor**e.
- **There is a need to identify a strategy for working synergistically with other HMIS software packages and organizations and develop capacity to align DHIS deployments with OpenMRS and multiple mobile data collection tools.**
- **There is a need to explore options for increased interoperability between DHIS and other tactical HIS and identify if opportunities exist to synchronize deployment strategies to leverage joint resources in planning, training, and building local technical capacity.**
- **There are clear key ingredients of success as demonstrated by successful deployments which, if replicated, will improve efficiency.**
- **There is an evolutionary difference between countries needing locally trained leaders to maintain the development of an HMIS system and needing external support to establish and set up a system leveraging global best practices.**
- **HISP funding is complex, with a long history of balancing incremental donor needs and incremental requirements with product development, market seeding activities, and academic goals.**
- **Lack of clarity around distinct requirements addressed by DHIS and the lack of a product road map for the next 36 months increases the risk of fragmentation and loss of momentum.**
- **Boundaries between applications are blurring, and the need for ministries of health to have harmonized and sustainable health information system plans that contain fewer applications and less technical diversity are growing.**

Recommendations

- **Norad should continue to support the HISP Network and DHIS software.**
- **The HISP Network should hire additional software development resources for DHIS v2. These should be distributed between UIO and other network nodes, and should include both project managers and developers.**
- **UIO should continue to directly support masters and PhD students to work with the HISP nodes.**

- **HISP should identify a strategy for working synergistically with other HMIS software packages and organizations and develop capacity to align DHIS deployments with OpenMRS and multiple mobile data collection tools.**
- **HISP should 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.**
- **HISP should develop a deployment strategy that builds on the success factors of India and South Africa.**
- **Funders and HISP should carefully prioritize new academic programs to support mature national deployments and HMIS capacity building, not precede their establishment.**
- **There is a need for coordination within the Norwegian government for systematic and rational program and product development, aligned with a HISP Network-defined product strategy and road map.**
- **DHIS has reached a level of maturity and accountability that requires management by a skilled product manager following established product development methodologies.** HISP and Norad should focus on clearly defining the road map for DHIS, especially addressing user and system requirements and managing the development of DHIS as a platform.

Chapter 1: Background

Introduction

The Health Information Systems Programme (HISP) is a global project to strengthen public health systems by improving the collection and use of health indicators. The project was started in the mid-1990s in South Africa and has grown to include a significant number of countries in Africa and Asia. The project was founded by researchers from Norway and has continued to get substantial support from the Norwegian Agency for Development Cooperation. HISP is organized as a group of semi-independent nodes, with South Africa and India being the two large nodes for program deployment and Norway retaining an important role in software development and education. HISP India and HISP Norway maintain a close collaboration while the South African node has significantly more autonomy.

HISP developed the District Health Information System (DHIS) software for collecting and aggregating health statistics. The development and deployment of the software has been central to HISP's activities, although it is critical to recognize that HISP is much more than a software development project. There are two separate versions of the DHIS software, DHIS v1.4, which is a Microsoft Access application, and DHIS v2, which is a client server Java application.

Purpose

The purpose of this review is to independently document and assess the achievements of HISP. The evaluation has resulted in recommendations for business and organizational strategy, as well as how to structure future support for HISP from Norad and potentially other contributing institutions.

Objectives

The evaluation has several objectives:

1. Document HISP's achievements to date (effectiveness) within the areas of:
   - Individual and institutional capacity building in the area of implementing an operating health information system.
   - Implementation and use of DHIS v1 and DHIS v2 software at the country level.
   - Impact on overall health information system (HIS)/health management system structures as well as quality and culture of use of information systems for program management and policymaking.

2. Assess the role of the Department of Informatics (IFI) at the University of Oslo (UIO) in the HISP network and in achieving results.

3. Assess the extent to which achievements to date address and meet the needs of partner countries.

4. Assess the *efficiency* of HISP in terms of achieving desired results.

5. Assess the use of financial resources from different Norwegian channels (Norad's Programme for Master Studies [NOMA]; Norwegian Programme for Development, Research, and Education; and The Research Council of Norway) focusing on interfaces, leverages, and potential challenges including reporting and attribution. Assess the wider context and

opportunities for HISP at the global and country level with particular focus on creating synergies with other major actors in the area of HIS strengthening and capacity building.

6. Recommend what changes, if any, ought to be made to the current business model and strategy to ensure that future interventions are:
    - Effective means toward contributing to strengthen HIS.
    - Tailored to needs.
    - Being more effectively implemented.
    - Lead to improved prospects for *sustainability*.

7. Provide recommendations in terms of continued support from Norad and potentially other financiers to the HISP.

Main Questions

Key questions evaluated by this study are:

1. What are the ingredients for successful deployment and sustainability as demonstrated by the lessons learned from HISP India, Tanzania, and South Africa?

2. What role does UIO play today, and what role should they play in the future?

3. How can the HISP network efficiently grow, strengthen and continue to meet the needs of consumers of data?

Scope

The main focus of the assessment is on India, Kenya, Malawi, Nigeria, South Africa, and Tanzania. However, interviews, correspondences, and survey evaluations included Burkina Faso, Ethiopia, Ghana, Liberia, Sierra Leone, Sri Lanka, Tajikistan, Uganda, Vietnam, the West Africa Health Organization (WAHO), and the World Health Organization (WHO).

The time frame of the activities and achievements assessed are between 2000 and 2010.

Main Users of the Evaluation

The main users of the evaluation are donor organizations—chief among them Norad, and key stakeholders within the HISP network.

Background on Chronology, Stakeholders, Organization, Budgets, and Policy Documents

HIS remains the backbone for providing information that tracks progress for improving the different health system components and monitoring. On the ground, however, HIS deployment in developing countries has proven to be difficult due to organizational complexity, fragmented and uncoordinated organizational structures, unrealistic ambitions, competing priorities, lack of capacity, and issues related to maintenance and sustainability. As a result, in many countries decision-making hampers sustainability when a system is implemented because of poor availability and quality of data as well as a lack of a "culture" of use of information for planning.

HISP network background

HISP is a network focusing on information systems and open source software for public health care. HISP aims to improve health care in developing countries through the combination of research on and implementation of HIS. The network, initiated by and coordinated from the Global Infrastructures Research Group at IFI, UIO, has been involved in many countries in the global south since 1994.

Starting in South Africa as a project to reform the public health information system, HISP later extended activities from a pilot project in three Cape Town health districts to a global network active in nearly 20 countries with over 1.3 billion people in Africa and Asia potentially covered by its services. The goal is to work toward improved information use to tackle public health challenges through enabling local managers to use reliable and good-quality data. This will help them make informed decisions that will save resources and improve health services

The primary focus for HISP is supporting stronger management of health systems through the development and use of management information systems. This is largely achieved through developing and implementing integrated DHIS for routine data, semi-permanent data, and survey data; however, it is also expanding to include individual-level data and the ability to connect with other tactical HIS such as electronic medical records and human resource management tools. DHIS has been customized to meet country-level requirements, and the user interface has been translated into many languages and alphabets; for example, Indian languages and scripts/alphabets such as French, Hindi, Malay, Mongolian, Portuguese, Russian, Spanish, Telugu, and Vietnamese. The information, communication, and technology solutions, materials, and experiences developed by HISP are shared based upon free and open source software principles.

With financial support from Norad, the UIO initiated its collaboration with the HISP project in 1995, and contributed to the development of the software application (DHIS v1[*]) in South Africa and the creation of HISP training programs at the University of Western Cape. During the 1990s, several research projects and training programs were carried out with this objective. As a result of this cooperative effort between the health authorities and academia, the first masters programs were established in South Africa and Mozambique in 2001, under the auspices of the former Norad Fellowship Program. In 2005 the project was extended to Tanzania, where the UIO started up with a course at the masters level. The goal is that the new PhD and masters programs will be a contribution to the further expansion of the HISP approach to using communication and information technology to support health structures.

Since 1995, HISP has received approximately 130 million NOK in grants from several institutions, including:
• Norad

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[*] DHIS v1 software was developed in South Africa in 1998 and is being introduced in many countries. DHIS v1 is based on MS Office. Since 2005, the UIO has been coordinating the development of the web-based and fully open source-based DHIS v2 (www.dhis2.org) application which has been taken up and implemented in many countries with India being the main collaborator and "test-bed." DHIS v2 is also the focal point in the collaboration between WHO and UIO. The WHO OpenHealthMapper GIS application is being developed as a module in DHIS v2. The two software platforms have contributed to the development of two relatively independent HISP implementation networks; while Oslo/India is focusing on DHIS v2 HISP South Africa is focusing on DHIS v1.

- USAID
- NOMA
- Norwegian Centre for International Cooperation in Higher Education (SIU)
- Norwegian Embassy
- European Union
- Danish International Development Agency
- Research Council of Norway

Additionally, equivalent funding levels of approximately 120 million NOK have been provided by the University of Oslo to support faculty, graduate students, and staff; as well as the research and development of HISP and DHIS. Two areas of in-depth focus for this evaluation have been India and Tanzania; both have unique histories and sets of stakeholders documented throughout this report and are briefly detailed below.

HISP-India

The activities of HISP India can be divided into three phases as illustrated in Figure 1 below.

Phase 1
- Between 1999 and 2007 a pilot phase of introduction of the DHIS software in various states took place. The efforts started slowly but eventually grew to statewide deployments. This early stage of the deployment was hampered by lack of readiness for computer deployment at the district or sub-district levels.

Phase 2
- HISP-India's major growth phase was during 2007 to 2009, with the deployment of DHIS v2 at the state level in about half of India's states and the recognition of DHIS at the national level as a tool for information reporting. The reason that DHIS was able to achieve such sudden prominence was that HISP staff were working very closely with national HIS and were embedded in a technical support institution of the National Rural Health Mission.

Phase 3
- The current phase of HISP activities consists of extending the deployment of DHIS in various states and integrating with other HIS.

Figure 1. The three phases of activities of HISP-India

HISP-India consists of roughly 30 people, with about 15 based in the Delhi office. Others are based in Chandigarh, Patna, Shimla, and Trivandrum. The activities in the Delhi office center on software development and training. The personnel in the state offices support specific HISP projects including the introduction of mobile technology for data reporting.

HISP-Tanzania

In 2003, DHIS was introduced in two districts of Tanzania as a pilot by the University of Dar es Salaam (UDSM) Department of Computer Science. Over the years, additional partners have adopted DHIS v2 and deployed it in a select number of districts. However, DHIS deployment is

still considered a pilot despite Ministry of Health and Social Welfare (MOHSW) endorsing it as the software of choice for health management information systems (HMIS). Data and reports from DHIS are not widely used for decision-making and data submission to regional and national levels is still a manual paper-based system.

University of Oslo (UIO) has had a permanent presence in Tanzania since 2009 in order to provide support to UDSM and strengthen it to take on a masters of science (MSc) health informatics program. UIO also provides financial support to UDSM and participates in joint MSc and PhD research. UIO also supports UDSM in the development of DHIS.

HISP's project office is funded by UIO and is hosted by UDSM. The team consists of four software developers and a project leader employed by UDSM which provide technical support to implementing partners, training to end users, and also help to customize DHIS to fulfill country-specific requirements without making changes to the core DHIS. The HISP strategy in Tanzania is to build capacity at the national level and participate in the implementation of the Monitoring and Evaluation Strengthening Initiative.

HISP Research Contribution

One of the key contributions over the last decade and a half from HISP has been the development of the corpus of knowledge around HIS. The information gathered in the literature review represents a comprehensive bibliography of 48 items documenting milestones and achievements of HISP and DHIS. These milestones and achievements include: implementation, geographic focus, impact, program evaluation, and capacity building. The types of publications varied: peer-reviewed or academic journal articles (14); masters and doctoral theses associated with computer science or informatics departments at UIO, University of Dar es Salaam, Mozambique's Universidade Eduardo Mondlane, and the State University of Zanzibar (18); HISP/Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector (also known as BEANISH) network program documents (13); conference presentations and proceeding (1); ministry of health documents (1); and other multilaterals and nongovernmental organizations (NGOs) (1). The publications touch upon implementation and evaluation of HISP and DHIS in 11 countries: Botswana, Ethiopia, India, Malawi, Mozambique, Nigeria, Sierra Leone, South Africa, Tanzania, Vietnam, and Zanzibar.

Chapter 2: Methodology and Analytical Framework

Research Strategy

We evaluated the seven objectives listed below by the following methods: conducting a literature review, online surveys and phone interviews, and in-depth field assessments and case studies in Tanzania and India. Table 1 below further outlines our objectives, methodologies, and the resulting deliverables.

Table 1. Objectives, methodology, and deliverables.

Objectives	Methodology	Deliverables
Objective 1: Document the achievements and effectiveness of HISP.	• Document achievements, milestones, critiques, and impact. • Document individual and institutional capacity building by detailing training programs and activities. • Compare HISP to peer products–OpenMRS, Electronic Tuberculosis Register, DevInfo, Vaccine Supplies Stock Management.	• Structured literature review and analysis of citations. • Matrix on implementation and use of DHIS by country. • Table comparing HISP and peer products against established HIS criteria.
Objective 2: Assess the role of IFI at the UIO in the HISP Network and in achieving results.	• Interview key stakeholders at UIO and in partner countries regarding the role of IFI and perceived impact.	• Documentation of the contributions of UIO.
Objective 3: Assess the extent to which achievements to date address and meet needs of partner countries.	• Understand key stakeholder requirements and needs (i.e., users, funders, procurement, decision-makers) and document fulfillment by HISP. • Develop an understanding of the impact on the culture of use and quality of decision-making for program management and policymaking.	• Documentation of whether if HISP is meeting partner needs and identify gaps. • Identify opportunities for addressing high priority unmet needs.
Objective 4: Assess the efficiency of HISP in terms of achieving desired results.	• Understand the impact on key stakeholders to build capacity and improve decision-making.	• Case studies highlighting use.

Objectives	Methodology	Deliverables
Objective 5: Assess the use of financial resources from different Norwegian channels and assess the wider context and opportunities for HISP at global and country levels.	• Identify and review sources of funding, proportion of funding, and the objectives by source.	• Summary of financial contributions. • Table of financial sources identifying primary objective by source, alignment to outcomes, and major points of influence or foci of investment by funder.
Objective 6: Recommend what changes, if any, ought to be made to current business model and strategy to ensure that future interventions are effective means toward contributing to strengthen HIS, tailored to needs, being more effectively implemented, and lead to improved prospects for sustainability.	• Map business strategy options.	• Final report detailing findings and recommendations for future opportunities and sustainability. • Organizational/financial/ structural recommendations for sustainability.
Objective 7: Provide recommendations in terms of continued support from Norad and potentially other financiers to HISP.	• Synthesize overall assessment of HISP evaluation.	• Recommendations for further funding.

Method

Literature review

Methodology
A comprehensive review was conducted by librarians at PATH using a variety of bibliographic databases and institutional portals such as: PubMed, Medline, ISI Web of Knowledge, and HISP Network websites. The search included the following: HISP or DHIS or "Health Information Systems Programme" or "District Health Information System" {AND} "Developing Countries" or "Low-Resource Settings" or "Low-Income Countries" or "Tanzania" or "India" or "South Africa." Additional results provided by the University of Oslo on April 5, 2011 during the final review. These additions have been added to the References attachment of this report.

Email and phone interviews

Methodology
The study used a brief 12-question questionnaire with a Likert scale and open-ended questions emailed directly to the participants with the basic premise of understanding the use, scale, and impact of the DHIS deployment. Follow-up via email and telephone interviews occurred with some participants, and several participants were contacted only by phone when more in-depth information was required or the standard survey was not appropriate. Specifically, this was the case with WAHO and WHO. Surveys targeted members of each stakeholder category: information workers, government officials, and implementers. The questionnaire is below; see Annex 1 for the completed survey responses.

1. What health domains are covered by DHIS? At what stage of deployment are you?
2. What examples can be pointed to that demonstrate the system's use in decision-making?
3. Has there been local customization of the system?
4. On a scale of 1-5 would you consider the system implementation to be a success? Why?
   1=very successful, 5= not successful
5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?
   1= full potential, 5= not meeting its potential
6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?
   1=efficient, 5=inefficient
7. What are/were the barriers to adoption?
8. Who is funding HIS work in your country?
9. How important is the contribution of the UIO to the continued sustainability of the HISP/DHIS program in the country you are working?
10. Do you see opportunities for the HISP program to increase effectiveness, address needs, ease implementation, and ensure sustainability?
11. Can you please recommend 2 to 3 people we could contact for additional details regarding the DHIS deployment in your country?
12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (Please do not constrain yourself to staying within current

financial or other resources; improvements could be in areas beyond the domain of the actual DHIS software.)

Email and phone interviews targeting HISP countries were conducted. Below are the participant lists.

Phone interviews:

Name	Location
Jorn Braa	Norway
Tome Ca	Burkina Faso (WAHO)
Kayode Odusote	Burkina Faso (WAHO)
Liz Peloso	Sierra Leone
Jason Pickering	Nigeria
Johan Saebo	Sierra Leone
Sundeep Sahay	India
Vincent Shaw	South Africa
Knut Staring	Switzerland (WHO)
Hanne Tilrem	Tanzania
Ola Hodne Titlestad	Norway
Ken Warman	Bill & Melinda Gates Foundation

Email survey responses and follow-up:

Name	Location
Denis Adaletey	Ghana
Prosper Behumbiize	Uganda
Samuel Cheburet	Kenya
Duong Dinh Cong	Vietnam
Vajira Dissanayake	Sri Lanka
Stephen Gbanyan	Liberia
Edem K. Kossi	Malawi, Sierra Leone, Burkina Faso
Murodullo Latifov	Tajikistan
Ayub Manya	Kenya
Chris Mayo	Malawi
Jacinta Mbindyo	Kenya
Mohamed Mumeneeh Jalloh	Sierra Leone
Anthony Muyepa-Phiri	Malawi
Anthony Ofosu	Ghana
Johan Saebo	Sierra Leone
Lamoussa Robert Zoma	Burkina Faso

In-depth field assessments and case studies

Field visits were conducted in India by Richard Anderson (PATH/University of Washington) and in Tanzania by Henry Mwanyika (PATH/Ifakara Health Institute). Interviews with district-level

users, HISP staff, and government staff were conducted, and the findings can be found in Annex 3. Full trip and itineraries can also be found in Annex 3.

Itineraries

India 2011	
31-Jan	Delhi
1-Feb	Delhi
2-Feb	Chandigarh
3-Feb	Chandigarh
4-Feb	Shimla
5-Feb	Shimla
8-Feb	Patna
11-Feb	Delhi

Tanzania 2011	
24-Jan	Mtwara
25-Jan	Ruangwa
27-Jan	Mkuranga
2-Feb	Kondoa
3-Feb	Dar es Salaam
10-Feb	Zanzibar
11-Feb	Nairobi, Machakos
16-Feb	Dar es Salaam

Interviews with stakeholders were documented and followed the field guide template (below) deviating where appropriate. (See Annex 1 for the completed field reports.)

Country Overview and Achievements

- *When was DHIS deployed?*
- *Why was DHIS selected? What is the status quo, and what were the alternative HMIS packages DHIS competed against? What else is in use?*
- *What health domains and key indicators are covered?*
- *What % of districts are reporting?*
- *How many lives are covered?*
- *What is the strategic plan for in-country deployment of HISP?*

Role of University of Oslo

- *In terms of financial and other resources, how much has UIO contributed to:*
  - *Development*
  - *Academic support (Graduate students)*
  - *Field Training*
  - *Research*
- *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 program in country X?*

- *Are there alternative ways University of Oslo could be contributing to support of HMIS in country X?*

Relevance
- *What key indicators are collected?*
- *Are data and reports generated by DHIS used? How? By whom? What decisions have been made?*
- *Has there been local customization of the system?*
- *How is the system perceived? Is the data useful, accurate, a burden to collect?*
- *Is the system implementation considered a success?*
- *What are requirements for health information systems? Does DHIS meet these requirements? Where are there gaps?*

Effectiveness
- *How was the need for DHIS identified? Who initiated the discussion for country deployment?*
- *Is the system being used to its potential?*
- *What examples can be pointed to that demonstrate the system's use in decision making?*
- *Has HISP contributed to local capacity building in the area of implementing and operating a health information system?*

Sustainability
- *What are/were the barriers to adoption?*
- *How could adoption be accelerated?*
- *What are the relative costs of operating the DHIS system?Have additional personnel been hired? Has it improved resource allocation? Are there any anecdotal examples of improved health or efficiency outcomes?*
- *Who is funding HIS work in this country? How could HISP/DHIS funding work synergistically?*
- *How has it impacted local capacity? Have staff been hired? Where are they trained? Are there local developers?*

Conclusions/Recommendations
- *How can the support by UIO and the HISP program be improved to increase effectiveness, addressing needs, ease implementation, and ensure sustainability. (Recommendations)*

Chapter 3: Findings

Objective 1. Document the achievements of effectiveness of the Health Information Systems Programme to date.

The achievements, impact, and value created by the HISP is unquestionably significant and can be measured by two methods.

1. The contribution to the global body of academic knowledge on the topic and progression of HIS structures (academic findings).
2. The impact of in-country implementations and use (country-level deployments).

Academic findings

The HISP program has been responsible for the advancement of over 120 graduate students, numerous independent consultants, and developers—all contributing to the global body of knowledge for HIS, as well as to their local community. Graduate students from Ethiopia, Malawi, Mozambique, Norway, Tanzania, and Vietnam have contributed with a focus on a broad array of developing countries to understand the lessons learned, challenges, and opportunities for HIS. As illustrated below, the 106 publications identified through our literature review yield academic dissertations, public reports and presentations, and peer-reviewed journal articles for 21 countries (Figure 2). An additional 82 conference papers are included in the References appendix, but are not reflected in the following tables or annotation due to the lack of availability for all abstracts and submissions.
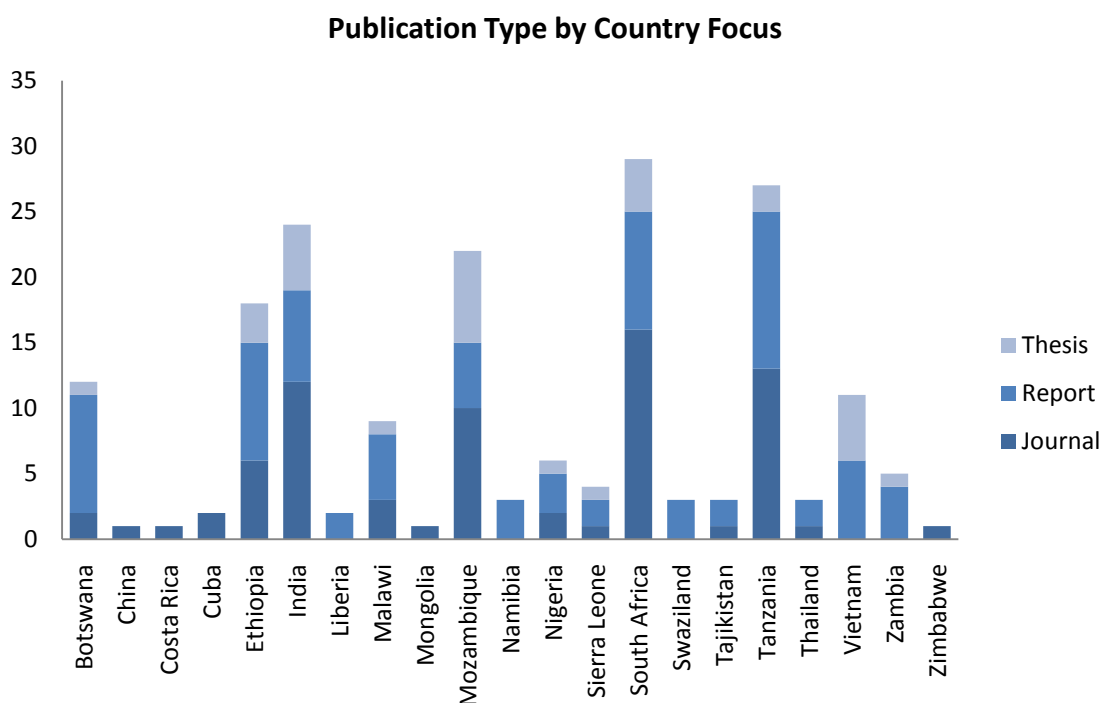
Figure 2. Publication type by country focus.

Our review also demonstrated a steady increase in publications over time as seen in Figure 3.

Publications by Year
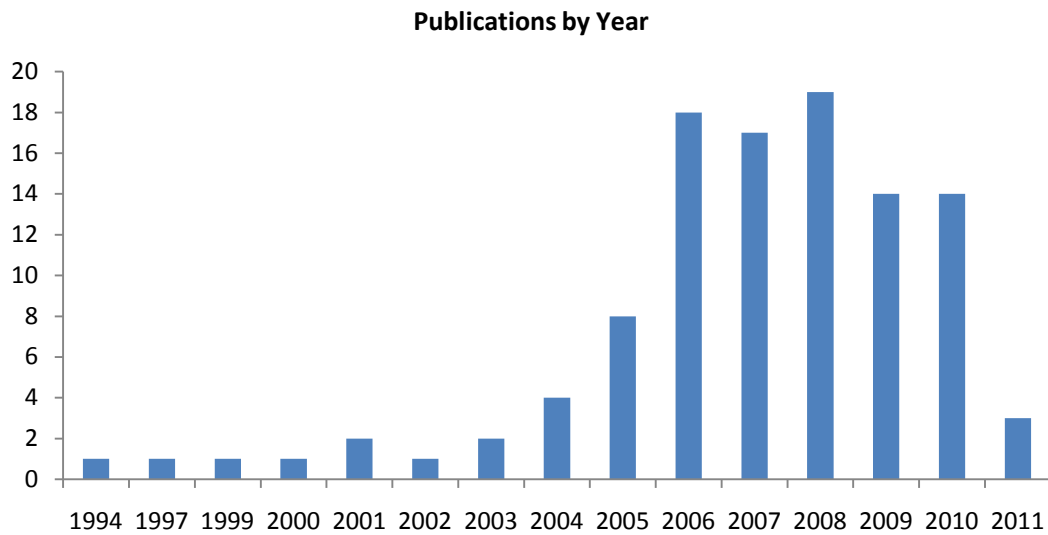
Figure 3. Publications by year.

Figure 4 shows a heavy emphasis on academic thesis and public reports.

Percentage of Publications by Type
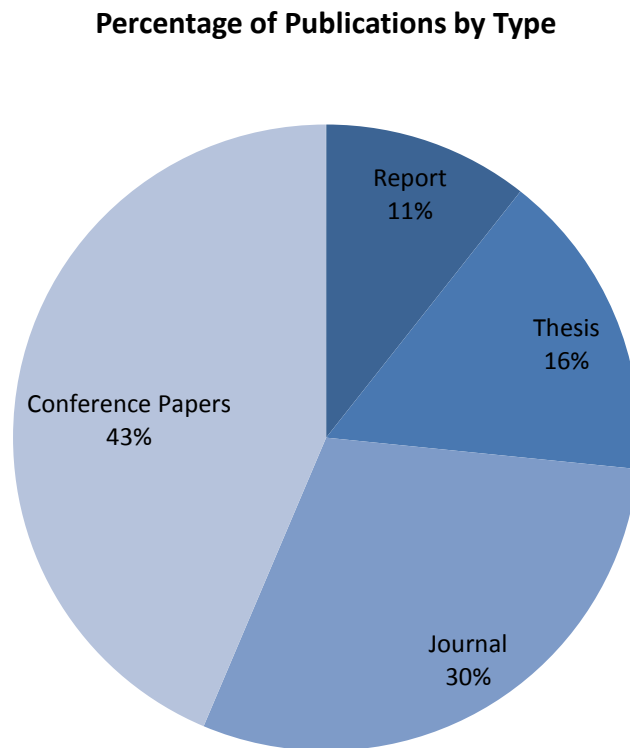
Figure 4. Percentage of publications by type.

Figure 5 illustrates the strong contribution and influence made by the University of Oslo.

Publications by Author Affiliation
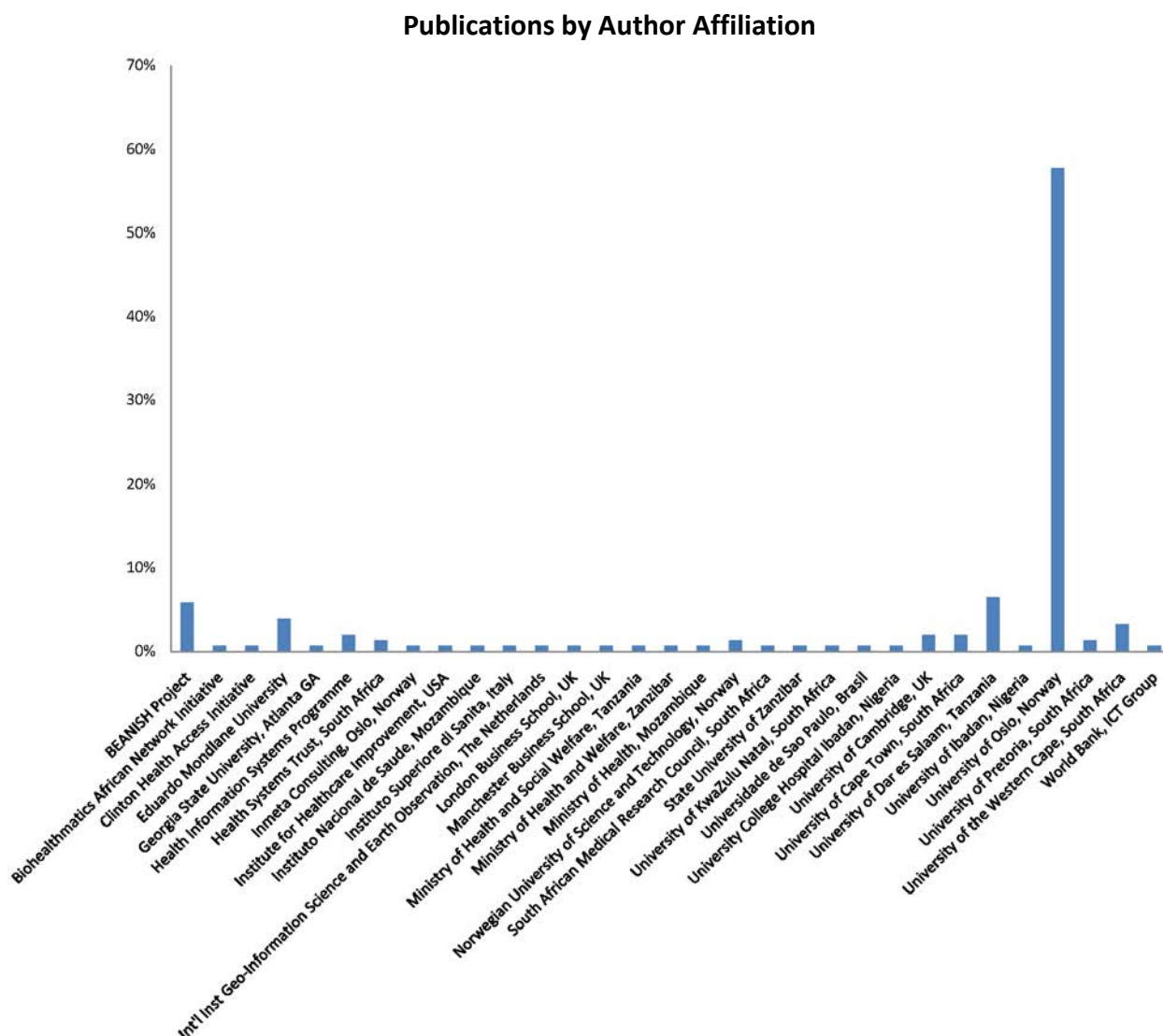
Figure 5. Publications by author affiliation.*
*Note: multiple author affiliations are possible for a single publication.

Additionally, the academic programs have led to operational successes in creating local capacity for deploying and maintaining HIS infrastructures. Several of the leaders within the HISP Network are graduates of the program such as John Lewis (eHealth systems lead, HISP-India), Ola Titlestad (DHIS v2 project and HISP coordinator), and Vincent Shaw (HISP-South Africa Manager).

Country-level deployments

Our evaluation yielded 20 active deployments using DHIS v1.3, v1.4, or v2, and, if fully implemented, have the potential of collecting data representing over 1.3 billion lives. The software is a robust and flexible tool providing utility to a wide spectrum of the facility-based and public health programs including a broad range of indicators and reports.

Nationally integrated health indicators:

- Reproductive health
- HIV/AIDs
- Malaria
- Tuberculosis
- Child nutrition
- Primary health care services
- Leprosy
- Expanded Program on Immunization

Reports generated from DHIS:

- Outpatient morbidity
- Inpatient morbidity and mortality disease
- Administrative statistics
- Workload report for health facilities

Among these deployments there were key differences regarding the maturity, impact on HIS, and culture of data use. See Table 2 below, a table listing information for all active UIO-supported countries is listed in Annex 2.

Table 2. Variations in country-level deployment of DHIS.

Two nationally integrated regional nodes—India and South Africa
India and South Africa are mature programs with deep integration into the HIS systems and development processes in their respective countries.
India and South Africa receive financial support directly from their respective country governments. This accounts for the majority of South Africa's funding and about 40% of India's funding.
India and South Africa have transitioned to service-based models for some of their activities. These models provide maintenance, training, and planning support to government agencies.
Six countrywide government-sponsored deployments (India, Liberia, Malawi, Sierra Leone, South Africa, and Zanzibar)
India and South Africa have clearly reached a point of sustainability where HMIS programs are cornerstones of health system management including resource management and planning.
Liberia is also using DHIS v1.4, and routine health data is submitted monthly to the central Ministry of Health and has been used for the development of the 10-year National Health Policy and Plan Situation Analysis 2011-2021.
Malawi has had a paper/computerized hybrid system since 2002 leveraging DHIS v1.3 and is currently migrating to v2.0. Data use has matured to the point where DHIS information is used for generation of graphs to support management decisions. In addition, district and program managers use the data in the formulation of district implementation plans and monitoring implementation, among other applications.

Six countrywide government-sponsored deployments (India, Liberia, Malawi, Sierra Leone, South Africa, and Zanzibar)—continued.
Sierra Leone began using DHIS in 2007 and continues to develop a culture of management decision-making based on data. Reports provided to government officials (Annex 2) were initially developed by implementing partners at the Health Metrics Network (HMN) and have evolved and been adopted and adapted by information workers within the government. Additionally league tables have been demonstrated to be effective means of leveraging competition to increase reporting and data use and have driven adoption to 85% from 70% over six months. (HMN Weekly Highlight 12 March 2010)
Zanzibar after establishing a harmonized HMIS system deployed DHIS v1.4 in 2005. The country is in the process of migrating to DHIS v2 and is actively promoting the culture of data use through the development of training packages to increased data management expertise.
Two countries with fragmented vertical specific deployments (Nigeria and Tanzania)
Nigeria and Tanzania both have significant DHIS deployments that have been guided by non-governmental organizations. As a result, the software is in active use and achieving user needs at the subnational level but is not part of a national management information system. The evaluation from Tanzania demonstrated that the MOHSW is not using data from the DHIS to generate its Annual Health Sector Review report, and data is not stored or easily accessible by the ministry. This is resulting in an uneven assortment of indicators being collected at the district level with no national-level harmonization or information flowing to the national level.
Five countries planning national deployments (Ghana, Kenya, Tajikistan, Tanzania, and Uganda)
Ghana, Kenya, Tajikistan, Tanzania, and Uganda all have Ministry of Health-sponsored pilots that have resulted in demonstrating business value for decision-makers and have resulted in support for national deployments.
Eight countries with active government-sponsored pilot projects (Burkina Faso, Kenya, Nigeria, Sri Lanka, Tajikistan, Tanzania, Togo, and Vietnam)
In-country pilot projects are a key step for national-level adoption. However, countries such as Nigeria and Vietnam illustrate that these pilots must clearly demonstrate business value for governments and must align with national priorities.

Four countries (Bangladesh, Botswana, The Gambia, and Rwanda) were not included in the assessment due to a lack of information. Additionally there are countries currently under the direct support and direction of HISP-South Africa which are not funded by Norad, and we viewed as outside the scope of this project; these include Afghanistan, Democratic Republic of Congo, Myanmar, Namibia, Southern Sudan, Zambia, and Zimbabwe.

The HISP program is also having a clear impact on the use of data in implementing countries and is illustrated below through the observations and reports of country-level users and implementers as reported on the field survey:

Kenya

- Health managers are able to access data at their convenience, without having to go through health records and information officers.
- Managers are able to identify areas with low coverage and, therefore, tailor interventions that fit the specific area.
- There are number of managers using the system as a real source of data but also in the planning process.

Liberia

- HMIS data is used for the development of the ten-year (2011 to 2021) National Health Policy and Plan Situation Analysis and planning process. Furthermore, data generated from the system is used during county and national review meetings where critical health-sector decisions are made. The performance-based contracts with NGOs, the county health team (Bomi), and the Global Fund sub-recipients are monitored and evaluated based on the HMIS data that are generated from the system.

Malawi

- Availability of data at the district level has promoted decentralization of decision-making.
- DHIS has provided data at the district level that is used in the formulation of district implementation plans and for monitoring their implementation.
- DHIS has produced a health facility comparative analysis showing facility performance. District Health Management Teams use this to identify poorly performing facilities in need of support.

Sierra Leone

- Statistics generated from DHIS have formed the basis for performance review for the health sector. It also provides data to support the annual health planning summit and will be used to generate data for the payment incentive for the performance-based financing scheme.
- The performance-based financing system in Sierra Leone is based on DHIS v2. Currently DHIS v2 is the official source for health information in the country. In particular it is the monitoring tool for the implementation of the maternal health plan backed by the President.
- The system implementation has been very successful in that completeness in reporting has increased from about 37% to 85% making programs and partners rely on the system for regional health information. It also increases the confidence level of partners to trust data from the ministry of health.

HISP-India

Considering the size and complexity of India, HISP-India has been remarkably successful. The scale of the deployment is unmatched by any projects of comparable size or funding working in HIS. Specific accomplishments of HISP-India include:

- Deployment of DHIS v2 software in roughly 20 states including Bihar, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, and West Bengal. The software is used for the monthly reporting of district health indicators to the national portal. The total population of states deploying DHIS v2 is 680,000,000 (based on 2005 populations).

- Successful integration of the HISP organization with the Indian health system. States view HISP-India as a technical organization inside of the NHSRC, and not as an independent NGO.
- HISP lead the effort to develop a small set of indicators to be reported to the national government. A set of 63 indicators was established for national reporting in 2007. All states now report these monthly from the district level to the national health information portal.
- A major component of HISP activities has been training on collection and use of health indicators. These trainings have been conducted at all levels—from the sub-center level up to the national level. Following the introduction of the new indicator sets in 2008, HISP conducted 600 separate trainings.
- HISP has started to integrate DHIS with other eHealth systems. In one notable project, 5,000 mobile phones were deployed in Punjab for daily and monthly reporting. (This project is by far the largest mobile phone deployment for a health application that the evaluation team is familiar with.)

HISP-India has had remarkable success in establishing the DHIS v2 software as a tool for national data reporting in 20 states in India and in supporting the use of health indicators for management decision-making at the state and district level. The success of HISP-India can be attributed to a broad approach to HIS that includes both capacity development though extensive training and the deployment of a software system that meets broad needs, as well as a tight integration of HISP-India with national and state government health organizations.

HISP Tanzania

In 2003, DHIS was introduced in two districts of Tanzania as a pilot by UDSM, Department of Computer Science. Over the years additional partners have adopted DHIS v2 and deployed it in 50 of 150 districts. However, based on our evaluation, DHIS deployment is still considered to be a pilot phase despite MOHSW endorsement as the software of choice for HMIS. The tool is clearly still in the testing stage as it only covers one-third of the total districts nationally; does not benefit from a harmonized indicator set; data submitted to regional and national levels is still a manual, paper-based process; and data and reports from DHIS are not used for national level decision-making. Currently, a broad-based consortium led by the MOHSW is driving the development of the Monitoring and Evaluation Strengthening Initiative (MESI) which is a continuation of the initial Proposal to Strengthen the HMIS in Tanzania program proposed in 2007. The MESI initiative is seeking to address some of the shortcomings from previous attempts by presenting themselves as an MOHSW owned and led program. As the monitoring and evaluation (M&E) chapter of the Health Sector Strategic Plan, the initiative seeks to harmonize indicators, refine strategies, and accelerate progress for the use of data for rational decision-making. This initiative represents a reset and is leveraging the lessons learned from past attempts.

Conclusion

HISP has significant, worldwide impact on HIS research, software development, and deployment, and changing the culture of data use.

Recommendation

Continue to support HISP and work with the HISP Network and other partners to scale up reach and enable sustainability.

Objective 2. Assess the role of IFI at the UIO in the HISP Network and in achieving results.

Information from country stakeholders identified a number of important contributions by the UIO.

The UIO is a strong initial 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. Country feedback for the survey question asking the importance of UIO to the continued sustainability of HISP/DHIS, was uniformly positive, and highlighted the groups value in terms of:

- Support for training and capacity development (Burkina Faso, Ghana, Kenya, Malawi, Sri Lanka).
- Technical support and customization (Ghana, Kenya, Uganda).
- Implementer support including workshops (Sri Lanka, Uganda).

One of UIO's important efforts has been in leading the development of the DHIS v2 software. DHIS v2 has been critical for enabling large-scale deployments as in the case of India where the NHSRC credits the introduction of the DHIS v2 as one of the reasons that the Indian government adopted it as a national system. DHIS v2 has the critical advantage over DHIS v1.3 of enabling data to be collected online and communicated through an Internet connection. This means that the application only needs to be installed on centrally managed servers, avoiding the need for client systems to be hosted and supported at the facility level. The DHIS v2 software continues to be enhanced as new functionality is added. Currently, software development resources are limited, and various countries (such as Sierra Leone) have reported that the UIO has been slow to address software issues because of a shortage of software developers. Additionally, several respondents stated that currently HISP relies heavily on students and researchers to support country deployments. It was noted that HISP can improve in effectiveness if it can mobilize staff for longer periods of time—beyond the term of a masters student (Sierra Leone) and that there was a clear need for professional support and implementation (Nigeria and South Africa).

Conclusion

Software development resources are limited; due to the success of the program there is a need to leverage enterprise-level service, product management, and development tools to meet the growing needs of partner countries. Additional full-time developer resources are needed for maintenance and new features and to provide continuity of services beyond the average term of a masters student.

Recommendation

Hire additional software development resources for DHIS v2. These should be distributed among UIO and other network nodes, and should include both project managers and developers.

Graduate students from UIO have had a major role in the development of HISP—both in developing the software and in establishing deployments in countries. There have been 14 HISP-related PhD students (1 Ethiopian, 3 Indians, 6 Mozambicans, 1 South African, 3 Tanzanians)

with approximately 34 in the pipeline. There have been approximately 75 masters students (25 African/Asian and 25 Norwegian from UIO, and 25 from masters programs in Africa and Sri Lanka) with more than 100 in the pipeline. The graduate students have documented the lessons learned by HISP through their masters theses, including some of the difficulties faced by HISP projects such as Kim Anh This Vo's thesis "Challenges of Health Information Systems Programs in Developing Countries: Success and Failure" discussing DHIS deployment in Viet Nam.

Conclusion

Masters and PhD students from UIO have had an important role in the development of DHIS v2, and in the introduction, deployment, and strengthening of the use of information for decision making in a wide range of countries. As technical resources, UIO students have been responsible for getting systems off the ground and providing customization support and are a low-cost option for rapidly dropping in technical capacity to countries that do not have internal means.

Recommendation

The UIO should continue to support the work of masters and PhD students to support the HISP nodes.

Objective 3. Assess the extent to which achievements to date address and meet needs of partner countries.

The flexibility of DHIS to be customized to meet local requirements has allowed the core software platform to meet the needs of partner countries. This is especially true in successful deployments such as India, Liberia, Malawi, Sierra Leone, and South Africa. In these situations the software is enhancing HMIS systems and has been adapted to meet specific local needs. Illustrating this point is a quote from a user in Liberia:

> "*Liberia has tailored the DHIS to its HMIS and has adapted a new data collection tool...*"

As was clearly demonstrated in Nigeria, Tajikistan, Tanzania, and other challenged deployments, slow adoption or not meeting stakeholder needs is not a result of the software, but a failure of understanding the needs and/or the planning of the HIS. To reiterate, DHIS is not a turnkey HMIS solution that will fix a broken system but a software solution that increases the efficiency of health information management. These failures do represent an opportunity for the HISP Network to help guide the development and planning of HMIS, and as a result strengthen the deployments of DHIS.

There are still certain software needs that stakeholders would like addressed. Several country stakeholders have reiterated the need for integration with complementary tactical health domain information systems such as patient records or inventory management. As was noted by a stakeholder in Sierra Leone:

> "…current DHIS [software] is very good as a data collection tool for aggregated data requirement. The one area that needs to be looked into is the patient base approach."

> And

"…the requirements are now especially focused on logistics management. DHIS v2 is not a logistics system, though it can be used to keep track of inventories…. I think an open source logistics software, that can handle tracking, orders, finance, etc., should be looked for, hopefully one with the intention of adapting SDMX-HD compatibility to make it interoperable with DHIS v2 and others."

Additionally, countries are customizing and developing eHealth modules that meet their specific needs but could be deployed more broadly—this includes name-based tracking (nBits), mobile data input, and OpenMRS integration.

eHealth initiatives

Country-specific modules and customizations are leading the efforts in eHealth where external systems are being used in conjunction with DHIS. This is being driven both by demand from government and NGO partners, as well as in response to opportunities identified by HISP nodes. The existing deployments of DHIS in countries provide a compelling case for mobile health projects where cell phones are used for data collection. In Punjab, India, 5,000 phones are in use by midwives for reporting maternal health data. This is one of the largest deployments of mobile phones in a health application in the world. Additional projects involving mobile phones integrated with DHIS are taking place in South Africa and Zambia.

One extension of DHIS v2 that is underway is nBits which is primarily supported by the Programme for Global Health and Vaccination Research (GLOBVAC) project. This allows registry information to be indexed by name and stored in DHIS v2. Currently, nBits is being used for antenatal care and immunization tracking in pilots in five states in India. The projects using nBits are closely aligned with state government projects and have the potential to grow rapidly. In Bihar, India, the nBits project also has the potential to align with a broader state initiative in introducing a unique identifier for adults.

OpenMRS is an open source clinical records software that is seeing significant adoption in developing countries. Both HISP-South Africa and HISP-India are working on projects that integrate DHIS with OpenMRS. This is important for them to do, both to develop capacity in working with OpenMRS and to ensure that DHIS can become a component of larger eHealth projects that include OpenMRS.

While many of the organizations working in eHealth have primary backgrounds in computing technology, HISP has a broader focus on HIS. This gives HISP a strong advantage when it comes to deploying eHealth systems that will meet health system needs.

Conclusion

Success in broader eHealth will require integration of other systems and working with partners as well as building on a strong DHIS core.

Recommendation

Identify a strategy for working synergistically with other HMIS software packages and organizations and develop capacity to align DHIS deployments with OpenMRS and multiple mobile data collection tools.

Comparison to peer software solutions

Five other software offerings were examined to compare their business models, offerings and development approach in comparison to DHIS. Of the five projects, OpenMRS and iHRIS are the closest to DHIS in providing flexible tools to address health business processes. These systems are also leaders in domains identified by stakeholders to be of high interest and are represented in Table 3. Data in the table were collected through interviews, questionnaires, and desk reviews, and information on additional systems is included in Annex 2. It is natural to consider OpenMRS, iHRIS, and DHIS being deployed together with some level of integration and various health systems are considering doing this. All three require customization for local deployments and some level of continuous support, so there are necessary service and support roles around them which can either be provided externally or by the health system. Two other systems evaluated, the Vaccine Stock and Supply Management (VSSM) and electronic register for tuberculosis (ETR) contrast with DHIS by being specific applications targeting very specific tasks (supply management for vaccines and registration for tuberculosis patients) and do not offer platform flexibility.

Table 3. Comparison of widely deployed software tools.

Organization or Product	HISP	OpenMRS	iHRIS
Core product; what solution does it provide and who are the target users?	DHIS software for aggregation, analysis, and reporting of health indicators.	Open-source medical record system.	Integrated Human Resource Information System. Human resource management tools for health managers.
What is the scale of adoption?	In use at the district level in about 20 countries.	Used worldwide for medical records. It is estimated to be installed in about 1,000 facilities.	Active deployments in about 10 African countries with roll outs to the district level.
What is the structure of the organization?	Three main country teams (India, Norway, South Africa) along with smaller country deployment teams and a number of affiliated universities.	There is a small core leadership supporting a fairly broad open source community.	Created and deployed initially by a large NGO with United States Agency for International Development (USAID) funding and many partners.
What is the funding model for the organization/ product?	Donor funding for initial country deployments and support of central organization. Support from government health system in mature deployments.	Donor and project funded. Several organizations (with strong fundraising) such as Partners in Health rely on OpenMRS.	Developed as part of the Capacity Plus Project, a $300,000,000 USAID project. Continued support through the Capacity Plus Project.

Organization or Product	HISP	OpenMRS	iHRIS
How is the product marketed?	People from the three main nodes maintain ties with ministries of health and promote DHIS. There are bottom-up efforts to introduce at the district level.	There is a strong community behind OpenMRS, with leadership from Paul Biondich of the Regenstrief Institute.	Introduced as part of a large-scale USAID project. Continued availability as an open-source project.
What is the support/ training infrastructure?	Training is a central component of HISP with a significant effort devoted to health worker training. There are also a number of affiliated university training programs that have the goal of building capacity in HIS.	The primary training around OpenMRS has been developer workshops.	The Capacity Plus Project is continuing to support training and technical support.
What is the software development approach?	DHIS v1.4 and DHIS v2 are managed as open source projects with the assistance of a small number of professional developers.	There is a strong open source community around OpenMRS, with a small number of project-supported developers running the show.	Developed as part of a large project by a professional team. Code is now available as an open source project with hosting through Launchpad.

Conclusion

OpenMRS and iHRIS provide opportunities for alignment with software platforms that share similar philosophies, business models, and deployment priorities with DHIS. By collaborating with one or more HIS platforms, the HISP Network could increase deployment efficiency and better meet country needs.

Recommendation

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.

One important caveat is that by incorporating the name-based tracking and general patient-level data warehousing, DHIS is moving in the direction of being a platform for broader registration of individual-level data services and is potentially in conflict with future functionality of OpenMRS and other HMIS systems. We, however, see this as an opportunity to more clearly define the role of DHIS, and would recommend prioritizing patient-level registration services in the core DHIS road map. This would allow the option of using DHIS as a national data warehouse versus a peripheral data aggregation and reporting tool. It is our opinion that there is a risk to long-term

sustainability that operational systems—such as OpenMRS—could expand their functionality and move into the data aggregation and reporting domain, negating the need for a separate DHIS application.

Objective 4. Assess the efficiency of the Health Information Systems Programme in terms of achieving desired results.
Critical Success Factors

Mature organizational nodes within the network, such as in India and South Africa, are strong examples of the success achievable by HISP. These independent and locally sustainable organizations in their mature state have evolved their technical offerings from early pilot projects to national DHIS deployments. Additionally, their business model has expanded from soft money-funded consultants responsible for bridging the technology and public health gap to service and support organizations.

These organizations share key similarities:

- Local governance and ownership, with clear organizational vision and mission.
- Contracted at the national level to provide training and indicator selection support.
- HISP staff have been embedded in the ministry of health.
- Hybrid service-based business models have two funding streams (1) providing services (maintenance, training, support) and (2) grant solicitation.
- Able to demonstrate that the technology is real and aligns with national goals.
- Growing spheres of influence outside inception countries.
- Long-standing senior management and staff that passionately believe in their organization's mission.

As a result of these core ingredients, successful nodes have demonstrated effectiveness of achieving impact, relevance in meeting stakeholder needs, efficiency in achieving desired results, and the foundation for long-term sustainability by diversifying their funding and business model. Examples of these core elements surfaced during the evaluation in both positive and negative examples but demonstrated that overall there is a clear path for the HISP organization for continued success and impact in improving health care decision-making.

Field visits and interviews with stakeholders illustrated both ends of the organizational maturity spectrum for successful and challenged HISP deployments and their ability to achieve relevance, sustainability and effectiveness.

HISP Success

The two strongest successes for HISP are the HISP-India and HISP-South Africa nodes, where success is defined as the institutionalization of DHIS and the establishment of processes where indicator data is used to strengthen management decision-making in the health system. Both of the nodes have established themselves over a period of many years, starting with pilots and reaching the point of having strong support from the national health ministry to allow DHIS to be adopted from national data reporting. Both nodes have teams that are large enough and strong enough to support a range of activities including DHIS support, training, and eHealth services.

Both HISP-India and HISP-South Africa have strong links with government which is critical to position the organizations to have national-level influence. In India, HISP is viewed as an "empanelled agency" of NHSRC which provides technical support. This was reported by the state mission directors of Punjab and Himanchal Pradesh. This has the significant practical advantage that it makes it easy for states to engage with HISP-India (and do not need to go through a complicated process that would allow working with a foreign NGO). This also means that HISP has a low profile and is not identified as external. The DHIS software is referred to as HMIS and not DHIS.

The key step for developing the close ties between HISP-India and the government through the NHSRC was to have HISP personnel working for NHSRC for several years in an advisory capacity. (Sundeep Sahay and John Lewis, 2008–2010).

One of the important ideas behind the work on DHIS is indicator rationalization—where the amount of health data that is reported is reduced to a modest number of items that can then be understood for their meaning to public health. The process of indicator rationalization involves both identifying the key concepts and also working out details for common reporting. In India, Kenya, Sierra Leone, South Africa, and Zanzibar, indicator rationalization preceded the wide-scale deployment of DHIS. For example, in India, prior to rationalization, states were reporting several thousand data elements. In 2007, a common set of 63 indicators was developed for reporting from the district level. All states now report these data items. HISP-India played a central role in developing these indicator sets. In an interview, T. Sundararaman, the Executive Director of the NSHRC said that the "the indicators were based on the work of Sundeep Sahay [of HISP-India]."

Additionally, both HISP-India and HISP-South Africa are mature organizations and are expanding their role to support additional eHealth services such as mobile deployments, data warehousing, and geographic information systems. Both organizations are discovering that opportunities around broader eHealth projects are well aligned with core competencies.

HISP challenges

Adoption of DHIS in Tanzania has been slow covering only 50 of 150 districts, as a result deployment is still considered by the authors to be a pilot despite MOHSW endorsing it as the software of choice for HMIS. Data and reports from DHIS are not widely used for decision-making and data submission to regional and national levels is still a manual, paper-based system. In addition though not conclusive, the publicly listed 27 Basic Health Indicators on the MOHSW website appear to not have been updated more recently than 1998 with critical Millennium Development Goals 4 and 5 maternal and newborn health indicators such as health personnel at birth not updated since 1985.[†] Current data for these indicators should be available through DHIS if it were in use. The slow adoption stems from several factors: a lack of strong national leadership by the MOHSW resulting in poor coordination among implementing partners, lack of qualified workers in health districts to provide technical support for the system, existence of the Health Management Information System of Tanzania (MTUHA)—an older non-standardized HMIS tool that is no longer relevant in the current environment, and lack of harmonization of reporting tools of different programs. Activities are already in process to accelerate DHIS

[†] http://www.moh.go.tz/Health%20Indicators.php

adoption with the development of a nationally unified and harmonized indicator set as a part of MESI. Critical to its success will be strong leadership and internalization by the MOHSW to guide coordination among implementing and funding partners and guarantee long-term sustainability. In addition to Norad funding, there are a number of partners that are also funding HIS work in Tanzania (e.g., Centers for Disease Control and Prevention [CDC], the Netherlands Embassy, the Norwegian Embassy, the Japan International Cooperation Agency, and the Global Fund). For this funding to work synergistically, there is a need for MOHSW to take a leading role so that these funds are used effectively in HMIS strengthening.

Figure 6 below is a network diagram based on information collected during stakeholder field visits that illustrates the complex web of interactions within Tanzania. This complexity exists despite the formal memorandum of understanding (MOU) guiding a consortium arrangement of the agencies specific to the MESI project. While these agreements are important steps, earlier attempts at large-scale projects in Tanzania such as the 2007 Proposal to Strengthen the HMIS in Tanzania failed to get traction, despite a signed MOU between key stakeholders. This project and agreement has continued to develop and is now part of the MESI project with a continuation of the existing MOU. What is critical to note in Figure 6 are (1) the significant number of nodes in the network versus what would be found in India which has closer to three (HISP-India, national government, and state government). (2) The Japan International Cooperative Agency (JICA) is a completely independent organization with no formal coordination, cooperation, or partnership relationship with any other organization as identified by our interviewer. As a result, their efforts are completely uncoordinated with other DHIS deployments in the country. (3) No organization is the dominant node in the network. All had the same number of connections to the others and no single node is a gateway or coordinator. While the MOHSW is the lead in the MESI, interview and survey respondents noted that it does not have the same level of technical capability or capacity as seen in countries like India, Kenya, or Zanzibar, which prevents the organization from being able to strongly dictate its needs and requirements in the presence of so many other influential and motivated stakeholders.
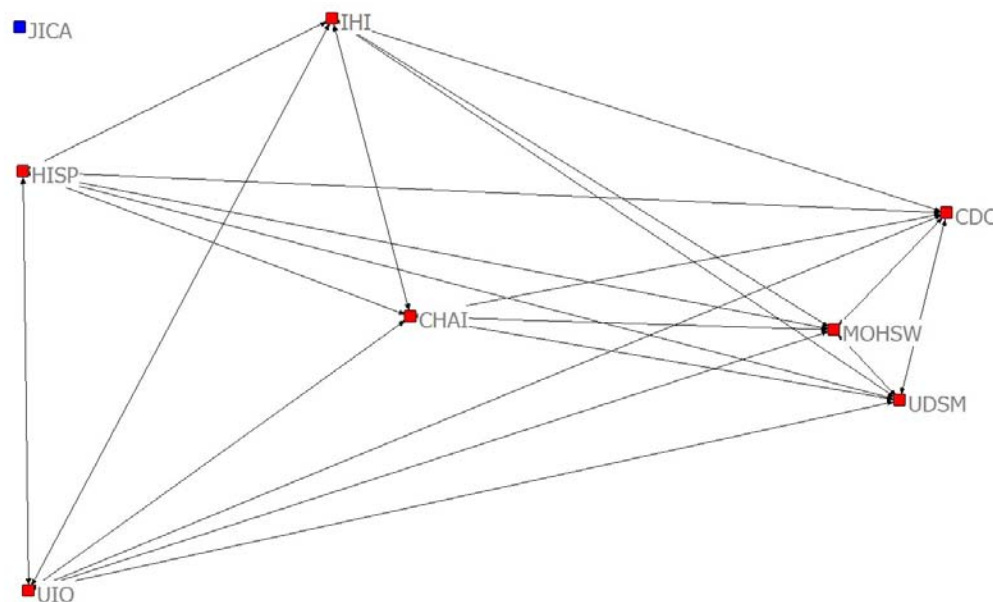
Key	
Acronym	**Agency**
CDC	Centers for Disease Control and Prevention
CHAI	Clinton Health Access Initiative
HISP	Health Information Systems Programme
IHI	Ifakara Health Institute
JICA	Japanese International Cooperative Agency
MOHSW	Ministry of Health and Social Welfare
UDSM	University of Dar es Salaam
UIO	University of Oslo

Figure 6. Tanzania network diagram highlighting complexity of the relationships among stakeholders.

Nigeria is another example where the lack of strong national leadership has led to fragmentation. Despite there being an independent HISP-Nigeria team supported by HISP-South Africa, there are a myriad of funders and implementation partners (e.g., Family Health International, Voxiva, the Centerfuge Group, the Partnership for Transforming Health Systems Phase II) all seeking to create reporting infrastructures for their specific projects. Additionally, there is neither a clear indication that there is government support or desire for health information data nor a proven to decision-makers that demonstrates clear business value for government or donor stakeholders for a nationally rationalized indicator set.

Conclusion

Critical success factors for the mature HISP nodes (India and South Africa) include strong leadership in the ministry of health in planning and deployment of DHIS and a national effort to

rationalize reporting of health indicators. Both the India and South Africa nodes have had strong roles in training health professionals on the use of data and supporting the deployment of DHIS.

Recommendation

Develop a deployment strategy that builds on the critical success factors of India and South Africa. This includes focusing on enabling strong project leadership in the ministries of health by building strong ties at the national level, working to harmonize indicators, and emphasizing training of health system personnel. Since new deployments will generally focus on countries with smaller economies than India or South Africa, a regional strategy, such as developing West African regional nodes, may be appropriate. As noted by a stakeholder in Sierra Leone, there is a "need [for a] regional network to support individual deployments." The foundation for a West African regional node is already starting to take shape through integration of DHIS and harmonization of indicator sets by WAHO.

Development of local academic capacity

Also impacting efficiency of the HISP Network is the emphasis on local capacity building at universities. While contributors to the greater body of knowledge on HIS and leaders within HISP and local governments, graduates from local academic program have not demonstrated that they are a critical ingredient for initial successful deployment. The funding of university programs in Ethiopia, Mozambique, and Tanzania have not had a high impact on adoption or deployment of DHIS. Decisions to cease DHIS deployment programs in Ethiopia and Mozambique meant that students from these countries did not have the opportunity to work with DHIS in their own country. Additionally, basing DHIS work in Tanzania at UDSM has not led to the required connections with or internalization by the MOHSW to achieve widespread deployment of DHIS as is seen in Kenya or India.

It is our finding that broad-based institutional capacity development does not necessarily lead to stronger local HMIS development or support, and there is little evidence that suggests leading with institutional capacity building results in accelerated or effective DHIS deployment. Academic support is, however, critical to ongoing HISP sustainability and continued contribution to the corpus of HIS knowledge, and the support and growth of HISP Network nodes and development of DHIS is fed by the continued creation of skilled resources. However, our findings suggest that the costs of locally-hosted programs for development work outweigh the benefits. A better strategy is to deliver this initial startup and development capability through the UIO working under the auspices of a local organization or the ministry of health directly. This is demonstrated by India, this country leverages UIO-trained staff for key programming and strategy roles. Kenya and Sierra Leone cite the UIO as being highly important because "the current technical assistants come from there," and "The contribution of HISP in the development of an integrated health information system is crucial as the local team decides to take the system customization to another iteration…and providing technical support to system development."

Local programs make sense where there is an established DHIS program and trained personnel are needed to meet local needs. Malawi is a clear example where local academic capacity building is aligned with the stated goal of establishing HISP-Malawi as a network of developers, users, and researchers as stakeholders of the project.

Conclusion

There is an evolutionary difference between countries needing locally trained leaders to maintain the development of an HMIS system and needing external support to establish and set up a system that leverages global best practices. Evidence suggests that the establishment of an academic node is not warranted prior to a stable and established DHIS program. As a result, we suggest delaying building new programs in Kenya or the Economic Community of West African States (ECOWAS) region until local demand for trained resources is established.

Recommendation

New academic programs should support mature national deployments and HMIS capacity building—not precede their establishment—and should be focused on developing management capacity or supporting software development and maintenance, but not both. The timeline for establishing academic programs pivots upon the specific human resource demands of the country and the maturity of the DHIS deployment. For instance, technical expertise for deployment—information technology (IT) specialists, project managers, and developers—are likely roles that will need to be filled as deployments gain scale and to replace visiting support staff. However, local thought leaders, HMIS specialists, and senior advisors—PhD- and masters-level credentialed roles—will also need to follow as demand for these roles in increases with a shift in the culture of data use and sophistication. To reiterate, based on the lessons learned from Ethiopia, Mozambique, and Tanzania, academic programs have not been demonstrated to drive data usage culture changes. However, as demand for local knowledge, skills, and abilities of graduates of local academic programs is established, HMIS becomes a more valued part of health care decision-making, in turn demand for these roles will increase and resulting academic programs can follow organically.

Objective 5. Assess the use of financial resources from different Norwegian channels and assess the wider context and opportunities for HISP at global and country levels.

As is to be expected with a program that has been in existence since 1995, the funding picture is complicated. This is illustrated on the following pages in the summary table of financial contributions and sources (Table 3), in the breakdown of Norwegian government funding by purpose (Figure 7), and in more detail in Annex 2. In addition, equivalent funding contributions have been made by UIO, who have generously supported faculty, students, and staff in the development of DHIS, and support of the HISP network.

Table 3. HISP program funding.

Funding period	Funder	Project title/ description	Sum NOK	Focus
1995-1998	Norad	DHIS development	2,500,000	Development/ Deployment
1998-2002	United States Agency for International Development (USAID)	Equity project run by Management Sciences for Health (MSH)		Deployment
1999-2001	Norwegian Programme for Development (NUFU)/ Norwegian Centre for International Cooperation in Higher Education (SIU)	HISP—A network program for empowerment of the marginalized in the globalizing world "Inclusion of the excluded"	11,500,000 (9,197,000 from SIU 2002-2007)	Development/ Deployment/ Research
2002-2006				Deployment/ Capacity Building
2000-2006	Norad/ NOMA	Norad-funded masters programs in health	35,000,000	Capacity Building
2007-2011				
2004-2008	Norwegian Embassy	PhD program at Addis Ababa University, Ethiopia	3,800,000	Capacity Building
2005-2008	EU-Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector (BEANISH)	BEANISH, EU 6th Framework Program	6,500,000	Development
2005-2007	Danish International Development Agency (DANIDA)	Developing HIS in Zanzibar	1,300,000	Deployment

Funding period	Funder	Project title/ description	Sum NOK	Focus
2006-2010	SIU	Integrated Masters in Health Informatics, Tanzania and Ethiopia	11,530,299	Capacity Building
2007-2011	Norwegian Research Council GLOBVAC	Integrated health information systems for vaccination in developing countries	10,000,000	Research/ Capacity Building
2007-2011	SIU	Masters in medical and health informatics: Asia focus	8,525,000	Capacity Building
2007-2008	SIU	Health Information Systems Programme finalization	1,045,000	Capacity Building
2008-2012	SIU	Improving access and quality in maternal health care in Sub Saharan Africa	5,560,000	Deployment
2010-2012	Research Council of Norway GLOBVAC	Integration and scaling of health information system to strengthen vaccination services delivery in India	13,000,000	Development/ Capacity Building
2009-2013	Research Council of Norway Core Competence and Value Creation in Information and Communication Technologies (VERDIKT) Program	Global integrated e-Health Infrastructures	12,400,000	Research and Capacity Building
2009-2010	Norad	Strengthening health information systems as part of Millennium Development Goals 4 and 5—programs in India, Malawi, and Tanzania	7,000,000	Development

There were, however, some clear findings that can help guide future funding decisions and challenges.

1. Approximately 130 million NOK have been spent by the Norwegian government on the HISP program since 1995. Additionally, an equivalent sum of approximately 120 million NOK has

been contributed by the UIO to support DHIS research and development as well as faculty, graduate students, and staff.

2. From government funding sources, there is a near-even split between funding development and deployment activities and academic capacity building through the creation and support of masters and PhD students (See Figure 7 below). This has resulted in the education of more than 100 masters students from Ethiopia, Malawi, Mozambique, Sri Lanka, and Tanzania funded by the NOMA/Norad Stipend Program. Additionally, 14 PhD students have matriculated with 34 in progress.
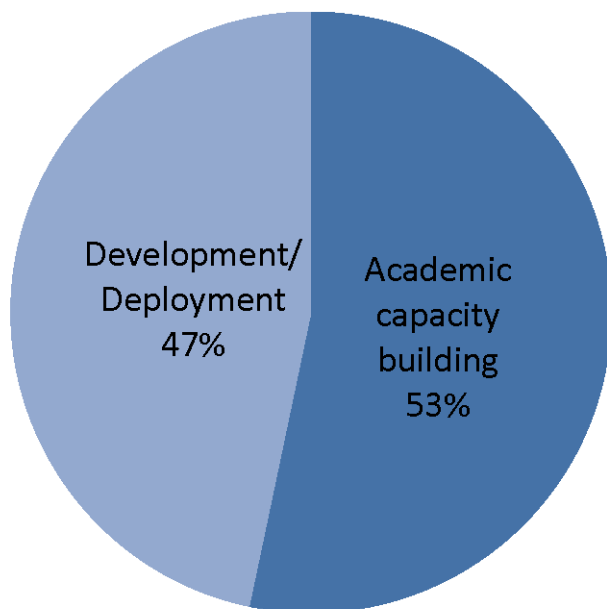
Figure 7. Breakdown of HISP funding by purpose.

3. Funding sources from within Norway are complicated and interwoven, making attribution for specific outcomes difficult (see Figure 8 below). For instance, during 1999 and 2008 at least three separate programs with three separate funding agencies contributed to development and capacity building in Mozambique. These same three programs funded work in Botswana, Ethiopia, India, Malawi, South Africa, Sri Lanka, and Tanzania, resulting in a fragmented funding story.
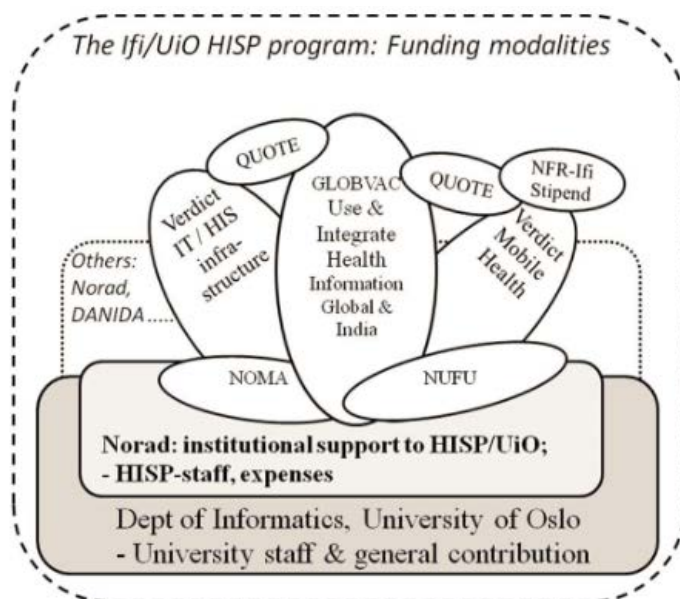
Figure 8. HISP program funding.‡

4. Funding programs often crossed different resource streams and include research and capacity building, or capacity building and deployment. Additionally, local capacity building and UIO-based research have been vehicles for deployment activities. As a result, it is likely that the various funding streams and reporting channels have impeded a holistic understanding of HISP activities. Broad findings from the analysis of existing projects broken down by resource streams suggest:

- Research is tightly embedded with technology development and advanced deployment; as a result they are hard to separate. Based on the literature review, much of the research impact has been strongest toward strengthening DHIS and deployments (74% of publications)—as opposed to contributing to the academic literature (26%).
- Capacity building at universities does not appear to have had much impact—HISP is no longer active in Ethiopia or Mozambique, Sri Lanka and Tanzania are still in pilot stages, and only Malawi has a strong academic and DHIS deployment, while countries like India, Kenya, and Sierra Leone are progressing without academic capacity building in tandem.
- HISP has been very successful in leveraging additional non-Norwegian funds for deployment activities. The list of 13 external funders contributing to DHIS deployments is a testament to the catalytic role Norwegian funding has played. Additionally, health worker training, a component of deployment funding, has had a very high impact for India and South Africa specifically, and eases the shift from pure grant funding to a service-based business model—providing funding for continued operations in the case of South Africa, and in India covering costs.
- Core support for development of DHIS v2 has been very successful. The project would not be where it is today without the web-based platform. Core development funding is

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‡ Relationships and complementarities between GLOBVAC, Core Competence and Value Creation in Information and Communication Technologies (VERDIKT), Norad, and other sources of funding. (Internal document provided by Norad)

harder to have supported from the country and other resource streams as it is broadly applicable and does not have the same academic research appeal.

5. Norwegian-originated funding from both the government and UIO is critical for supporting core software development, HISP Network activities (sharing best practices, opportunity development, etc.), providing (through the academic programs) temporary technical assistance to new deployments, and global awareness and policy conversations. This investment is also heavily leveraged and individual country deployments are supported by a diverse group of financial contributors including:

- Asia Development Bank
- CDC
- DANIDA
- European Union
- GAVI
- The Global Fund
- Macro International
- National and state-level ministries of health
- Swedish Cooperation
- UN Country teams
- USAID
- WHO/HMN
- World Bank

Conclusion

HISP funding is quite complex with a long history of balancing incremental donor needs and incremental requirements with product development, market development activities, and academic goals. As a result, attribution for specific deliverables is challenging, and opportunities exist to streamline funding to align with HISP program and DHIS product development. In addition, opportunities exist to focus Norwegian funding on specific priority activities with an emphasis on developing the network and platform and leveraging other major funders for local capacity building, technical assistance, and long-term deployment support.

Recommendation

There is a need for coordination within the Norwegian government for systematic and rational program and product development, aligned with a clear HISP Network-defined product strategy and road map. The links between capacity building and development and deployment are not strong, and while there may be reasons for hosting funding out of a university to drive deployment, the development of masters and PhD programs has not yielded strong results in driving DHIS adoption. Delinked, Norwegian funding bodies can provide core support for permanent staff who can (1) perform a product management role to include more professional management of the DHIS code base; (2) act as paid developers and address issues that are not of academic significance but serve the health of the network; and (3) perform global program management to include supporting the network, gather and coordinate needs, develop road maps, share best practices, and communicate and grow awareness among country-level decision-makers and international donors. This funding model would be analogous to the system employed by

DevInfo, which receives its core development support from dedicated funding and additional support selling services.

A more focused and stable support environment would not necessitate increased support by Norad or other Norwegian channels but would come from streamlining activities and a reassessment of the return on investment by supporting country-level academic programs as detailed above. Additionally, this lays the foundation for Norwegian funding to act as a deployment catalyst and integrate HISP into large- scale health system strengthening projects such as the Bill & Melinda Gates Foundation program in Bihar. This strategy is detailed further in Objective 7.

Norway India Partnership Initiative (NIPI)

An example of where funding between different Norwegian channels could be coordinated is between NIPI projects and HISP. NIPI has several active projects for using mobile technology to improve maternal and child health. These projects are going on in states where HISP also has significant projects, such as in Bihar. There is no relationship between the NIPI and HISP work.

Recommendation

Norwegian government funding representatives should determine how the NIPI and HISP activities can achieve better alignment. NIPI is supporting projects in locations where HISP is active, yet there are very few connections between NIPI and HISP.

Objective 6. Recommend what changes, if any, ought to be made to current business model and strategy to ensure that future interventions are effective means toward contributing to strengthen HIS, tailored to needs, being more effectively implemented, and lead to improved prospects for sustainability.

Clarify the HISP roles, responsibilities, and strategy within the HISP Network

DHIS is at risk of losing momentum without a clear, strategic road map for the core product with regard to product development, messaging, and strategy. The reviewers made the assumption that the combination of the four core components of HISP (capacity building, DHIS product development, research, and country-level deployment) are an integrated set of activities, and the evaluation validates this approach. This reinforces the emphasis on DHIS product development as a core responsibility of HISP and the critical role of Norad support.

While we are not recommending a change from the agile development process that has worked successfully for the HISP network to date, we are recommending a more focused design effort— pairing agile software development best practices with strategic product design and planning. As illustrated in Figure 9, the Global HISP network (all major node stakeholders) with strong participation from UIO should have a key role in global planning and strategy as well as supporting the core product (left-hand quadrants). Likewise, regional and local nodes have a key responsibility in working with ministries of health to define the HMIS vision, objectives, requirements, supporting deployment, and customization and training (right-hand quadrants). Each quadrant has a distinct role and core competency, and the communication between each quadrant is critical to inform and synchronize actions.
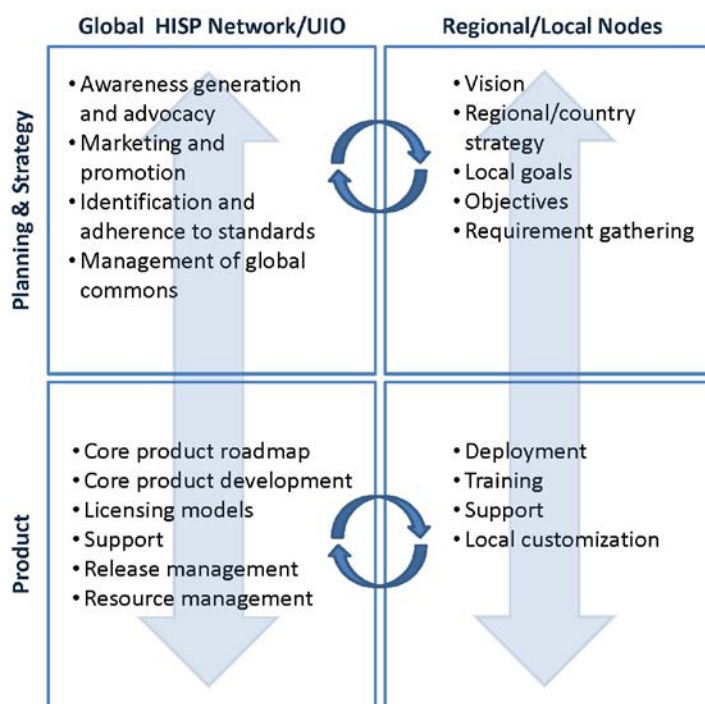
Figure 9. Proposed roles and responsibilities within the HISP Network.

HISP-India Strategy

The HISP-India project faces a continual challenge because of the competitive environment that they operate in. HISP provides a very low-cost solution for indicator aggregation through the deployment of open source software and by providing training and support at low rates. However, they face competition from other national organizations that would like to expand their mandates, as well as companies who would like to deploy proprietary eHealth solutions. About 20 of the 38 states are using DHIS, although some might drop DHIS for other systems, and DHIS may be adopted by other states. The deployment of national-level (or in India, state-level) HIS is very political, and changes in personnel or introduction of initiatives can lead to cancellation or adoption of systems. There are different goals in collecting and aggregating health statistics. These complicate the deployment and use of HIS. For example, HISP focuses on the collection and use of indicators for strengthening the health system (i.e., using the data in order to support management decisions at all levels). However, the national statistics organizations have a goal of collecting accurate numbers at the top level, which leads to different goals in data collection.

These challenges are recognized by HISP, and various strategies are in place to maintain the deployment of DHIS in the states. A continued presence and support in the national organizations is critical. Customizing DHIS for state needs, so that it is not just a national reporting tool, is a way to add value to the state deployment. HISP is also expanding to other eHealth initiatives to leverage deployments of DHIS.

HISP-India's business model is evolving. The initial phase of HISP-India's work was externally funded, but a growing portion of its income is coming from state deployments in payments for

training or product customization. However, a substantial amount of the revenue (60% according to Sundeep Sahay, President, HISP-India), comes from external grants.

Conclusion

As HISP-India matures, it is essential to develop a strategy to ensure its products and services continue to be used by the states and that an increasing amount of revenue is generated from deployments and services. This is recognized by the leadership of HISP-India.

Recommendations

HISP-India has the opportunity to be a leading force in HIS in India, but faces a competitive and political environment. The most important step for HISP-India will be to continue efforts to strategically map out a business plan for supporting HIS while building on the DHIS v2 platforms. Components of this include:

- Developing a business plan that builds on the multiple strengths of HISP-India: delivery of training, connections at state and national levels, placement of the DHIS platform, and expertise in HIS and eHealth.
- Expanding information services in selected states, evaluating the costs and benefits of focusing on particular technologies.
- Aligning with other eHealth organizations and donors to work cooperatively in states and at the national level.
- Continuing to strengthen financial practices.

HISP East Africa Strategy

Tanzania

After a false start in 2007 with a project that failed to get traction, the MESI consortium has continued the effort, modifying and learning from the previous HMIS strengthening initiative by combining MOHSW leadership with the technical and financial support from a broad array of funding and implementing partners. This project, just exiting the planning stages, includes a new set of 43 national-level indicators, and outlines a number of M&E objectives to provide a foundation for rational data use and includes:

- Elevating the Health Information Research Unit to become a M&E directorate with clear roles, structure, and authority including information management and coordination of research at regional and district levels.
- Developing and implementing M&E policy guidelines in terms of harmonization and better use of information and its rationalization.
- Strengthening disease and demographic surveillance in terms of upgrading classifications and ensuring quality and trend analysis.
- Strengthening the routine HMIS to function effectively at all levels to provide timely, quality data that is used for planning, management, monitoring, and evaluation of the health sector.
- Improving data management to ensure that appropriate information is accessible, using appropriate information and communication technology, including the Internet and an integrated data warehouse approach that rationalizes and harmonizes different subsystems and databases.

- Improving rationalization, coordination, and harmonization of surveys and operational research, to ensure they complement the routine HMIS and fit in the M&E plan of the health sector.[§]

Zanzibar

Zanzibar deployed DHIS after they established a strong and harmonized HMIS system. MOHSW is also taking a leadership role in the deployment of DHIS and making sure the HMIS system is updated annually with participation of all programs and partners. This has increased usability and ownership.

Kenya

HMIS strengthening and DHIS deployment are driven and lead by the Kenyan MOHSW HMIS unit. This is critical and was noted by a Kenyan survey respondent in the ministry of health, "the system will be a success because it is a country driven system and owned by the ministry." This unit has provided additional requirements for DHIS, including requirements for role-based access, user management, and inclusion of a community health-worker level. Currently, the lowest level supported by DHIS v2 is the clinic; in Kenya the lowest level is community health worker which is situated below the clinic. The HISP team in Norway is currently working on implementing these requirements. The HMIS unit is responsible for providing support to the records information officers who are responsible for HMIS at the district level. To do this they are trained to perform simple troubleshooting. The ownership and availability of technical support create an avenue for DHIS deployment in Kenya to be sustainable.

Deployment of DHIS followed the strengthening of the Kenyan paper-based HMIS, ensures that the digitalization by DHIS was improving the efficiency and effectiveness of a functional HMIS system. Kenyan stakeholders began with the most critical piece—harmonizing indicators and tools. As a result, these tools and indicators can be used by all stakeholders to collect routine health information, and programs can use what is collected through the HMIS instead of their own forms. In this case DHIS was deployed to support a strong and harmonized HMIS and make it more efficient.

Conclusions

DHIS is a robust, flexible tool that has demonstrated its effectiveness at scale in a number of deployments. The success of DHIS primarily depends upon a good HMIS system and a strong authoritative HMIS team at the MOHSW and rationalization of the HMIS system prior to digitalization with DHIS. In this role the MOHSW should be able to stipulate requirements and provide guidance and direction to implementing partners as was demonstrated in Kenya. By doing so, the product is internalized and the country takes ownership.

Recommendations

- HISP should help in strengthening the HMIS unit at the MOHSW. This could be achieved by basing a technical assistant at the ministry to provide technical assistance, identify and develop a team that will participate in the revamping of HMIS, and eventually sustain the

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[§] MESI Combined Plan. October 26, 2010.

system. This team can be composed of people from within the MOHSW or recruited from outside.

- The focus for strengthening HMIS should go beyond the deployment of DHIS. The use of DHIS is critical, but the first step is to concentrate on the overhaul of the HMIS and involve all partners. Introducing a computer system to integrate into the existing HMIS environment will not yield the expected improved results. The process should involve mapping and harmonizing national indicators; get it right on paper; then perfect and improve the efficiency of the system by digitalizing it. This approach was used in Zanzibar. Zanzibar's MOHSW successfully deployed the DHIS system, and it is used as the main source for reports at all levels of the health system.
- A local HISP team is not critical to the success of DHIS, as demonstrated in Kenya and Zanzibar. In both countries the requirements were specified by the MOHSW HMIS team, and the HISP team in Norway was contracted to customize the system based on the specified requirements.

HISP Network Roles, Responsibilities, and Strategy Across the Entire HIS domain

Business Strategy Risks and Evaluation

Risks to effectiveness

Fragmentation is the main risk to the loss of momentum and effectiveness. Currently DHIS consists of two products—v1.4 and v2. Both are independently and actively being developed and promoted with the same general focus and branding. There is a clear movement by countries to migrate from v1.4 to v2 (Botswana, Liberia, Malawi, South Africa, and Zanzibar) to take advantage of modern software development and web-based application infrastructure leading to better centralized data management, analysis, and reporting, as well as reduced total cost of ownership. Fragmentation is still a risk as DHIS v1 and v2 have different visions and are propagating messaging that lead to confusion among decision-makers. This is exacerbated by a schism within the HISP Network between UIO and HISP-South Africa. This divide and associated risk to platform effectiveness will likely increase as HISP-South Africa continues to explore a transition to a web-based version of DHIS distinct from DHIS v2[**] and will sow hesitancy among decision-makers, putting in question the sustainability and support for future versions of the software.

Risks to efficiency

The need for developers to be flexible and independent for meeting their partner country needs and the reduction of development redundancy are at odds. A lack of a central product road map this can result in the potential wasting of limited development team resources, with similar projects being conducted by multiple teams without the benefit of shared learning. Key user needs are consistent among many country deployments such as interoperability with other HMIS software suites. Currently, these needs are not being incorporated into the core software or road map or shared as global best practices and are developed independently by country or regional nodes. Examples include the development work around integration with OpenMRS which is

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[**] Sources: HISP-South Africa. *A Description of Core Functionalities in the DHIS Software and Rationale for Use*. February 2009 and personal correspondence with Vincent Shaw, HISP-South Africa.

happening at many sites. However, development efforts and lessons learned are not transferred, and as a result India has operational OpenMRS support while Sierra Leone is on hold awaiting additional capacity for expanding a limited OpenMRS antiretroviral therapy management pilot. A second example is mobile phone development, with projects in both India and Zambia developing separate systems. Increasingly as integration with additional software tools and hardware platforms is needed, a strategy and method for efficient integration will need to be developed.

Risks to relevance and sustainability

Currently, DHIS competition is minimal but increasing. Based upon our evaluation, there are no clear software program competitors that aggregate, check quality, and provide analysis and reporting of routine health service data at the scale of DHIS. However, HISP is at an important inflection point and must decide where they see the role of DHIS to be in the future. For example, there is rapidly growing interest in tools to capture essential medicine and vaccine consumption data from the service delivery point to improve demand forecasting. These tools are emerging to perform roles very similar to DHIS and yet are proceeding rapidly in the direction of duplicative systems. The primary path being followed by the HISP network is as an aggregation tool that collects summary information from all sources (electronic medical records, human resource systems, inventory management, etc.) and provide industry-leading detailed analysis and reporting to decision-makers. In this role, DHIS v2 is defined as a central data warehouse/data repository according to the technical architecture described in the HMN framework and as illustrated in Figure 10 with service delivery capabilities to deliver business intelligence tools for data analysis and visualization. A second spur to this path is to become a centralized data warehouse with individual-level data and the direct attachment of other service delivery tactical programs (e.g., logistics, human resources, community health workers). An example of this is the direction being pursued with the nBITS project. The role of collecting individual-level data would place DHIS in direct competition with electronic medical record systems such as OpenMRS, and as noted by donor organizations funding enterprise architecture, this is not a route seen as a DHIS core competency. The role for DHIS and investment priorities are strategic questions that are critically linked to how DHIS views its role and core competency and who future competitors will be.
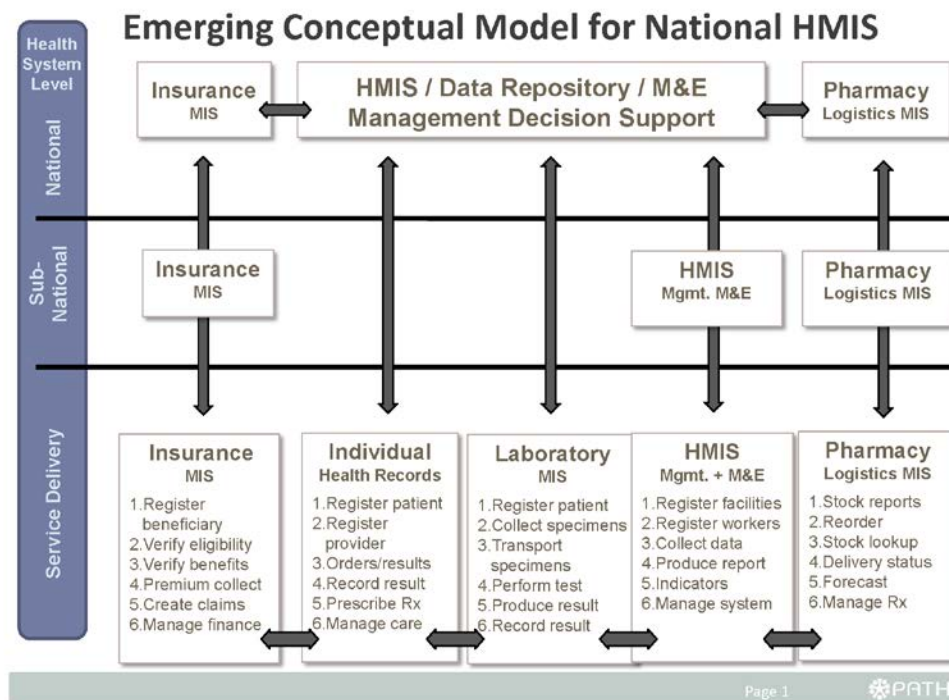
Figure 10. Emerging conceptual model for a national HMIS.

Conclusions

Lack of clarity around the requirements addressed by DHIS and the lack of a product road map for the next 36 months increases the risk of fragmentation and loss of momentum by diluting the messaging and sowing uncertainty around the future support of the software by the global community.

Recommendation

DHIS has reached a level of maturity and accountability that requires management by a skilled product manager following established product development methodologies. This will allow the software to continue to evolve to the next level of scale and sustainability by creating a rigorous framework for future development, deployment, and sustainability. A process needs to be developed and resources allocated for key members and stakeholders of the HISP Network to come together to clearly define the following:

- What is future of the web-based version of DHIS and what can users, managers, and stakeholders expect to do with it?
- What is the role of DHIS as a part of an integrated HMIS ecosystem?
- What should DHIS be in three years?
- What strategy will deliver the next version of DHIS?

Additionally, there is a need to create and publish a product road map to clearly state and lay the groundwork for:

- What requirements will DHIS address in the future.

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- What features will be integrated into the core, when, and by whom.

Objective 7. Provide recommendations in terms of continued support from Norad and potentially other financiers to HISP.

The HISP Network is at a critical point in its evolution. Early efforts to seed usage, demonstrate effectiveness, and build capacity of the DHIS developer community has yielded tremendous results, with multiple examples of national wide-scale adoption and indications of increased momentum. These are truly remarkable achievements, but the world of global health informatics is advancing very rapidly. Analysis from India, Kenya, Malawi, Nigeria, South Africa, and Tanzania demonstrates that the successes and failures of DHIS deployments hinge not only on high-level government endorsement but also the integration of the software into a functional environment. Without harmonization of indicators, clear understanding of the business use for data, and stakeholder buy-in, the best-designed software will fail. There is a clear opportunity for the HISP Network to continue to develop the core competency around software development. However, it is essential that product planning, determining and documenting requirements, and creating frameworks necessary for efficient and effective deployment of HMIS systems also become core competencies of the HISP Network. This has not been a major focal area for Norwegian government funding. Historically 53% of funding has a primary objective around capacity building and academic research in a specific country or function. However, while academically appropriate, these discrete funding objectives in the absence of long-term strategic planning do not efficiently build and support enterprise-ready software.

As demonstrated by Figure 11, historical funding for the HISP Network by Norad has centered on country-level deployments or capacity building. However, much has been learned regarding the ingredients for successful deployment, and leveraging those lessons to help guide WHO standards and guidelines, work with key decision-makers in the ministries of health, and develop frameworks for rapid and efficient adoption coupled with strong product vision and development could yield accelerated results.
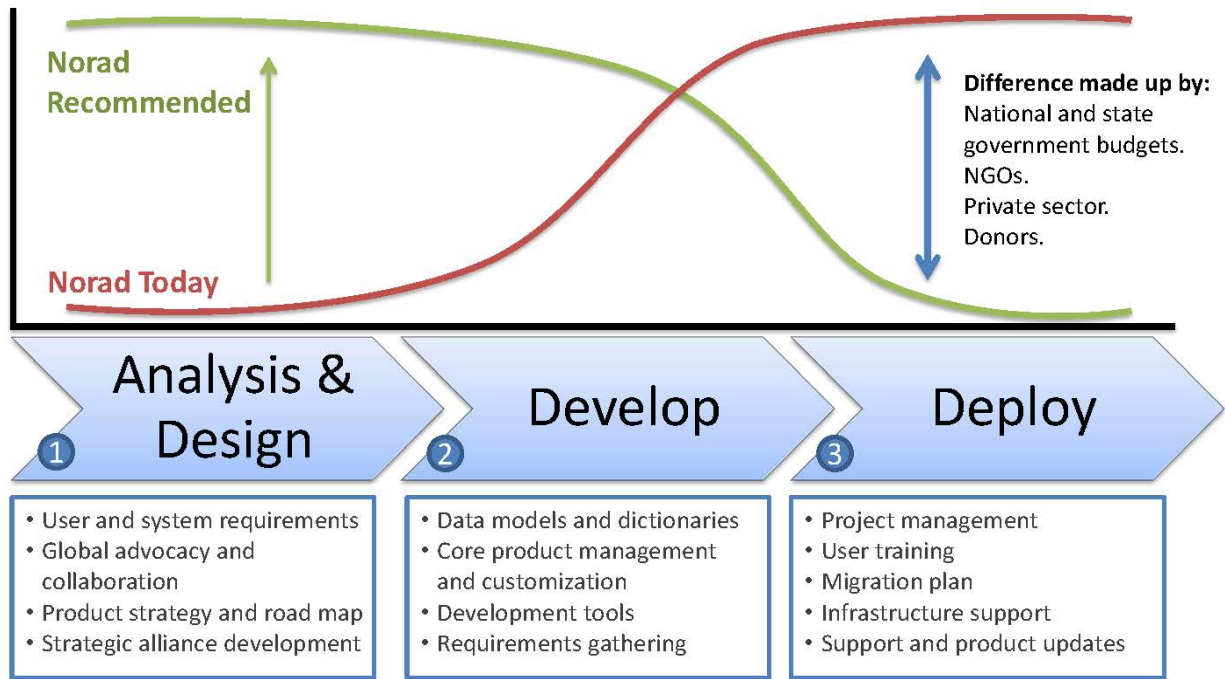
Figure 11. A model for balancing focus between upfront analysis and design versus development and deployment.

Conclusion

A shift from action research to applied development will require specific support outside of country-level deployments but with an emphasis on strengthening the core software and HISP Network core competencies.

Recommendation

Funding for HISP has evolved over the years. We propose the HISP Funding Framework to set the context for recommendations related to funding (see Figure 12 below).
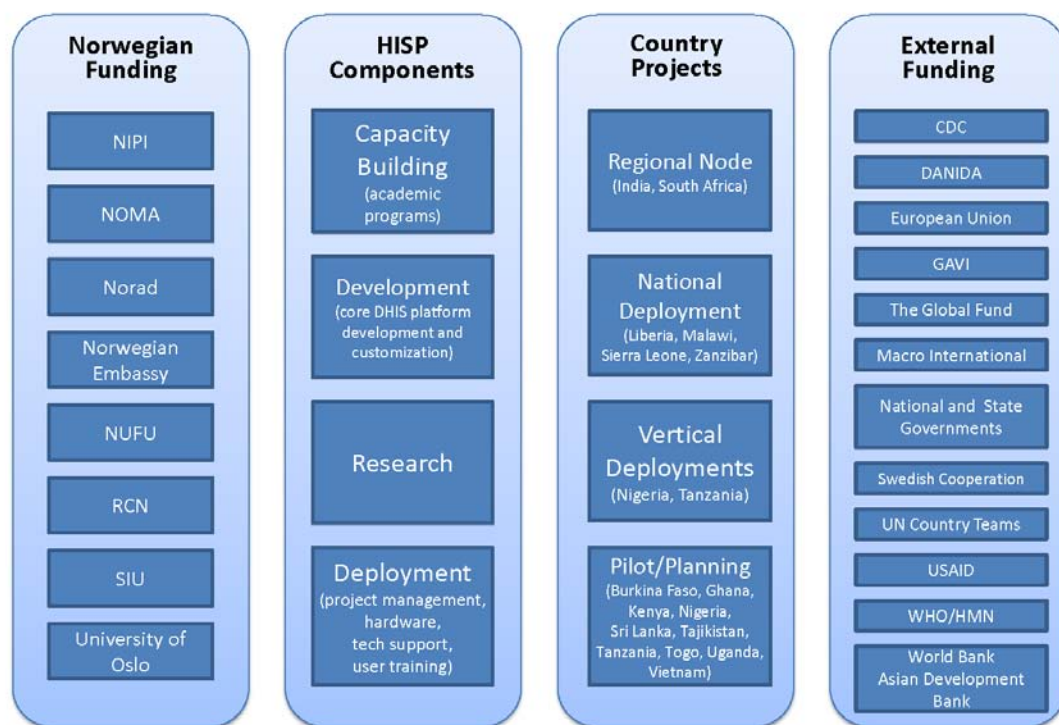
Figure 12. HISP Funding Framework

The HISP Funding Framework contains four major elements: Norwegian sources of funding, core HISP platform components where funding can be applied, types of country deployments and, the diverse forms of non-Norwegian government funding most often associated with country deployments.

The four core components of HISP that have been funded by Norwegian sources are:

1. Capacity building. University programs in developing countries have been set up to train people in health informatics who will then contribute to HMIS in their countries.
2. Software development. This is primarily software development around the DHIS platform, although recently it has expanded to include integration of mobile technology to DHIS and work with medical record systems.
3. Research. Projects conducted by PhD and masters students affiliated with the HISP Network. Much of this has been done by students from UIO.
4. Country deployment. The deployment of DHIS at the national or regional level and training of health professionals in the use of health indicators.

Funding from Norwegian sources has been applied to these four components over the life of HISP. Each of the sources of Norwegian funding comes from an organization that may have its own mission and strategic objectives related to HISP. This review focused on the targets of funding as represented by the core HISP components in column 2 of the Framework. To this end, it is possible that use of Norwegian funds may serve the mission and strategic objectives of the organization providing support but not optimize the impact on HISP as an overall program. For example, supporting the development of university-based academic programs may align very

well to a funding source (such as NOMA) but not translate into a stronger national deployment of DHIS or creation of a national HISP project. This may in fact not be viewed as a bad investment if the outcome meets organizational objectives. We will address each of the core components below as targets of funding.

Capacity building includes support of university programs in Ethiopia, Mozambique, Tanzania, and other countries with the goal of producing graduates who will contribute to HMIS in their countries. Our evaluation indicates that this has not had a high impact on the activities directly related to HISP. However, there are some very important caveats. First, much of the capacity building has occurred in countries that did not receive focus in this evaluation; for example, we have little firsthand information on activities in countries such as Ethiopia and Mozambique. Second, there are strong reasons to support higher education in these countries beyond impact on HISP activities as described above, so potential benefits of funding this component are beyond the scope of this evaluation. The strongest DHIS deployments are not represented by the countries where university programs have received significant funding, leading to the conclusion that the university programs did not have a high impact in the short term. One conclusion that can be drawn from the experience of capacity building in higher education is that it might be more effective to provide support after there is a strong HIS system in place at the national level and not before. The graphic below illustrates the recommendation that capacity-building activities, while core to HISP and a possible valuable area of investment by the Norwegian government, should be focused on programs that have matured to the level of regional nodes or national deployments. This will help ensure that supply of human resources is in sync with local demand for HIS expertise.
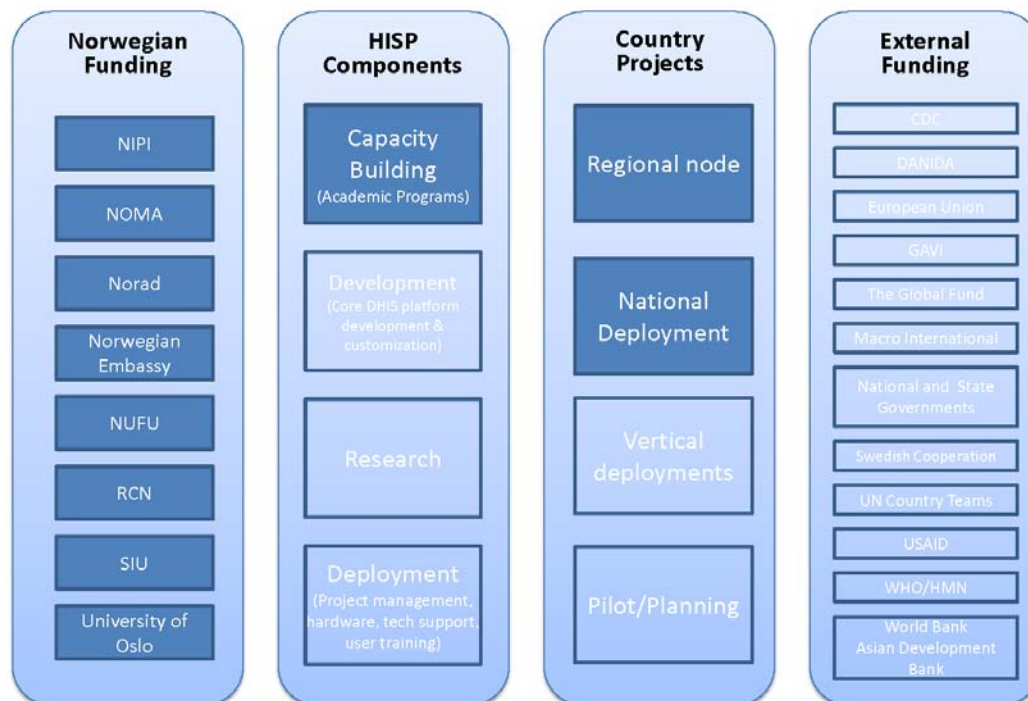
Figure 13. Funding recommendation: Capacity-building

Software development has been a focus of Norwegian funding through Norad, and this is considered a necessary role for continued support. Having a DHIS platform that continues to be strengthened through the use of software industry best practices for design and development is central to the success of HISP. The future success of DHIS will be dependent on how well it meets the needs of users, integrates with other HIS, and is scalable and locally sustainable. In the fast moving market of global HIS, this requires a clear and compelling strategy and plan for software development as well as collaboration with other development efforts and coordinating bodies like WHO, the United Nations Children's Fund, and the Institute for Health Metrics and Evaluation. This is a task that is beyond any single country deployment effort or local software development team or university. The opportunities for applying new and powerful innovations in software development and deployment are increasing, and coordinated software development support will enable DHIS to benefit from them. For example the migration to web-based software has been enabled by this support. Based on deployments in India and current uptake of the DHIS v2 software in Africa, previous funding of this component should be regarded as highly successful.

As illustrated in the graphic below, Norwegian sources of funding are critical to support development and benefit all stages of deployment, and are unlikely to come from external funding sources for core software development.
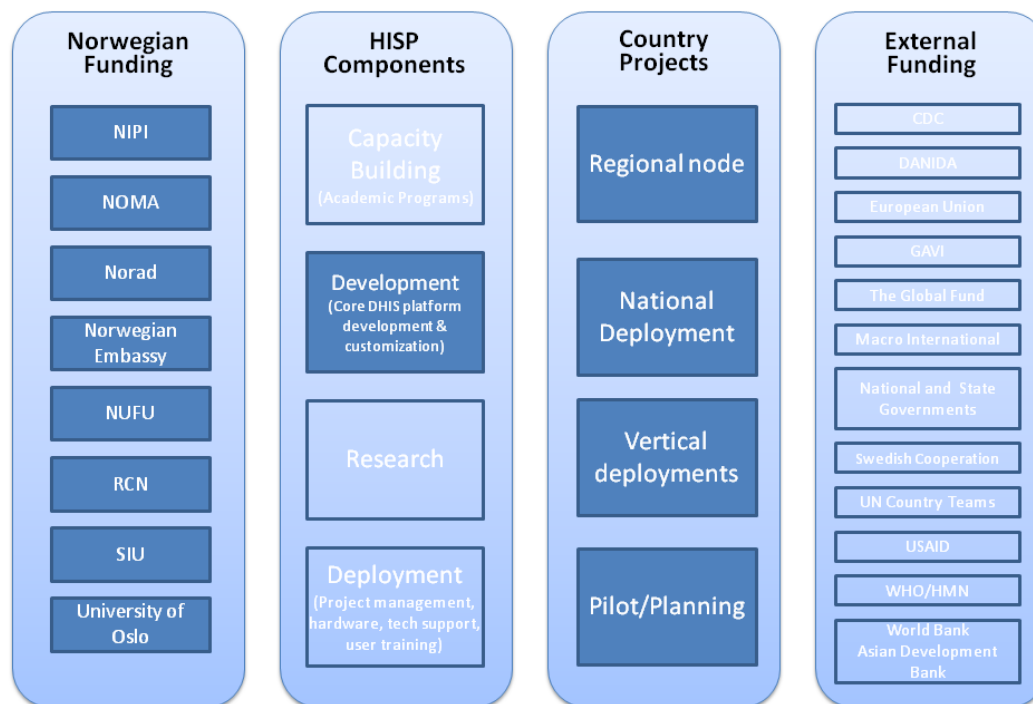
Figure 14. Funding recommendation: Development

Research funding to UIO has had two levels of impact. Noted under Objective 1, the contribution of publications is discussed with the impact on furthering the academic field. The other impact, *which may be much greater*, is the direct impact that the researchers have had on the technology development and the new deployments of DHIS and other HIS. The reason for this elevated effectiveness is that the research and academic programs have a blended structure

with an emphasis on practical fieldwork-enabling deployment activities so that the masters and PhD students contribute directly to the HISP deployment programs and advancing research. Interviews with HISP staff in India emphasized the important role that UIO graduate students had played in HISP-India. Similarly, the contributions of UIO graduate students have been key in nearly all country deployments and were specifically called out in Kenya and Sierra Leone. Academic research contributions can have a significant impact on DHIS software development, the formation of country-based deployment plans, and mobilizing resources to enable them. This component has benefited from Norwegian funding and is an effective catalyst for successful DHIS deployments.

As illustrated in the graphic below, research funding benefits all stages of deployment and is a critical activity for Norwegian funding. While additional externally funded research activities are likely to occur, alignment with HISP development activities funded through the Norwegian government and UIO increase the efficiency and impact of the HISP program, allowing for masters and PhD students to contribute to the advancement of the research field and applied software development.
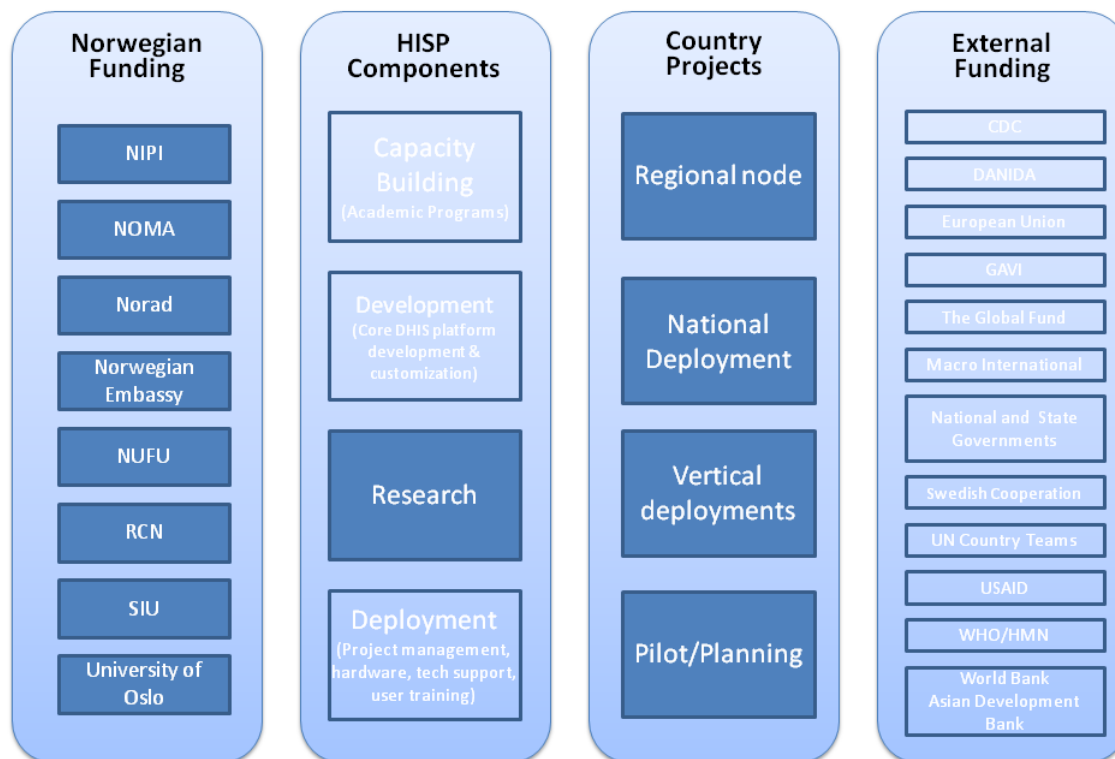
Figure 15. Funding recommendation: Research

In the most successful countries, Norwegian government funding has had a multiplier effect, with external funding playing a significant role in deployment, adoption, and sustainability of DHIS at the national or state level. The funding picture for country deployments is affected by the number and diversity of non-Norwegian government sources of funding. But this is also a strength of HISP and critical in moving deployments from dependence on Norwegian funding to engaging other donors and then ultimately leading to sustainable

funding from national and state governments. One measure of success of deployments may be the degree to which sustainable funding originates from a country's or state's annual health budget or external financiers. Strategic structuring of country-node funding to diversify revenue streams to include not only Norwegian grant funding but also a service and training component would result in leveraging development funds and achieve two objectives:

1. Norwegian government funding might best be viewed as catalytic for deployment. By funding development and research, country HISP deployments have the software and technical expertise to cost-effectively meet local country and donor needs. We recommend that deployments have a clear strategy for non-Norwegian government funding sources from the beginning of the planning phase. Ideally Norwegian government funding would only be required for initial deployment activities if at all.

2. Training of users and managers in working with health indicators is a key activity of country deployments, and in the case of mature nodes such as India and South Africa is a source of revenue. Service and training revenue can provide a more stable funding environment and further reinforce the role of HISP within the government as HMIS experts.

As illustrated in the graphic below, leveraging external funding for capacity building and deployment maximize the investment made by the Norwegian Government and UIO by increasing the HISP Network's ability to scale, diversifying risk, and increase stakeholder buy-in from the country government or other financiers.
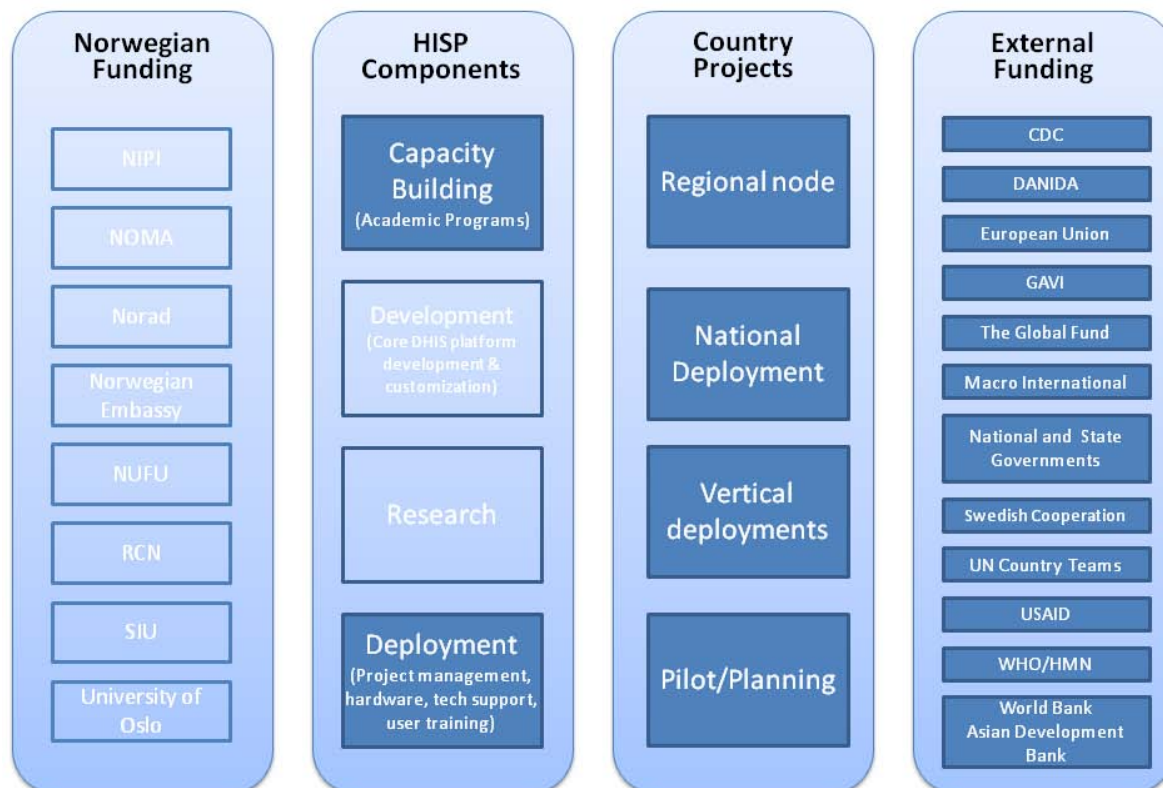
Figure 16. Funding recommendation: External funding

In summation, based on the evaluation of the HISP program, the highest return on investment for Norwegian Government funding is to focus on software development and research and when deployments have reached sufficient maturity, the consideration of local academic capacity building.

Chapter 4: Conclusions and Recommendations

The following recommendations follow from the findings in the previous chapter and highlight the conclusions and recommendations relative to each HISP component as specifically identified for either Norad and other funders or the HISP Network.

Norad and other funders

The patience, effectiveness, and generosity of the Norwegian government has resulted in the creation and deployment of one of the largest HIS initiatives to date, a rich dossier of research, a legacy of HIS capacity building, and a robust and flexible software product that has demonstrated the ability to help change health care management.

Deployment

HISP is having a significant, worldwide impact. Our evaluation yielded 20 active deployments using DHIS v1.3, v1.4, or v2, while if fully implemented, have the potential of collecting data representing over 1.3 billion lives.

It is our recommendation that Norad continue to support HISP and work with the HISP Network and other partners to scale up reach and enable sustainability. Future funding should be structured to maximize the multiplier effect of each kroner spent by the Norwegian government and leverage existing and new investment by focusing funding on the core tools and research while acting as a catalyst for local sustainable deployments.

Capacity Building

There is an evolutionary difference between countries needing locally trained leaders to maintain the development of an HMIS system and needing external support to establish and set up a system that leverages global best practices. Evidence suggests that the establishment of an academic node is not warranted prior to a stable and established DHIS program. As a result, we suggest delaying building new programs in Kenya or the ECOWAS region until local demand for trained resources is established.

It is our recommendation drawn from the experience of capacity building in higher education that it is more effective to provide support after there is a strong HIS system in place at the national level and not before.

Research

Masters and PhD students from UIO have had an important role in the development of DHIS v2, and in the introduction, deployment, and strengthening of DHIS in a wide range of countries. As technical resources, students have been responsible for getting systems off the ground, providing customization support, and are acting as a low-cost option for rapidly providing technical capacity to countries that do not have internal means to do so.

It is our recommendation that the Norwegian government funders and UIO should continue to directly support masters and PhD students to work with the HISP nodes.

Development

Software development resources are limited, and due to the success of the program there is a need to leverage enterprise-level, service, product management and development tools to meet the growing needs of partner countries. Additional full-time developer resources are needed for maintenance and new features and to provide continuity of services beyond the average term of a masters student.

It is our recommendation to hire additional software development staff for DHIS v2. These individuals should be distributed among UIO and other network nodes and should include both project managers and developers. Software development has been a focus of Norwegian funding through Norad, and this is considered a necessary role for continued support. Having a DHIS platform that continues to strengthen through the use of software industry best practices for design and development is central to the success of HISP.

HISP funding is quite complex, with a long history of balancing incremental donor needs and incremental requirements with product development, market development activities, and academic goals. As a result, attribution for specific deliverables is challenging, and opportunities exist to streamline funding to align with the HISP program and DHIS product development. In addition, opportunities exist to focus Norwegian funding on specific priority activities with an emphasis on developing the network and platform and leveraging other major funders for local capacity building, technical assistance, and long-term deployment support.

It is our recommendation that there is a need for coordination within the Norwegian government for systematic and rational program and product development, aligned with a clear HISP Network-defined product strategy and road map. Providing core support for permanent staff who can (1) perform a product management role to include more professional management of the DHIS code base; (2) act as paid developers and address issues that are not of academic significance but serve the health of the network; and (3) perform global program management to include supporting the network, gathering and coordinating needs, developing road maps, shareing best practices, and communicate and grow awareness among country-level decision-makers and international donors.

Global HISP Network

The management, vision, and perseverance of the HISP organization have resulted in a globally recognized district health information management tool that is the recognized leader in this space. Additionally the organization has contributed to the growing breadth of applied and theoretical research, moving the HIS field forward.

Deployment

OpenMRS and iHRIS provide opportunities for alignment with software platforms that share similar philosophies, business models, and deployment priorities with DHIS. By collaborating with one or more HIS platforms, the HISP Network could increase deployment efficiency and better meet country needs.

It is our recommendation that the HISP Network 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.

Capacity Building

As technical resources, UIO students have been responsible for getting systems off the ground, providing customization support, and acting as a low-cost option for rapidly providing technical capacity to countries that do not have internal means.

It is our recommendation that the UIO should continue to support the work of masters and PhD students to support the HISP nodes.

Development

Success in broader eHealth will require integrating other systems, working with partners, as well as building on a strong DHIS core.

It is our recommendation that the HISP nodes identify a strategy for working synergistically with other HMIS software packages and organizations and develop capacity to align DHIS deployments with OpenMRS and multiple mobile data collection tool**s.**

Lack of clarity around the requirements addressed by DHIS and the lack of a product road map for the next 36 months increases the risk of fragmentation and loss of momentum by diluting messaging and sowing uncertainty among the global community for future support of the software. Additionally the schism between HISP-Norway and HISP-South Africa threatens the long-term stability of the project by introducing stakeholder confusion regarding the different products and developer communities.

It is our recommendation that DHIS has reached a level of maturity and accountability that requires management by a skilled software product manager following established product development methodologies. This will allow the software to continue to evolve to the next level of scale and sustainability by creating a rigorous framework for future development, deployment, and sustainability. Additionally, the global HISP Network needs to increase its visibility, clarify its messaging, and unify its voice to more actively promote the software and services it provides. Low hanging fruit would be the promotion and development of the HISP web presence—global nodes are not linked, HISP.org is owned by HISP-South Africa, HISP sites do not easily link to DHIS2.org, and product descriptions and attributes are not clear.

Research

Critical success factors for the mature HISP nodes (India and South Africa) include strong leadership in these countries' ministries of health for planning and deployment of DHIS and a national effort to rationalize reporting of health indicators. Both the India and South Africa nodes have had strong roles in training health professionals on the use of data and supporting the deployment of DHIS.

It is our recommendation to develop a deployment strategy that builds on the critical success factors of India and South Africa. This includes focusing on enabling strong project leadership in the ministries of health by building strong ties at the national level, working to harmonize the

indicators set, and emphasizing training of health system personnel. Since new deployments will generally focus on countries with smaller economies than India or South Africa, a regional strategy, such as developing regional West African nodes, may be appropriate.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 1, Burkina Faso

1. What health domains are covered by DHIS? What stage of deployment are you?

DHIS2 will cover aggregated data for all health domains in Burkina Faso but also patient data at community level. It is currently in customization phase.

2. What examples can be pointed to that demonstrate the system's use in decision making?

We are only at the customization phase now

3. Has there been local customization of the system?

Yes. There is a need for local customization and the process is going on now.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

<div align="center">1=Very Successful, 5= Not Successful</div>

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

<div align="center">1= Full potential, 5= Not meeting its potential</div>

1 if things go as planned, it will be used almost at 95% of its potential

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

<div align="center">1=Efficient, 5=Inefficient</div>

2 because HISP takes time understand countries' need and work with them closely to develop better approach to the problems. Also HISP invests time and resources in local capacity building. However this can be improved maybe if more resources are available

7. What are/were the barriers to adoption?

The system is still under development.

8. Who is funding HIS work in your country?

Royal Dutch Embassy

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

The importance of University of Oslo is critical since its researcher are heavily involved in the process and it provides expert to support local team in managing, improving and adapting to changes. It also provides academic training in (health) Information system. The ministry of health does not have at all any health information specialist.

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

Right now HISP relies on students, researchers to support countries. HISP can improve in effectiveness if it can mobilize easily the staff and for longer period.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Boureima OUEDRAOGO (boureimaoued@gmail.com), Lamoussa ZOMA (torezo2000@yahoo.fr)

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

- integrate a more specific tool for performance based financing system

- improve the mobile module and especially for disease surveillance

- develop a flexible data importer tool that can easily import data from different databases

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 2, Burkina Fasso

1. **What health domains are covered by DHIS? Quels sont les domaines sanitaires couverts par DHIS?**

Information sanitaire, personnel. Health Information personnel.

2. **What examples can be pointed to that demonstrate the system's use in decision making? Quels exemples peuvent être citer pour démontrer l`utilité du system dans la prise de décisions?**

Les informations sanitaires sont dispersées à travers de multiples bases de données et il faut regrouper. La transmission des rapports pose problème: la mise en œuvre du DHIS permettra la promptitude et la complétude des rapports. Health information is scattered across multiple databases and must regroup. The transmission problem reports: implementation of DHIS will the timeliness and completeness of reports.

3. **Has there been local customization of the system? A t`il exister une personnalisation locale du système?**

Pas encore. Not yet.

4. **On a scale of 1-5 would you consider the system implementation to be a success? Why? 1=Very Successful, 5= Not Successful. Sur une échelle graduée de 1-5 considéreriez vous l`application du system comme une réussite? Pourquoi ?**

<div align="center">1= Très réussi, 5= pas réussi</div>

Oui 2 parce qu'il permet de recueillir toute l'information sanitaire dont on a besoin et en grande partie sous la forme appropriée. Yes 2 because it captures all the health information you need and largely in the form appropriate.

5. **On a scale of 1-5 would you consider the system to be used to its full potential? Why? Sur une échelle graduée de 1-5 considérerez vous que le système est utilisé a son plein potentiel? Pourquoi?**

<div align="center">1= Full potential, 5= Not meeting its potential.</div>

<div align="center">1= plein potentiel, 5= ne parvient pas a son potentiel.</div>

Oui 2. La partie GIS n'est pas utilisé et on a pas utilisé encore la fonction d'interopérabilité avec les autres applicatifs. Yes 2. Part GIS is not used and was not yet used the feature interoperability with other applications.

6. **On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why? Sur une échelle graduée de 1-5 évaluez l`efficacité  du programme HISPen terme d`atteinte de résultats escomptes?**

<div align="center">1=Efficient, 5=Inefficient.</div>

<div align="center">1= Efficace, 5= Inefficace.</div>

Oui 2: l'information est disponible à tout moment et est mises à jour régulièrement. Yes 2: information is available at any time and is updated regularly.

7. What are/were the barriers to adoption? Quels sont/furent les obstacles a l`adoption? La langue utilisée par le DHIS surtout dans les pays francophones.

The language used by the DHIS especially in Francophone countries.

8. Who is funding HIS work in your country?

Qui finance le travail de HIS dans votre pays? PADS à travers la coopération suédoise. Through the Swedish cooperation.

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

Jusqu`a quel point l`université d`Oslo contribue a la durabilité du programme HISP/DHIS dans le pays ou vous travailler? A travers la formation et l'implémentation, la disponibilité des consultants à répondre aux questions et attentes des utilisateurs et techniciens. Through training and implementation, availability of consultants to answer questions and expectations of users and technicians.

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

Voyez vous des opportunités pour le programme HISP d`accroitre son efficacité, ses besoins en audience, faciliter son implémentation et assurer la durabilité? Mettre en ligne une version française du DHIS. Donner des formations poussées aux techniciens informaticiens qui peuvent travailler après l'implémentation de façon autonome sans trop attendre le soutien des consultants. To release a French version of DHIS. Provide extensive training for computer technicians who can work after implementation independently without waiting for support consultants.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country? Pouvez-vous SVP recommander 2-3 personnes que nous pourrions contacter pour des renseignements supplémentaires?

kapiother@yahoo.fr (KABORE Pierre); gillesmki@gmail.com Gilles TANGUI), torezo2000@yahoo.fr (ZOMA Lamoussa Robert).

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.) Si vous pouviez recommander un changement qui améliorerait la performance du système DHIS, Que serait ce ? (SVP ne vous contraignez pas de rester sur les finances actuelles ou d`autres ressources, et les améliorations pourraient être dans des domaines au delà du présent logiciel DHIS).

Créer un seul fichier d'installation et de configuration automatique surtout pour les non techniciens en informatique. Create a single file installation and automatic configuration especially for non-technicians.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 3, Ghana

1. DHIS Version used

2.6.0

2. What health domains are covered by DHIS? What stage of deployment are you?

Planning to deploy this year

3. What examples can be pointed to that demonstrate the system's use in decision making?

N/A

4.   Has there been local customization of the system?

Not yet but there will be before deployment

5. On a scale of 1-5 would you consider the system implementation to be a success? N/A Why?

1=Very Successful, 5= Not Successful

N/A

6.   On a scale of 1-5 would you consider the system to be used to its full potential? N/A Why?

1= Full potential, 5= Not meeting its potential

N/A

7. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

N/A

8. What are/were the barriers to adoption?

N/A

9. Who is funding HIS work in your country?

Mainly MOH/GHS and development partners

10. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

The University of Oslo is crucial to the sustainability of the programme because of its facilitating roles in customization, training, coordination and general maintenance of the system.

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

Yes

12. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Not at the moment.

13. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.).

Cannot tell since have not deployed yet.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 4, Kenya

1. DHIS Version used:

DHIS 2.0.6

2. What health domains are covered by DHIS? What stage of deployment are you?

hiskenya.Org

3. What examples can be pointed to that demonstrate the system's use in decision making?

    a. The system is user friendly and provide open window for managers at a click.

    b. There number of manager using the system as real source of data, but also in planning process.

4. Has there been local customization of the system

Yes – National super user played major role in customizing with guide with able TAs.

5. On a scale of 1-5 would you consider the system implementation to be a success? Why?

<div align="center">1=Very Successful, 5= Not Successful</div>

1—The system will be a success because its country driven system and own by the Ministry with stakeholders will in putting investment into the system processes. Also, there is minimal operational cost needed in the long run with global support. Nevertheless, the country has harmonized tools which address the need of every user.

6. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

<div align="center">1= Full potential, 5= Not meeting its potential</div>

1—The system will be utilized with gradual improvement to accommodate other functionality until full maturity modal and gradually provide every user to depend on the system once operational countrywide.

7. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

<div align="center">1=Efficient, 5=Inefficient</div>

5—As a county and on my own perspective HISP is more efficient in response to issued raise by DHIS users globally. HISP has right manpower since Kenya tested the system customization during DHIS 2.0.4, it has grown based on our need requirement which had added functionality within a short time which is applicable to any country setting.

8. What are/were the barriers to adoption?

- There is no barriers at all, the system can be implement even within small unit and open source. Integration of various System by demonstration the full functionality especially on management information (IHRIS and patient data OpenMRS (long term process but if country have support there should be room for quick fix)

- Country internet infrastructure

9. Who is funding HIS work in your country?

Initial DANIDA was supporting the all process since but other partners has come in like USAID, Macro International, world bank and many others

10. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

It is highly important, and require regional meeting to share experience from various countries not just during customization but also future requirement and widened the region support/county support (Resource persons for HSIP)

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

Highly yes

12. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

a) Jeremiah Mumo - jeremwendwa@yahoo.co.uk
b) Wanjala Pepela - wanjala2p@yahoo.com
c) Suzuki Shinishi - shin461@gmail.com

13. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

1. There is need to restructure some DHIS functionality to great a more flexible ways like section forms which has different unit reporting which is difficult to determine the number within section form until its separated as dataset or make assumption.
2. The DHIS software require to have a demo link to other existing system like openMRS, EMR, IRHS, Logistics where carry can get support and say yes I can support Hospital modules and other support data capture but at the end the system should integrate all data source. Very important component of management information system require to be incorporated and link to routine data.

14. Does DHIS 2 require internet connectivity to work in Kenya? Was the problem at the Ministry that they did not have the ability/capacity for server hosting or that it wasn't fully connected?

About the DHIS 2 requiring internet is based on country decision not to have offline to minimalism data loose due to emailing and importing of data to central database. it is cost effective to have full internet but with rare cases have offline like functionality of outlook where it automatically synchronized or have distributable database when connected with internet which

is the best.

The ministry is still working on setting up server room because it has poor internet connection and we hoped for hosting outside to speed up the process of customization and piloting.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 5, Kenya

1. What health domains are covered by DHIS?

At the moment, we are concentrating on routine health information from health facilities. It is hoped that other domains including financial, human recourses and logistics management information systems will be incorporated in the near future.

2. What examples can be pointed to that demonstrate the system's use in decision making?

The system is able to provide quick analysis and put up graphs in the form of dash board. This can easily be seen by the people involved in decision making. The system is also seen to be focusing on the district or health facility and does not appear as though the information is meant to be forwarded to higher levels. Simple analysis on indicators can also be generated at the point of entry providing vital information on the trends of various diseases that may require urgent attention

3. Has there been local customization of the system?

We are rolling out a pilot in one province/region and there is high demand by districts to provide specific indicators for use at that level. The districts would like to make local customizations to suit their needs. This is being addressed.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

I would score 3 because we are still at the pilot stage but all the districts that have been visited are showing great interest in the system

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

I would score 3 due to the fact that the system has a lot to offer but not all the features might be used unless a lot of training to the users is done

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

the score is 1 because so far the consultants have listened to all our demands and fixed emerging issues on time. They are available and busy trying to improve the system

7. What are/were the barriers to adoption?

We still have fears that the system may be abandoned just like many systems in the past. We need to assure the stakeholders that this will not happen. Other barriers include the fears that the system may not address all the stakeholders needs. The fact that it is web based posed some real challenges and fears

8.   Who is funding HIS work in your country?

Mainly, DANIDA. USAID is coming up as a potential supporter

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

It is very important since the current Technical assistants come from there.

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

Yes, I believe HISP can partner with local learning institutions so that the work can continue with local Technical assistants. It is also hoped that exchange programs can be arranged to enable local competence which will improve efficiency and address the issue of sustainability

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

1. Samuel Cheburet: samuelcheburet@gmail.com

2. Jacinta Mbindyo: jmbindyo@yahoo.com

3. Dr. Martin Osumba: mosumba@yahoo.ca

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (Please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

Think of the offline possibilities. Most workers have challenges in computers and worse internet. Issues of connectivity are real (even our own ministry headquarters is a victim of poor internet connectivity).

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 6, Kenya

1. DHIS Version used.

Version 2

2. What health domains are covered by DHIS?

- Immunization
- Outpatient Morbidity
- Inpatient Morbidity & Mortality Disease Reporting
- Administrative statistics
- Workload Report for Health Facilities
- National Integrated Report capturing
  - Reproductive Health
  - HIV/AIDs
  - Malaria
  - TB
  - Child Nutrition

3. What stage of deployment are you?

Piloting

4. What examples can be pointed to that demonstrate the system's use in decision making?

- Data is aggregated by facility and therefore decision can be made for every individual health facility.
- Health managers are able to access data at their convenience i.e without having to go through health records and information officers.
- Managers are able to identify areas with low coverages, and therefore tailor interventions that fit the specific area.

5. Has there been local customization of the system

Yes, so much customization to suit our reporting structures and systems

6. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

2 - because there are challenges

7. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

3

8. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

2

9. What are/were the barriers to adoption?

- Internet Connectivity
- Low Computer Literacy levels
- Conflict of interests by partners
- Low staffing levels

10. Who is funding HIS work in your country?

- DANIDA
- USAID
- MINISTRY OF HEALTH

11. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

They are the technical people; they are assisting us with customization of the system especially the technical issues.

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

Yes

13. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

1. Mr, Samuel Cheburet - Ministry of Health HQs
2. Jeremiah Mumo - Ministry of Health HQs

14. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

Mult-isectoral approach, Involving all health workers, community, all sectrts

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 7, Republic of Liberia

1. What health domains are covered by DHIS? What stage of deployment are you?

The current domain of the DHIS is facility utilization data (out-patient and in-patient data) that included PHC Services, HIV/AIDS, TB/Leprosy, Malaria, Expanded Program on Immunization etc. that are collected, compiled and submitted monthly to central MOH from the peripheral through an electronic system. The DHIS1.4 has been deployed at the national and county levels.

2. What examples can be pointed to that demonstrate the system's use in decision making?

The use of HMIS data for the development of the 10-years (2011 – 2021) National Health Policy and Plan Situation Analysis, and planning process. Furthermore, data generated from the system are use during county and national reviews meetings where critical health sector decisions are made. The performance based contracting contracts with NGOs and county health team (Bomi), and the Global fund sub-recipients are monitored and evaluated based on the HMIS data are generated from the system.

3. Has there been local customization of the system?

Yes, Liberia has tailored the DHIS to its HMIS and has adapted a new data collection tools.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

On a scale of 1-5 rating success, Liberia is at 2(successful). Liberia introduced the DHIS1.4 in 2008 through a pilot approach and has fully decentralized the system to all of the 15 counties, improved data generation and has commence trend analysis over the past three years (2008-2010). With this tool, the health sector is gradually developing evidence-based policies and plan. See www.moh.gov.lr for reports and document of the Liberian health sector with data produced by the system.

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

On a scale of 1-5, Liberia is at 3 (limited potential), such a sophisticated tool/software needs detail/intense training with more relevant staff involve and not one per country. Presently, the GIS, HRIS, and other components of the system are under use due to limited capacity.

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

In terms of a system for handling data – 2

DHIS installed in all counties, many people been trained

In terms of strengthening a HMIS by streamlining the dataflow process, reducing duplicate parallel systems = 2

In terms of having a reduced data set that only collects the minimum data – 1

Developed a culture of information use - 3

7. What are/were the barriers to adoption?

Adoption of DHIS as a system to handle data – no real barriers

8. Who is funding HIS work in your country?

There are many partners that are supporting HMIS in a variety of ways. GAVI is the biggest donor, followed by USAID/RBHS (technical assistant, printing, policy development, data collection tools, etc), World Banks (computers, Servers, printers, etc), UN agencies (WHO, UNICEF and UNFPA), and WAHO.

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

The contribution of the University of Oslo at this particular point in time when the Ministry of Health has now adopted a revised integrated report tool and also looking for a system that will speak to others open source software I think the development of the DHIS2 is very vital and the ministry highly appreciate the contribution for a sustainable system. Also the invitation extended the ministry of health to be represented in the DHIS implementer workshop proved that a capacity will be build and skills will be transferred to other competent Liberian in the use of the DHIS for a sustainable system. Also short term courses in Health Informatics, epidemiology from the university will also help in sustaining the HISP/DHIS program in country.

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

 Yes

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

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12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

I think some of the things that will improve the performance of the DHIS system in Liberia would be International trainings of more than one persons from a country on the use of the DHIS and also short term courses in Epidemiology, Health Informatics and other statistical courses.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 8, Malawi

1. What health domains are covered by DHIS? What stage of deployment are you?

DHIS2 covers aggregated data for all health domains in Malawi. It is currently at a pilot phase.

2. What examples can be pointed to that demonstrate the system's use in decision making?

Maybe it is too short now to demonstrate that it is used for decision making. However the version 1.3 currently in use countrywide is the system used by the ministry and district officers for resource allocation and decision making

3. Has there been local customization of the system?

Yes. There were a need for local customization and it took place in Malawi. It is still going on since changes happen as we go.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

<div align="center">1=Very Successful, 5= Not Successful</div>

It is too short to say that it is a success or not in Malawi

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

<div align="center">1= Full potential, 5= Not meeting its potential</div>

2 because it can be used for much more than it is now and especially for survey data management and disease surveillance.

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

<div align="center">1=Efficient, 5=Inefficient</div>

2because HISP takes time understand countries' need and work with them closely to develop better approach to the problems. Also HISP invests time and resources in local capacity building. However this can be improved maybe if more resources are available

7. What are/were the barriers to adoption?

In Malawi there were almost no barriers but rather some complications. People were so enthusiast that they thought DHIS2 can do everything. It was not easy to explain that it is not the case

8. Who is funding HIS work in your country?

NORAD, HISP at least from what I know

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

The importance of University of Oslo is critical since its researchers are heavily involved in the process and it provides expert to support local team in managing, improving and adapting to changes. It also provides academic training in (health) Information system which.

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

Right now HISP relies on students, researchers to support countries. HISP can improve in effectiveness if it can mobilize easily the staff and for longer period.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Anthony Muyepa(muyepaa@gmail.com), Chris Moyo(<moyochris@gmail.com), Andreas Jahn(andreas.jahn@lshtm.ac.uk)

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

- integrate a more specific tool for performance based financing system
- improve the mobile module and especially for disease surveillance
- develop a flexible data importer tool that can easily import data from different databases

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 9, Malawi

1. What health domains are covered by DHIS? What stage of deployment are you?

Malawi has been implementing a comprehensive and decentralized health management information system (HMIS) nationwide since 2002. It is a pen and paper based system at facility level but it is computerized at district and national levels using the District Health Information System DHIS software version 1.3 for data processing and report generation. A dedicated person has been employed at district level to use the system. Currently Malawi is in the process to migrate from DHIS 1.3 to DHIS 2.0 a web based system.

Health Information Systems Project (HISP) in Malawi intends to achieve the following
- Implement the DHIS in the country
- Build capacity within the country in health informatics and research
- Establish HISP Malawi a network stakeholders within the country and linking it with the Global HISP project

Stage of deployment
There two stages of the deployment of DHIS 2.0. Malawi is currently in the first stage of the implementation of DHIS ver2.0. So far the following activities have been implemented
a. Selection of districts to implement DHIS2 and programmes to integrate with DHIS2 in the first phase
b. Customization of reporting forms and harmonisation of data elements from HIV/AIDS programme.
c. Provision of training to the users and provide support to the users on site
d. Dissemination through website development

e. Established HISP Malawi, a network of developers and users, researchers as stakeholders of the project including University of Malawi-College of Medicine, Ministry of Health – Central Monitoring and Evaluation Division (CMED), Community health Sciences Unit (CHSU)-, Baobab Health Trust, Luke International Norway (LIN)

f. Establishment of a health informatics course in the University of Malawi to build capacity

g. International cooperation- Global HISP project

The second phase will involve strengthening the above activities in phase 1 including rolling out the programme nationwide.

2. What examples can be pointed to that demonstrate the system's use in decision making?

DHIS is based on the collection and analysis of routine data from the health facilities. Its implementation at district and national levels has ensured that data is available for use at those levels. DHIS is used for generation of graphs that are used by programme managers and facility in charges to make management decisions. Availability of data at district level has promoted decentralization of decision making.

- DHIS has provided data at district level which is used in the formulation of district implementation plans (DIPs) and monitoring its implementation.

- DHIS has produced health facility comparative analysis showing performance facilities. District Health Management Teams (DHMTs) use this to identify poor performing facilities in need of support

3. Has there been local customization of the system?

There has been local customization of the system to some extent. The system contains data elements according to data requirements at national level. There has been limited customization at district level due to capacity limitations. Most districts have not been able to incorporate local indicators/data elements for their own use. In addition, demand for data from most decision makers at that level is low as they not familiar with what DHIS can do. There is high turnover of staff at district level and it becomes difficult to orient each time we have new staff

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

Scale=2

DHIS implementation has been successful in a number of ways.

- Availability of data at district level. Using DHIS processing of data, generation of reports and maintenance of data bases at district levels

- Capacity has been built in the districts in the use of DHIS

- Dissemination of data has improved as districts are generating their own health bulletins

- Use of information in decision making enhanced such as in the formulation of district implementation plans based on data from HMIS

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

Scale=4

- Limited capacity is a major issue to ensure that the system is used to its full potential. While it is used for data processing and report generation at district level, it can also be used at health facility level for data entry. This is not the case at the moment.

- Limited accessibility of the current system (DHIS 1.3) as not many people (policy makers, programme managers) are aware of the system. The current system is on stand- alone computer managed by one person. This limits its use.

- Linking DHIS with GIS to improve data presentation is not done currently due to capacity

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

Scale=3

- Establishment of a HISP network within the country and across the borders through capacity building activities, technical assistance and research

- Strengthen South-South and South-North Cooperation. Sharing of experiences , expertise and documentation for instance procedures and training manuals between countries

- Use of the DHIS developed under HISP programme. Flexibility of the system encourages customization to meet local information needs

7. What are/were the barriers to adoption?

- Access to computers by programme managers at district levels

- Limited capacity in computing knowledge at the district and lower levels

- Absence of power at health facilities

- Limited publicity of DHIS 1.3

8. Who is funding HIS work in your country?

- The Dutch Government provided both financial and technical support through a project for strengthening HMIS and DHIS 1.3 up to 2003

- From 2004 Malawi Government through Health Sector Wide Approach (SWAp) provides support for implementing DHIS1.3

- University of Oslo is providing financial and technical supports for implementing DHIS 2.0 in phase one.

- Potential funders to support national roll out programme include Global Fund and CDC

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

- Capacity building through the training and research of Malawians at Masters and PhD levels in the country, the region as well as in Oslo.

- Provision of financial and technical resources for phase one activities.

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

- DHIS2.0 established as a common platform for both national level and programme monitoring.

- HISP Malawi to be the advocate for adoption of DHIS 2.0

- HISP programme providing capacity in the country

- Stakeholders buy in. DHIS2.0 is seen as a rallying point among stakeholders (users, donors and within the country to ensure availability and accessibility of quality data

- Strengthened South- South and South- North collaboration

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

1. Mr Anthony C. Muyepa-Phiri
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2. Dr Andreas Jahn
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3. Mr Patrick Naphini
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12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

DHIS should be harmonized with existing organizational issues especially at district level. It should assist and not constrain or create additional burden on the order over burdened health worker.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 10, Malawi

1. DHIS Version used:

DHIS2

2. What health domains are covered by DHIS? What stage of deployment are you?

Health Information systems, customisation done, implementation is next - awaiting training and national roll-out, and other hardware

3. What examples can be pointed to that demonstrate the system's use in decision making?

The previous version is used for District Imprementation planning and the Ministry of Health Reports and budgeting. The new version is in it's initial imprementation stages.

4. Has there been local customization of the system?

Yes, not system, but forms, data collection tools.

5. On a scale of 1-5 would you consider the system implementation to be a success? Why?

<div align="center">1=Very Successful, 5= Not Successful</div>

1

6. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

<div align="center">1= Full potential, 5= Not meeting its potential</div>

4

7. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

<div align="center">1=Efficient, 5=Inefficient</div>

5

8. What are/were the barriers to adoption?

Delayed funding in national roll-out. Old system widely accepted, new system needs training and hardware

9. Who is funding HIS work in your country?

Initial funding came from Norway through the university of Norway's informatics department.

10. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

UiO support is critical in DHIS2 implementation in Malawi, by kickstarting customization and piloting stage through funding and technical support.

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

New version of DHIS2 would be effective in developing countries through its web presence, and will cut short the time to send paper-based reports from catchment erea. A small technical team can efficitively help a bigger community of health statisticians, unlike the previous version.

12. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Edem Kossi, ekossi@gmail.com, has been instrumental in providing technical support to the Malawi implementation.

13. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

DHIS Technical Workshops where important issues related to data management, customization, data upsizing, importing from old versions can be demonstrated

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 11, Sierra Leone

1. **DHIS Version used:**

Sierra Leone has been implementing DHIS version 2.0 since 2008.

2. **What health domains are covered by DHIS? What stage of deployment are you?**

Ministry of Health & Sanitation we are currently using DHIS as a dataware housing approach to develop an integrated health dataware house for the heath sector catering all routine information needs of stakeholders. The current system collect data covering a wide range of programs including but not limited to the following: Reproductive health, Maternal & Child Health, Leprosy/TB, HIV/AIDS, Malaria etc. We are current expanding the system to include community reporting, integrated disease surveillance (IDSR).

3. **What examples can be pointed to that demonstrate the system's use in decision making?**

Statistics generate from DHIS has form the basis for performance review for the health sector. It also provides data to support the annual health planning summit and will be use to generate data for payment of incentive for the performance based financing scheme.

4. **Has there been local customization of the system?**

Local customization of the DHIS has largely been incorporating local demands with technical input for HISP Oslo.

5. **On a scale of 1-5 would you consider the system implementation to be a success? Why?**

1=Very Successful, 5= Not Successful

I would put the system on scale 1. The system implementation has been very successful in that reporting completeness has increases from about 37% to 85% making programs and partners to rely on the system for RHIS. It has also increase the confident level of partners to trust data from the Ministry.

6. **On a scale of 1-5 would you consider the system to be used to its full potential? Why?**

1= Full potential, 5= Not meeting its potential

In Sierra Leone even though the current customized DHIS is been used at it fully potential, there is room for improvement, as we want to take the system customization to the next iteration level to include other reporting requirement mention above.

7. **On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?**

1=Efficient, 5=Inefficient

I would put HISP program on a scale of 1 (Efficient). The HISP approach of building systems around local team by developing their capacity during system development is very important for low resource countries like ours. Also using Open source platform free up a lot resources for implementing countries which can them go into capacity development.

8. **What are/were the barriers to adoption?**

One of the major barriers to adoption of the DHIS was based on previous HIS system failures as they dependence on TA for their maintenance. As the system was develop around a core local team. Another was it reliability, but as the DHIS has shown, since 2008 it has been running with little disruption to information flow.

9. **Who is funding HIS work in your country?**

Government of Sierra Leone, Health Metrics network, Most of the Health development partners with World Bank, UN Country team and Global Fund as the major fund providers.

10. **How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?**

The contribution of HISP in the development an integrated health Information System is crucial as the local team decides to take the system customization to another iteration. This is especially crucial in areas like capacity building and providing technical support to system development.

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

With the right resources HISP can increase it effectiveness with more technical support in terms of training, further customization of the current dhis to meet new user realities. The HISP can also develop local training institution to continue providing training of local staff.

12. **Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?**

DR. Edward Magbity, Pricipal M&E Officer, MOHS

Mr. John Baimba, M&E Officer, UNICEF

Mr. Richard Kaimbay, M&E Officer, Ministry of Health & Sanitation

13. **If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)**

The current DHIS is very good as a data collection tool for aggregated data requirement. The one area that needs to be looked into is the patient base approach.

<center>**EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE**</center>

Respondent 12, Sierra Leone

1. What health domains are covered by DHIS? What stage of deployment are you?

DHIS2 covers aggregated data for all health domains in Sierra Leone. It is currently in use countrywide since 2009.

2. What examples can be pointed to that demonstrate the system's use in decision making?

The performance based financing system in Sierra Leone is based on DHIS2. And currently DHIS2 is the official source for health information in the country. Particularly it is the monitoring tool for the implementation maternal health plan backed by the President.

3. Has there been local customization of the system?

Yes. There were a need for local customization and it took place in Sierra Leone. It is still happening time to time as changes go.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

<center>**1=Very Successful, 5= Not Successful**</center>

1 because in less than 2 years, the stakeholders built a consensus on a single integrated system and all rely on data coming from DHIS2. Almost all parallel system were abandoned in favor of DHIS2

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

<center>**1= Full potential, 5= Not meeting its potentia**l</center>

 2 because it can be used for much more than it is now and especially for survey data management and disease surveillance.

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

<center>**1=Efficient, 5=Inefficient**</center>

2 because HISP takes time understand countries' need and work with them closely to develop better approach to the problems. Also HISP invests time and resources in local capacity building. However this can be improved maybe if more resources are available

7. What are/were the barriers to adoption?

In Sierra Leone existing practices and culture of working in isolation (health programs) were the main barriers. It was then hard for them at the beginning to grasp what integration is in fact. However, gradually it got momentum and became the main source of information and even better the backbone of the information infrastructure in the country.

8. Who is funding HIS work in your country?

HMN, ministry of health

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

The importance of University of Oslo is critical since its researcher are heavily involved in the process and it provides expert to support local team in managing, improving and adapting to changes. It also provides academic training in (health) Information system. The ministry of health does not have at all any health information specialist.

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

Right now HISP relies on students, researchers to support countries. HISP can improve in effectiveness if it can mobilize easily the staff and for longer period.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Mohamed Jallow (mumeneeh@hotmail.com), MAGBITY EDWARD (magbity@gmail.com)

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

- integrate a more specific tool for performance based financing system

- improve the mobile module and especially for disease surveillance

- develop a flexible data importer tool that can easily import data from different databases

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 13, Sierra Leone

Country Overview and Achievements

When was DHIS deployed?

Four pilot districts from early 2008, by 2009 all 13 districts

Why was DHIS selected? What is the status quo and alternative HMIS packages did DHIS compete against? What else is in use?

Decision to use DHIS2 was made by MOHS and Bob Pond from HMN, who had been recommended it from others within WHO and HMN. Not sure about the evaluation of other alternatives, but what was currently in use were Excel spreadsheets.

What health domains are covered?

Morbidity, mortality, mother and child health, some aggregate data on HR, inventory. I will attach data collection forms as of 2010. Then OpenMRS has been set up for patient management of ART patients in the main hospital, covering about 2/3 of eligible patients. OpenMRS can now transfer aggregate data to DHIS, but there is not capacity to follow up on this pilot. The iHRIS software, for HR management, will be introduced soon, also exporting aggregate data to DHIS2.

What % of districts are reporting?

All are reporting some, but there have been a couple of weak reporters. The national average has been around 85-90% of expected reports (then focusing on only 1-2 forms). But not all on time (to national level by the 15th the following month). Measures to increase reporting through publicly ranking districts had great impact. There remains a problem of poor infrastructure to support districts with problems, and of networked reporting.

How many lives are covered?

Estimations on national population roughly range from 4.5-5.5 million. Whole country covered, but —problems" with migration and refugees.

Describe the network infrastructure of the country

Very poor, though most district have invested in USB-modems that is ok for using email though the cell phone network. Last time I heard, it costs around 50 USD per month, but districts still see it as a worthy investment. With this they can send exported files of DHIS-data to Freetown, where it will have to be imported. It's thus semi-networked.

What is the strategic plan for in-country deployment of HISP?

Relevance

What key indicators are collected?

Reporting forms attached. From these, various indicators (rates, ratios) have been defined in DHIS2, and are used in outputs. Most are on mother and child health, and some on service provision (work load etc, stock outs), and a few meta-indicators are also made, such as data completeness rates and ad-hoc data quality scores.

Are data and reports generated by DHIS used? How? By whom? What decisions have been made? Is the data displayed?

It varies from district to district. HISP has developed some custom reports, but I'm not sure how much they are used. But in the early stage a lot of attention was given to train people to use pivot tables, and when visiting districts later we found that many were composing their own reports based on charts and tables from the Excel pivot tables. Many also print and put on public walls.

I don't have a good overview of how information is used in the districts today, but a year and a half ago a couple of districts were quite advanced. Western Area, for example, was appalled by their low score in ―institutional delivery rate" in some district league tables we made (mainly because so many are using private clinics in this urban district, which are not included in the data collection process). They made the decision to make antenatal visits free, and published this in the newspapers. This has later become a national policy.

Has there been local customization of the system

The system has been fully customized to provide the data entry screens needed, as well as a few reports. It has however not been too many requests for reports. The work has been done by HISP, but training has also been given to MOHS to be able to do this themselves.

How the system perceived? Are the data useful and improving decisions, accurate, a burden to collect?

As mentioned, some district managers are using information in very clever ways, and in general I think there is more use of information at district level than at national. But even at the national level this is improving, and the yearly evaluation in December 2010 was the first where data from DHIS2 was used for the whole MOHS. Data accuracy is a problem, but we have reason to believe this is improving with more use of information, less data to collect (a result of a strategic use of DHIS2, see paper on comparative study of four countries), and a focus on data quality. The annual reviews of the data collection forms have led to better forms, less ambiguity in definitions, and less data to collect.

Is the system implementation considered a success?

Very much so. Personally I think it's the only real success HMN has to show from it's 5 core countries. Belize, the last of them, was adopted as a core country after results had been proved. The DHIS implementation itself, while there is a continuous stream of issues to improve and incorporate, has been acknowledged by all major donors and the MOHS as a good system, since it was decided that it would alone be used for M&E of the new free mother and child health program. Regionally, Sierra Leone has become a model, a best practice, and we are now collaborating with the West African Health Organization (WAHO), which will help other countries implement something similar. This has greatly been aided by the development of interoperability between DHIS2, iHRIS, and partly also OpenMRS, of which HISP has been a key actor.

What are requirements for health information systems? Does DHIS meet these requirements where are there gaps?

The requirements are now especially focused on logistics management. DHIS2 is not a logistics system, though it can be used to keep track of inventories. It is therefore often used to collect data on inventories, which is functioning as a rudimentary logistics system in many countries. The

requirements listed regarding logistics are also more like a simple inventory; start balance, received, dispensed, end balance, and the like. However, I think an open source logistics software, that can handle tracking, orders, finance, etc, should be looked for, hopefully one with the intention of adapting SDMX-HD compatibility to make it interoperable with DHIS2 and others.

Of other requirements there are few at the moment. For analytic purposes, the user maturity is not yet fully there to take advantage of all functionality presently in DHIS2.

Requirements

Requirements when considering Health Information systems. Ranked from highest to lowest importance.

	Facilities	Implementers	Researchers/academics	Government
Low cost				
Open source				
Analysis tools				
Ease of deployment				
Reliability				
Usability (clarify specifics)				
Others				

DHIS scored against requirements (+/-)

	Facilities	Implementers	Researchers/academics	Government
Accuracy				
Open source				
Analysis tools				
Ease of deployment				
Reliability				
Usability				
Others				

Effectiveness
How was the need for DHIS identified? Who initiated the discussion for country deployment?
As this was a decision made by MOHS and Dr. Bob Pond then working for HMN. The HMN-supported HIS assessment and subsequent strategic plan called for a data warehouse to be deployed both nationally and in the districts.

Is the system being used to its potential?

No, there is still a lot of unused functionalities. It is currently used to collect data on customized forms, with export of data to pivot tables. Some outputs in the forms of maps and customized reports have been prepared, and are used to a limited extent. Scaling up the use might include:

From district installations to one online central server (not in a few years time)

Central server open to the public (not the raw data, but reports, dashboard, maps etc). The hardware is in place, but limited capacity at MoHS to support this.

What examples can be pointed to that demonstrate the system's use in decision making? Has HISP contributed to local capacity building in the area of implementing and operating a health information system?

Cost vs. Benefits *(Benefits can be qualitative, however provide explicit examples)*

Costs	Benefits
Implementation: Training: Data entry: Other:	Improved resource allocation: Improved facility performance: Advocacy for additional resources: Development or revision of policies: Other:

Sustainability
What are/were the barriers to adoption?

How could adoption be accelerated?

What are the relative costs of operating the DHIS system? Have additional personnel been hired? Has it improved resource allocation? Are there any anecdotal examples of improved health or efficiency outcomes?

Who is funding HIS work in this country? How could HISP/DHIS funding work synergistically?

How has it impacted local capacity? Has staff been hired? Where are they trained? Are there local developers?

In country project funders:

Funders	Purpose	Amount

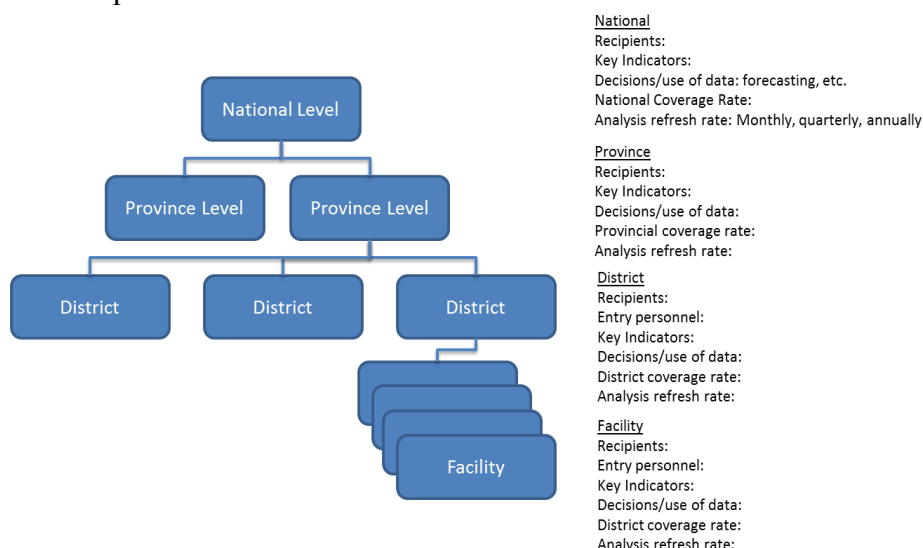**Country level information flow diagram:**
How would you describe the flow of information?
At service delivery, tally sheets are used to keep track. At the end of the month, the totals from two sets of tally sheets (one for facility, one for outreach) are transferred to a monthly summary form, which is then sent to the next level, which is the district office. This is supposed to happen

before the 5th of each month. There this aggregate data is entered into DHIS2 for each facility. When done, this is sent by various means to the national office. Most now use email with export files attached. Some may still rely on usb-sticks, either to take it to a point where it can be sent (internet café), or sent by someone traveling to the capital. All facility data is supposed to reach the national level from the districts approx. by the 17th. Then they will have at facility; their tally sheets with totals, at district; summary forms from all facilities, and this electronically in DHIS, at national; electronic facility data. Feedback I don't know too much about now, but league tables were developed earlier and also the bulletins were sent to districts.

National
Recipients:
Key Indicators:
Decisions/use of data: forecasting, etc.
National Coverage Rate:
Analysis refresh rate: Monthly, quarterly, annually

Province
Recipients:
Key Indicators:
Decisions/use of data:
Provincial coverage rate:
Analysis refresh rate:

District
Recipients:
Entry personnel:
Key Indicators:
Decisions/use of data:
District coverage rate:
Analysis refresh rate:

Facility
Recipients:
Entry personnel:
Key Indicators:
Decisions/use of data:
District coverage rate:
Analysis refresh rate:

Network Model
Key information:
For each organization please indicate whether you contacted them in order to do your work in Health Information Management over the last 6 months, what type of relationship you have with them, and how often you contact them.

Organization	How would you describe your relationship and reason for contact with them? [Interviewer: Please read to respondent all items and select only **one.]**	How often did you contact with them? [Interviewer: Please read to respondent all items and select only **one.]**
Examples: University of Oslo MOH (specify department) Clinton Foundation IHI CDC JICA HISP Tanzania Other	1=Communication (shared information only when it is advantageous to either or both parties) 2=Sought strategic information or advice 3=Cooperation (shared information and worked together when an opportunity arose) 4=Coordination (worked side-by-side as separate organizations to achieve common program goals; efforts were coordinated to prevent overlap) 5=Partnership (worked together as a formal team with specified responsibilities to achieve common goals (had a Memorandum of Understanding (MOU) or other formal agreement). 6=No link (or no contact)	1=Daily 2=Weekly 3=Monthly 4=Quarterly 5=Biannual

Role of University of Oslo
In terms of financial and other resources, how much has University of Oslo contributed to Development

All, paid for both by HMN and by themselves.

Academic support (Graduate students)

Several PhD students from Oslo have done research and published in relation to work carried out in Sierra Leone. There have not yet been any graduate students from Sierra Leone involved, but a key person from MOHS has now applied for a Master degree with HISP in Oslo, through a quota program.

Field Training

Most of the training was done by University of Oslo-affiliated people (PhD students), though contracts were made individually and on demand between the students and HMN.

Research

Several papers have been published, on open source development, scalability, integration and interoperability. Research in other countries has also been strengthened due to synergetic effects of having comparative studies.

Has support by University of Oslo been seen to grow or wane?

Both. It has waned in absolute terms from the time when HMN was in a position to heavily support Sierra Leone, but at the same time they have nevertheless been quite active and invested their own resources to keep the momentum.

How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program in country X?

Absolutely crucial, both to continue to give advanced support and train key staff, and to involve people from Sierra Leone in their master and PhD programs in Oslo for long term sustainability. However, the contribution does not need to be direct, HMN is supporting development of a regional network for HIS, based on WAHO being a Centre of Excellence for health informatics. HISP will work with WAHO on this.

Are there alternative ways University of Oslo could be contributing to support of HMIS in country X?

Now that the initial phases are over, where the most direct support is needed, University of Oslo can shift focus more to facilitate collaboration with other implementing countries, and participation of Sierra Leoneans to Master and PhD programs (for example in Tanzania). An indirect support mechanism through WAHO is promising to develop regional capacity, but there will be need also for direct support for the foreseeable future, due to the general lack of skilled personnel in Sierra Leone.

Influencing Actors

When multiple organizations (or individuals) are suggested, rank from most to least influential.

	Organizations/individuals
Identify organizations who are HMIS decision makers	MOHS, various health programs within MOHS, HISP, other major donors such as UNAIDS, UNICEF, DfID
Identify organizations who are influential on decision makers	The office of the President, major donors, in particular DfiD, World Bank, UNAIDS, UNICEF, to a lesser extent WHO
Identify organizations who can finance HMIS systems	DfiD, World Bank, UNICEF, UNAIDS
Identify organizations who can provide technical assistance to HMIS systems	HISP, West African Health Organization (WAHO), Intrahealth international, to a lesser degree UNICEF, WHO. Note; sometimes we find out someone has sent ―technical assistance" that does not much more than confuse or create conflicting interests. Key local actors may feel obliged to comply to such offers, if not just because it provides some income to staff.

Conclusions/Recommendations

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

Securing funding for core software development is crucial, so there can continue to be at least one or two full time developers. It's much harder for implementation projects to allocate funding for software development, though there will be bits and pieces here and there if special requirements appear. However, since it is an open source and free software, many who request functionalities are not prepared to pay for it. But as it is now, coordination of and core development needs adequate funding to keep DHIS2 evolving.

Developing more capacity outside Oslo is also crucial, but here quite a lot is happening. There are strong user and developer bases in India and Vietnam, and very promising activities are taking place in West Africa. This should be followed up, as it is of gain for all partners and users to enlarge the network.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 14, Sri Lanka

1. What health domains are covered by DHIS? What stage of deployment are you?

Preventive Health Domain (Family Health Bureau)
Deployment Stage - Customization and Piloting

2. What examples can be pointed to that demonstrate the system's use in decision making?

Maternal and Child Health: Collection of Weekly and Monthly returns from MOH (Medical Officer of Health) and generating weekly, monthly and quarterly aggregate reports.
Eg. Quarterly MCH Clinic Return(H 527), Maternal and Child Health Return(H 509), School Health Screening Programme.
School Health Monitoring Programme
Family Planning Equipment Distribution
(experimenting with IMMR and surveillance)

3. Has there been local customization of the system?

Yes. Since the Sri Lankan preventive health data flow is unique, Family Healt Bureau has decided to customise an instance of DHIS for maternal and child health and school health programmes.
The organization hierachy represents the health administration levels from MOH level, RDHS (Regional Director of Health Services) level and Central Level (Family Health Bureau/Ministry of Health).

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

2 - Customization matches the requirement. However, there are minor areas which may need the code level modifications. Needs more testing in the field level.

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

1 - Customizable Forms and Indicators make it easy to adopt in to the system. Different hiararchical level can be created. Customizable Analysis and data representation is strong. Perhaps DHIS could be used for Disease Surveillance and IMMR as well.

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

1 - Assessing the needs of different implementations and keep on developing to meet up the domain requirements.

7. What are/were the barriers to adoption?

Hierarchical architecture of data management in the preventive health sector (paper based system). May need minor changes in the business process, which may need higher level approval.

8. Who is funding HIS work in your country?

NOMA/UiO (DHIS)

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?
Training - developer training, Implementor workshops, further research and project supervision (MSc/PhD level).

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

Yes. When comparing recent versions of the DHIS released, it is more easy to customize and implement. Reporting and GIS features have improved significantly. Many of Sri Lankan requirements, have met already after having identified specific requirements in Sri Lankan workshops. With the profound understanding of the meta concepts embedded to the DHIS, it seems that many preventive and surveillance programmes are in a position to use DHIS for data collection and analysis.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Sir, if you name me, I can give them more detail about customizations. Dr. Chitramalie will give domain side input.

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

More support for developing local DHIS group in Sri Lanka.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 15, Tajikistan

1. What health domains are covered by DHIS? What stage of deployment are you?

Now we are in second phase of DHIS2 implementation. In phaseI (2007 - 2008) we run DHIS2 in pilot districts with success. Currently we are preparing revised metadata (Indicator list, categorizing indicators, primary and secondary data collection forms) as reccomendation of phase one of HMIS reform in Tajikistan. A number of meetings and workshops were conducted with stakeholders to address these issues. Currently working group revised all existing 834 indicators and reccomded to reduce them to about 300. Accordingly primary and secondary data collection forms will be reduced, in order to prioritize goals of National Health Strategy for 2010 – 2020 as well as MDG.

It has been decided to implement DHIS2 nationwide as analytical tool and primary database for health related data starting from health facilities up to national level. DHIS2 will cover all areas of healthcare, in a hierarchy, from bottom to top of organizational structure.

Phase II will mainly prepare revised metadata and run pilot projects to assess new metadata. Phase III will roll out DHIS2 in all levels of healthcare management in Tajikistan.

2. What examples can be pointed to that demonstrate the system's use in decision making?

DHIS2 has lots of analytical capabilities. One to mention here is its GIS capabilities. Mapping indicators to geographic locations will provide valuable information for senior managers in process of decision making. Showing huge amont of information in a single undestandable view and adding to this chronological analysis for example could influence budget allocation, say depending on spread of this or that desease in regions.

3. Has there been local customization of the system?

Yes. In phase I all DHIS2 interface were localized into Tajik and Russian, two main languages in use in Tajikistan in addition to English and many other languages onbuilt. Reporting forms were implemented into DHIS as to support smooth transition from paper based reporting into computerized system.

Currently there is a need to customize metadata dictionary to host latest metadata structure proposed by working group. Also all reporting forms will be custom built . DHIS2 has many option to generate reports, some with use of other open source reporting tools. The core of DHIS2 serves as global sceleton for implementing HMIS. Its modular design allows for addition of extra features that are specific to particular locale.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

1. in phase I we have gone through full cycle of DHIS piloting. Many lessons learned. One of the issues was indicator/data missmatch or keeping data elements that had null or zero values. These monents are being addressed in phase II and I believe we are in a right truck. I personally don't see any falure point for success of the project.

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

1. First, importance of correct, timely and reliable data for decision making has been stressed in national health strategy 2010 – 2020. This is evidence of political will and efforts local government has put to achieve higher levels of healthcare management. Implementation and use of computerized system will contribute to achieve above goals.

Secondly, computer literacy of healthcare personal is much higher compared to 5-10 years back. DHIS2 provides easy, customized set of interfaces for data collection and analysis. This should be interesting to health personal using DHIS2 to minimize burden of paper based data handling (locating, sorting, aggregating data).

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

1. Achievements of HISP program comes through hard work of healthcare practitioners and academia. DHIS2 as product of this work has been implemented in many African and Asian countries. These collaboration created a network of professionals globally spread and at the same time very close to each other in terms of knowledge sharing, combining efforts and making steps towards standardizing commonly used patterns of working practices. I feel this as major achievements of HISP project.

7. What are/were the barriers to adoption?

It is always hard to introduce innovation. There are always institutional bariers, especially when new ways of doing things has to replace old one. Inherited from Soviet period, data in healthcare was mainly collected and reported to level above, and decision was made at higher levels. Introducing DHIS2 emphasises local use of data for analysis by local managerial staff, and taking preventive measures. Implementing such practise goes through itterative process of negotiation.

Another barier was adoption of Tajik language as main language of official reporting and document handling. Terminology in Tajik for healthcare are emerging, many practitioners had difficulty with, as they studied in Russian. Patients also used to name diseases in russian, so this issue existed in all levels. Nowadays transition had given good results and health doctors are more comfortable using Tajik terminology. DHIS2 as multilanguage application had assited in this, though bringing Tajik into DHIS2 was hard.

8. Who is funding HIS work in your country?

PhaseI was funded by Asian Development Bank (ADB) loan to Tajikistan. European Commission has funded phase II and III of the HIS implementation.

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

Role of HISP program is high in supporting DHIS2 developers and implementers (individuals and organizations). HISP program is central for all HISP initiatives, it is repository and hub of knowledge/experience. Uninversity of Oslo as host of HISP program makes valuable contribution towards sustainability of DHIS2. Organizing developer/implementor workshops to address current trends and issues, conducting research in different areas of health informatics are of

particular interest to countries implementing DHIS. These contributions are made available through scientific publications. Many master and PhD students from developing countries are enroled into UIO departments, and their knowledge and skills will contribute to sustainability of HISP in their respective countries.

Particularly for Tajikistan, where the need for IT experts is apparent for the full success, involvement of UIO is highly important.

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

Yes, HISP program has long experience in development and implementation of health informatics. There are initiatives like integrating different open source application lead by HISP program. One such collaboration is SDMX-HD standard dedicated to data exchange between applications implementing it. WHO and OpenMRS are other members of this collaboration among others. DHIS2 is multi component, client/server application and installation of each component has to be performed by professional. Immproving installer for different platforms could be one area HISP program could contribute to sustainability.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Safar Rahimovich Saifuddinov – Head of Department of International relations, MoH Tajikistan. s.safar@mail.tj

Rajabova Lola Safarkulovna, Director, Medical Statistics Division, MoH Tajikistan. lola200880@mail.ru

Omid Ameli – Programme manager for EU funded project for phase II of HMIS implementation in Tajikistan, being implemented by EPOS Health Management. omid.ameli@epos.de

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

To revise and enhance data dictionary implementation. Because DHIS2 already has analytical capacity and could be easily deployed in other areas of public administration, not only healthcare.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 16, Uganda

1. What health domains are covered by DHIS? What stage of deployment are you?

Our plan is to cover all domains covered by the current revised HMIS tools in Uganda. These include HIV/AIDS, TB, Malaria and others.

We are still in the initial stages of implementation. We have only had one training by HISP Tanzania on DHIS2 overview, customization and implementation. We are still harmonizing implementation plan with key HMIS stakeholders as the manual HMIS tools get finalized, trained and implemented.

2. What examples can be pointed to that demonstrate the system's use in decision making?

As mentioned we have not progressed much, but one important evident role DHIS will play in Uganda is harmonization of all MoH and partners reporting that has been a major challenge. The ability of MoH managers and partners to have all information in one central place and at a click of a button.

3. Has there been local customization of the system?

For DHIS2 we have had a local training by HISP Tanzania and during the training, we managed to customize about 8 reporting tools but the process has not been complete due to the following.

- MoH Uganda has just completed the process of revising its HMIS tools to accommodate all parallel reports including HIV/AIDS and the new tools have not been rolled out/used

- The customization is still subject to the usual starting challenges with stakeholders not yet committed, tools not yet finalized, support structure not yet established, etc.

- However, Uganda had customization of the DHIS by Calle Hedberg (HISP-South Africa) of Version 1.3 - 1.4 in Kayunga district. It was deployed as a pilot by Makerere University Walter Reed Project (MUWRP) in 2007 and it has been functional to date.

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

Responses to questions 4 to 7 refer to the Kayunga system given in response 3 above. (2) - From what I have heard in different forums and in comparison to other electronic Systems so far tried by the Uganda Ministry of Health, it is the only system with legacy data; the back end is a Relational Database Management Software which will allow for easy migration of data to other relational database systems, and it has been functional for the past 3-4 years. However, Ms Access is not as efficient as other DBMS, and secondly, the software is not web-enabled.

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

As a non-user of the system, it would be difficult to comment

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

<div align="center">1=Efficient, 5=Inefficient</div>

As a non-user of the system, it would be difficult to comment

7. What are/were the barriers to adoption?

As a non-user of the system, it would be difficult to comment

8. Who is funding HIS work in your country?

We have not yet identified funders for this activity. But CDC-Uganda took up the initiative of introducing DHIS2 to Ministry of Health and US government partners working in Uganda. Initial training was partly funded from CDC-Uganda and two other Implementing partners. Planning and some customization support are currently being done by USG employed staff at CDC and those seconded to MoH.

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

Oslo team has been very key and getting the team in Ugandan to appreciate the system. The team set up a demo server in Oslo that was used to sell the idea to Ministry of Health and partners here in Uganda. They have been very helpful in reviewing and guiding us on the implementation planning. The team has been able to answer many questions from Uganda regarding the requirements for DHIS2 in Uganda.

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

Yes, this is because there has been a growing adoption of the DHIS in many developing countries in the past 3-5 years, as well as a collaboration of developers which creates a forum of users with growing/ changing needs that will have to be addressed.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Albert Nyero
Data Management Officer
Makerere University Walter Reed Project - Kayunga Field Office P.O. Box, 16524, Kampala Tel. +256-414-534588
Mobile- +256 777165764
Email:ANyero@muwrp.org

Maria Namuyomba
HMIS focal person in Kayunga District
Mobile: +256 772474802
Email: Marynamuyomba@yahoo.com

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

For sustainability and avoiding countries just jumping to start using the system without proper planning, I would advise HISP to come up with strategic minimal standards that compel countries from the start to adhere to set minimum standards. I agree it's an open source software, but HISP needs to evaluate a country's readiness before they allow a country to adopt it for national use.

13. Minimal or recommended standards should be defined. We will highlight your thoughts on this in the report. Were there particular areas you saw as challenging? Infrastructure, in-country support personnel, political buy-in?

On the challenges, we have had quite many as far as politics is concerned.

There has been general good buy in of the system by all stakeholders and partners including MoH that I have managed to present the system to, but the only issue has been the willingness of MoH to share openly their strategy and plans so as to align with partners and funders who are more than willing to support.

On infrastructure, right now MoH has no capacity to host the online DHIS2 we plan for in Uganda, both in terms of hardware, connectivity, and power solutions including physical access to server room after work. The foreseen solution would be having a funder here in Uganda whose role would be coordinating first of all MoH and then partners, because CDC's strictures doesn't allow this. Like these willing partners are willing to work closely with such a funder. Not sure if NORAD can support in this.

In-country support leadership was with CDC-Uganda but real to work closely with MoH staff and build capacity to the team there to take charge. As CDC we have managed to get more in country team members on board, but this has all been frustrated by the turn of attitude of MoH towards wanting to share.

We are right now fighting egos of the members who have assumed team lead right now.

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 17, Uganda

1. **DHIS Version used**

   DHIS 1.4.x

2. **What health domains are covered by DHIS? What stage of deployment are you?**

3. **What examples can be pointed to that demonstrate the system's use in decision making?**

   When we enter data we get analysis not only at district level but even by sub county which helps us know which sub county or sub district is performing how and so decisions are taken accordingly for example when we analyze using the RED approach of immunization we can tell which sub county is performing poorly because of distance, poor service, lack of awareness and the like.

4. **Has there been local customization of the system**.

   Yes

5. **On a scale of 1-5 would you consider the system implementation to be a success? Why?**

   1=Very Successful, 5= Not Successful

   I would rate it at 2.

   Because despite my not being a computer wizard I have been able to get whatever information or data has so far ever been demanded using the system and compilation of my reports has been eased. I have also not had any big challenges apart from wanting to learn more.

6. **On a scale of 1-5 would you consider the system to be used to its full potential? Why?**

   1= Full potential, 5= Not meeting its potential

   I would rate it at 4.

   This is because much as I'm computer literate, I don't have full potential to manipulate and use all that is available with DHIS.

7. **On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result?**

   Why? 1=Efficient, 5=Inefficient

   For a efficiency I would rate it at 2because so far Im able to getalmost all i need except translating it from health faculity format to district format

8. **What are/were the barriers to adoption?**

   My training is not Information Technology so I feel I lack skills to manipulate the soft ware despite having it open to me.

9. Who is funding HIS work in your country?

Whatever I'm doing has been funded by Makeree University Walter Reed Project in Kayunga district only.

10. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

Don't Know

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

Yes. This is because during the training it was set in such a way that the implementer doesn't need the programmer from time to time eg when adding or subtracting data elements.

13. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

Dr. Fred Magala Programs officer Makerere walter Reed Project Kayunga

Mark C Breda- Makerere UniversityWalter Reed Project Kampala

Alfred Anyero -Makerere University Walter Reed Project Kayunga

14. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

Having the system translate the report into the district format instead of leaving it in the health facility format because area like where you would have number of facilities reporting, having stock out etc which would be on the district copy cannot be reflected on the health facility copy

EVALUATION OF THE HISP SYSTEM AND DHIS SOFTWARE

Respondent 18, Vietnam

1. What health domains are covered by DHIS? What stage of deployment are you?

National Health Information report system:

We finished the first and second levels: from ward (primary health centre to District health Centre and from District health centre to City Health department).

We are working on the third or last level: reporting from city or province to Ministry of Health (National or central level).

2. What examples can be pointed to that demonstrate the system's use in decision making?

We work very close to the Ho Chi Minh city Reproductive Health Centre, so they use our software for the Mother and Child Health Programs, All data and Indictors were used by Centre Director to manage their programs – Through their monthly meetings.

3. Has there been local customization of the system?

We develop the DHIS software – which have been developed by the international IT team, so we have to customize for Vietnamese system, such as language, health situation, local demands…

4. On a scale of 1-5 would you consider the system implementation to be a success? Why?

1=Very Successful, 5= Not Successful

We can give 2, because the DHIS is good and stable, but the local needs are not clear and strong. We don't have the official guidelines from the MoH yet.

In this year we may integrate into National HIMIS project, after that all things will be easier.

5. On a scale of 1-5 would you consider the system to be used to its full potential? Why?

1= Full potential, 5= Not meeting its potential

We can give 1, because DHIS is stable and it was used successfully in India besides that we have a good IT team here to customize it.

6. On a scale of 1-5 assess the efficiency of the HISP program in terms of achieving desired result? Why?

1=Efficient, 5=Inefficient

We can give 1, because we did carried out successfully in the first and second levels, now we have to develop the DHIS for the last level (from City / Province to Ministry of Health).

7. What are/were the barriers to adoption?

We don't have a lot of barriers to adoption because we have participated in the DHIS development; so we know how to adopt it into the local needs.

The only barrier that we met is ―lacking of the strong guidline from MOH", but we hope to get it this year.

8. Who is funding HIS work in your country?

We are until now ―the research and development team for DHIS – District Health Information System" this is part of HISP international Project carried out by Oslo university – Norway.

So we get fund from Oslo University – Norway.

9. How important is the contribution of the University of Oslo to the continued sustainability of the HISP/DHIS program the country you are working?

We think it is very important because we can work as a team; the University of Oslo had a lot of experiences that we need for the implementation here in Viet Nam

Oslo Uni. also help in training for our team member here; help us to particpate in some international meeting such as WITFOR or others.

Oslo Uni. help us to upgrade our works, as we begin to work in ―Mobil Health project"...

Oslo Uni. may cooperate with University here to set up the training courses for ―Health and Informatic", such as the Master degree in Sri Lanka.

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

To increase effectiveness we need:

To work closely with the Health Authorities such as Viet Nam MoH and provincial Health departments to get their commitments.

To have more funding in the first period because we have to go and meet Health Authorities in different levels, to make them understand their needs and our reponses, our helps.

To have more funding to keep and to train our IT workers here in Viet Nam because actually there are a lot of other It companies who try to find IT workers and they can pay more.

11. Can you please recommend 2-3 people we could contact for additional details regarding the DHIS deployment in your country?

First of all is our team – HISP Viet Nam or DHIS team in Ho chi Minh city, you can contact me – Duong Dinh Cong MD, PhD – cell phone number + 84 (0)903359924.

Dr Nguyen Hoang Phuong Deputy Head of the Science and Training Department of MoH.

Mrs Ms. Hoang Thanh Hương Head of the Statistic Unit of Planning and Financial Department of MoH - Her email address: huongtkth@yahoo.com

Mr Dao Quang Huy – IT of Planning and Financial Department of MoH – his email address: dqhuy@yahoo.com

12. If you could recommend one change that would improve the performance of the DHIS system, what would it be? (please don't constrain yourself to staying within current financial or other resources, and improvements could be in areas beyond the domain of the actual DHIS software.)

The answer is the same for # 10.

Better Information, Better Decision, Better Health

Government of Sierra Leone
Ministry of Health & Sanitation
Health Information Bulletin

This bulletin provides statistics from the District Health Information System (DHIS) through routine data collected by facility workers of the Ministry of health & sanitation of the Government of Sierra Leone.

Volume 2, Number 1

Jan—Jun 2010

Inside this issue:

1. Reporting Completeness

The District Health information System (DHIS) manages data from 5 key data collection forms submitted monthly by each health facility to report on services, stocks and HR. Statistics generated from this system permits district and national officials to continually monitor health care services including those related to the Free Health Care (FHC). Figure 1 shows the reporting completeness by district for the first half of 2010. Overall, 80% of health facilities reported for the first 6 months of 2010. Only 4 districts (Koinadugu, Bonthe, Kono & Pujehun) had less than 70% reporting completeness (see figure 1), a remarkable improvement from the 30% rate in 2007. There is a need to support the districts to sustain and even improve on this rate so that effort in 2011 could be focus on improving timeliness and data quality.

2. Child Health
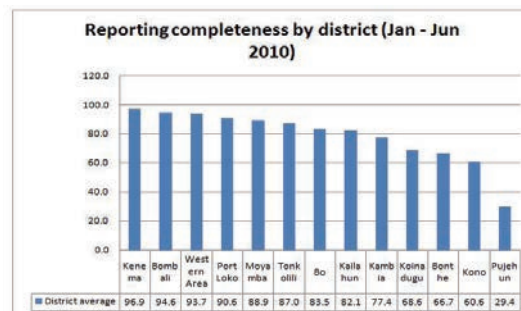
2.1 Immunization

Figure 1 Reporting completeness
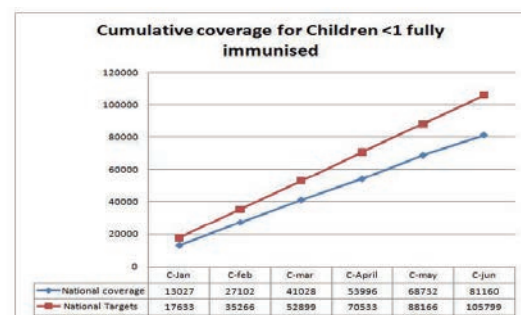
Figure 2 Cumulative coverage for Children <1 fully immunised

The objective of Immunization program is to see that all children are fully immunised before their first birthday. A child is certified as fully immunised if he/she has received full doses of following vaccines according to schedule: BCG, 3 doses of OPV and Pentavalent vaccine, a dose of measles and yellow fever vaccines. Figure 2 clearly shows that the immunisation coverage for the second quarter of 2010 (the period after the launch of free health services) seem to show a downward trend rather than the desired increment. There is need to review this trend and institute necessary measures to improve on coverage. This is because, the higher the fully immunized coverage (FIC), the higher the herd immunity of the children which is a strong guarantee reduction in mortality and morbidity due to vaccine preventable diseases.
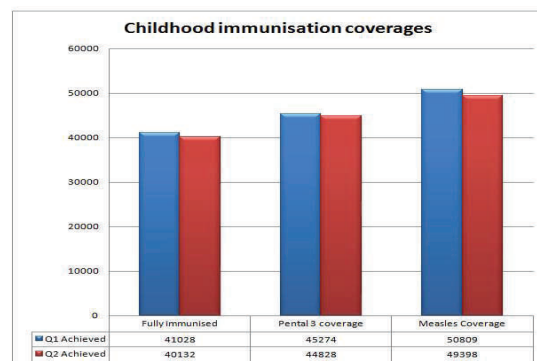
Figure 3 Coverage for childhood immunisation (Penta3, measles & fully immunised)

As seen in figure 3 above, the country is progressively slipping further from the set immunisation targets which are underscored by the same trend for two anti-gents (Penta3 and measles coverage).

2.2 Underfive Consultation

Treatment of <5 children with ACT within 24hrs of onset of fever reduces the possibility of malaria becoming complicated and leading to death. As seen in figure 4 below the ACT uptake amongst under-five children increased considerably with the launch of the FHC by 148% in April further rising to a peak of approximately 372% in May and tapering down to 272%. The sudden increase in May could be related to the FHC and the decline may be as a result of patient flow regularising itself after the FHCI euphoria or distortion in the supply line of the ACT. In its fight against the key killer disease the Ministry has adopted several strategies including the use of com-

munity health workers to provide ACT. The increase in ACT coverage is an encouraging trend considering the fact that malaria is the leading cause of morbidity and mortality in Sierra Leone.
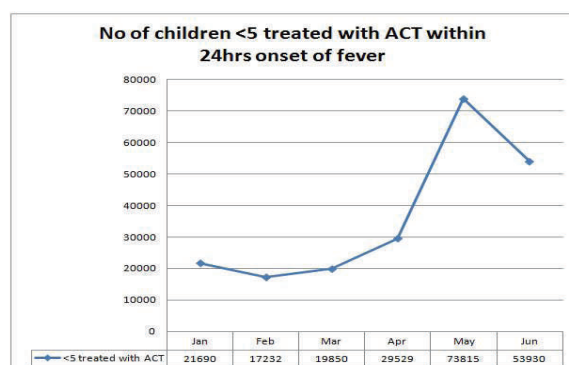
Figure 4 Children treated with ACT

As seen in figure 5 below malaria, acute respiratory infections and diarrhoea continue to be the main reason for PHU consultation amongst children <5. An almost equal number of children under five report for clinical malnutrition, worm infestation and skin infection. Worrying is the fact 4,306 suspected cases of measles were reporting during the period under review.
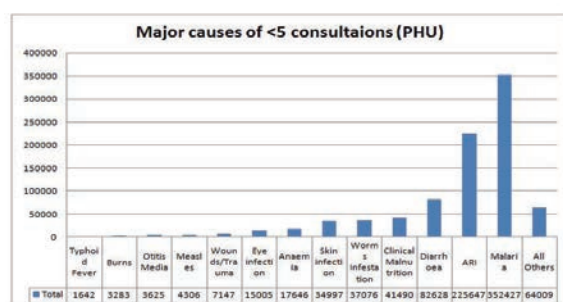
Figure 5 Causes of <5 consultations

2.3 NUTRITION

Preventive interventions such as the distribution of vitamin A supplementation and exclusive breast-feeding in the first 6 months of life are among the best proven, safest and most cost-effective interventions in public health. Figure 7 shows a marked increase in the distribution of Vitamin A in quarter 2. The uptake of Vitamin A supplementation increased by more than 100 percent in the second quarter. A possible reason for this increase is that as more children were coming for consultation at health facilities as a result of the FHC, health care staff were taking advantage of this situation to distribute Vitamin A. Figure 6 demonstrates a steady increase in Exclusive Breast Feeding (EBF) from January to May and a decline in June. EBF is a cost free feeding behavioural change phenomenon that does not only provide children 0-6 months old 100% of their needed nutrients, but also protects them from infections and immensely contributes to the realization of their full potentials. Efforts should therefore be exerted to halt and reverse the down ward trend that took place in June and to increase uptake of this important life-saving intervention.
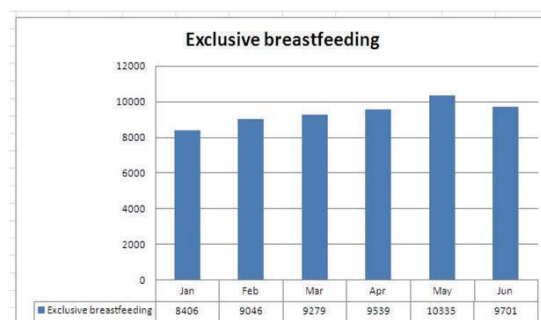
Figure 6 No of children exclusively breastfed within six months
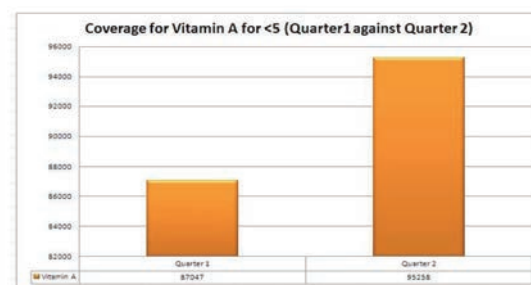
Figure 7 No of children <5 receiving Vitamin A supplementation

3. Maternal Health

One of the key objectives of the Free Health Care policy is to increase access by pregnant women and lactating mothers to quality health care services provided in health facilities by professionals.

3.1 Ante Natal Care for Pregnant Women

As desired, the numbers of women attending ante-natal clinics (ANC) has increase progressively since March . Pregnant women are expected to make at least four ante-natal visits during each pregnancy. During these visits, health workers can detect and manage conditions that could adversely affect the health of the mother and baby, provide education and preventive packages which will increase the chances of her safe delivery in a health facility. Figure 8 shows that the number of pregnant women making at least 4 ANC visits increased from January to April but experienced a downward trend in May and June. That calls for intense efforts to increase uptake of ANC services in order to reduce maternal mortality. While more women seem to be delivering at Health facilities, fewer women are making the required number of ANC visit.
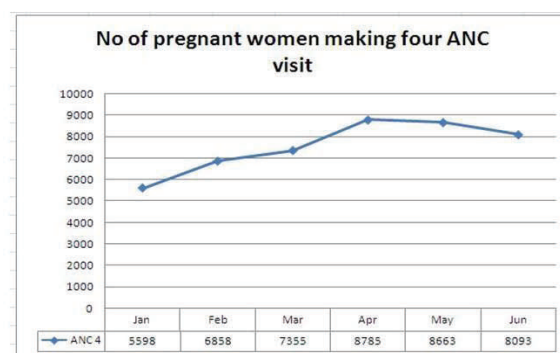
Figure 8 No of pregnant women making four ANC visit

The Free Health Care Policy has greatly increased the uptake of health care service. In order to sustain these gains , the Ministry is appealing to all its partners to continue supporting this policy.

3.2 Personnel Deliveries (PHU)
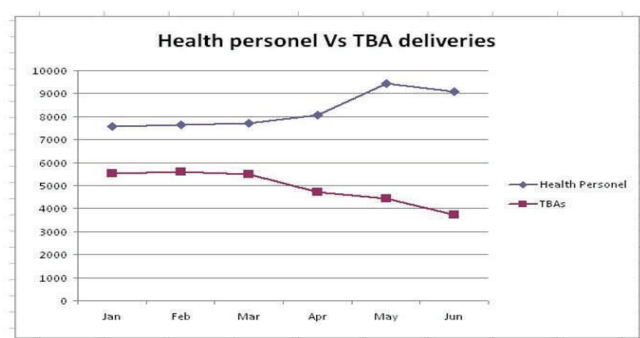
Figure 9 No deliveries conducted by Health personnel against TBA deliveries

Deliveries continue to be conducted by different providers including trained and untrained traditional birth attendants (TBAs). As seen in figure 10 below, about 55 percent of deliveries are conducted by MCH Aides and 28 percent by Trained TBAs. According to Figure 9 above, the number of deliveries conducted by TBAs seems to be decreasing since the launch of the FHC in April, while those conducted by health personnel is increasing. This is a very encouraging development, and effort must now be put into ensuring that this trend continues. This can be done through community sensitisation, capacity building of staff and equipping the facilities to provide quality and client-friendly reproductive health care services.
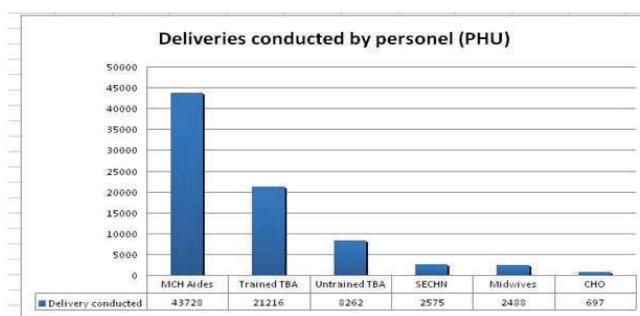
Figure 10 No of deliveries conducted by category of personnel

3.3 Institutional Delivery (Hospital)

To reduce maternal deaths it is important that mothers deliver their babies in an appropriate setting, where life saving equipment and hygienic conditions can also help reduce the risk of complications that may cause death or illness to mother and child. Hospitals undoubtedly provide such a setting. According to Figure 11, the number of deliveries conducted at hospitals increased steadily from January to April 2010, but very steeply in May 2010. About 57 percent of the total deliveries conducted at Government Hospitals from January to June were conducted in the months of May and June - after the launching of the Free Health Care Policy. Since the launching of the FHC, the total number of deliveries conducted at Government hospitals around the country has increased by more than 2 folds. There has also being a considerable increase in the number of deliveries by caesarean section. In June, the number of normal deliveries and caesarean sections conducted at hospitals seem to be tapering down-wards. There is a need to investigate the reasons for the down-ward trend in June so that appropriate remedial action can be taken. Meanwhile, there is a need to ensure that hospitals are properly equipped to manage the increasing demand for services.
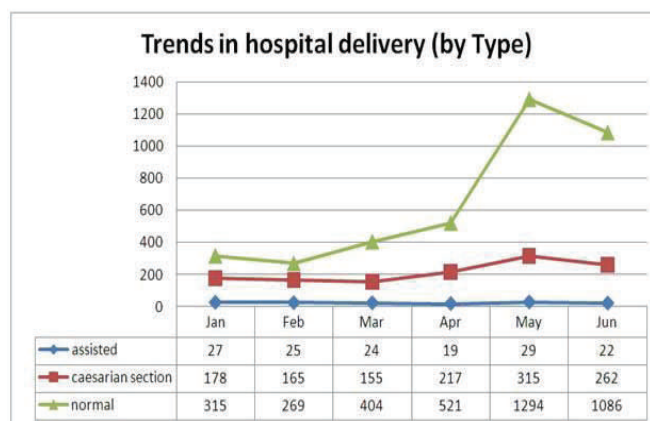
Figure 11 trends in hospital deliveries

3.4 Maternal Death

A total of 147 maternal deaths were reported by the Government hospitals nationwide within the period January – June 2010. The major causes of maternal deaths (see figure 12) were obstructed labour 17 percent, pre-eclampsia 13 percent, aneamia 8 percent, Ante-Partum Hemorrhage (APH) 8.2 percent and Post-Partum Hemorrhage (PPH) 6 percent. About 31 percent of the deaths were due to other direct and indirect causes that were not defined in the reports. Most of the maternal deaths are avoidable, as health care solutions to prevent or manage them are well known. Therefore, since complications are not predictable, there is the need to intensify effort to have all pregnant women making the required number of ANC visit and subsequently delivering at health facilities where skilled health professionals can manage any complications during deliveries. For instance, severe bleeding after birth can kill even a healthy woman within two hours if she is unattended. Injecting the drug oxytocin immediately after childbirth reduces the risk of bleeding very effectively. There is therefore a need to continue sensitizing mothers about the need to make the required number of ANC visits, and delivering in a health facility.
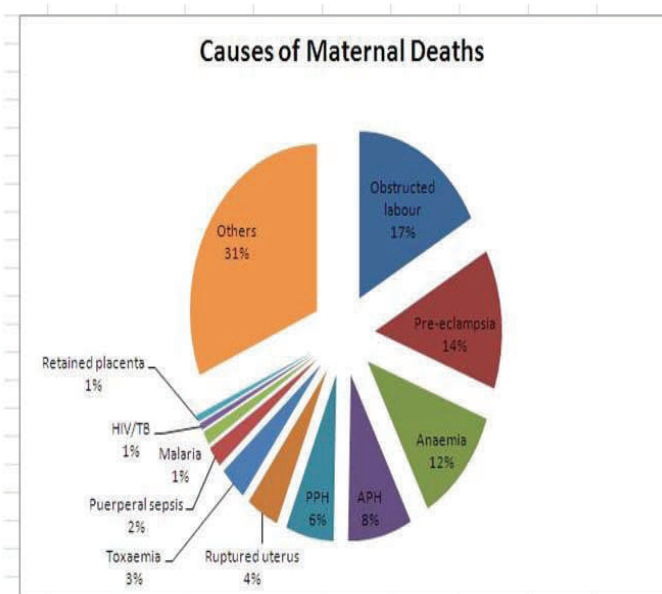
Figure 12 Main causes of maternal deaths (Hospital)

3.5 Service utilization (Hospital)

Table 1 shows that a total of 23,229 patients were admitted from January - June 2010, of which 59 percent were children under five years of age. Three of the hospitals did not provide data on under-fives admission. Kenema Government hospital accounted for about 25 percent of all hospital admission and 36 percent of all under five admissions, while the Ola During hospital accounted for 14 percent of all hospital admissions and 22 percent of all under fives admissions. This clearly shows a massive variation in case load among hospitals. It is therefore important that these variation be taken into consideration when deciding on the allocation of Financial, material and Human resources for hospital.

HOSPITAL	TOTAL ADMISSIONS	<5 ADMISSIONS
Govt. Hosp. Kenema	5,855	4,840
Ola During Childrens Hospital	3,302	2,956
Koidu Govt. Hospital	1,665	786
Connaught Hospital	1,204	
Bo Govt. Hosp.	1,161	651
Govt. Hosp. Makeni	1,140	555
Kabala Govt Hosp	1,069	584
Govt. Hospital - Port Loko	953	315
Govt. Hospital Kailahun	918	606
Magburaka Govt. Hospital	893	473
Kambia Govt Hosp	725	292
KingHarman Rd. Hospital	643	92
Mattru UBC Hospital	643	417
Govt. Hospital Moyamba	628	197
Lumley Hospital	618	150
Rokupa Govt. Hospital	475	-
Govt. Hosp. Pujehun	463	279
Govt. Hosp. Bonthe	400	283
Masanga Mission Hosp	371	190
Kingtom Police Hospital (MI Room)	103	-
TOTAL ADMISSION	23,229	13,666

Table 1 Service Utilization coverage (hospital)

3.6 Coverage for key Health services (Jan-Jun 2010)

Indicator	Estimated Population	Q1 Achieved	Q2 Achieved	% Covered
No of children <5 treated in Public health facilities	958,883	260,506	631,744	93.1%
No of children <5 treated with ACT	958,883	58,772	157,274	22.5%
<5 receiving Vitamin A	958,883	87,047	95,258	19.0%
No of pregnant women having two doses of IPT	231,893	56,903	56,078	48.7%
No children <1 Fully Immunised	229,872	41,028	40,132	35.3%
No of pregnant women having two doses of TT	231,893	33,845	33,703	29.1%
Pregnant women receing LLITN	231,893	19,897	32,974	22.8%
No children <5 receiving LLITN	958,883	17,701	30,539	5.0%
No children Exclusive breastfed in the first six month	229,872	26,731	29,575	24.5%
No of deliveries conducted in a health facility (PHU)	231,893	24,093	27,473	22.2%
No deliveries Health Personel	231,893	22,937	26,551	21.3%
pregnant women having 4 ANC	231,893	19,811	25,541	19.6%
No of deliveries by caesarian section	231,893	498	794	0.6%

Table 2 Coverage for key health services

Table 2 shows the performance on key health indicators by Quarter. Quarter 1 is for the period January—March and Quarter two is from April—June. According to table 2 there was a higher uptake of most of the services in Quarter 2 than in Quarter 1. The increase in the second quarter could be attributed to the implementation of the FHC Policy. It is however worth noting that while coverage's for certain services are on the increase those for other services are decreasing. The Table shows a decrease in the number of fully immunized children in Quarter two relative to Quarter one. This is a concern because full immunization provides children with protection against common infectious disease that would jeopardize their chances of celebrating their first five birthdays. There is a concern that the high influx of patient to health facilities as a result of FHC is leaving Health Workers at PHU levels with not enough time to engage in outreach activities. These activities are critical for tracing defaulters and sensitizing communities about the importance of certain health care services. Urgent steps need to be taken to address these problems.

District Health Management Information Systems Country Deployments

Country	District Health Management Information Systems (DHIS) Version and Implementation Start Date	Funders	Estimated Coverage	Deployment Status **Regional node** **Self-sustaining** **National deployment** **Vertical deployment** **Pilot/planning national deployment** **No information**
Bangladesh	DHIS v2, 2010.	• Deutsche Gesellschaft fuer Technische Zusammenarbeit	158 million	No information
Botswana	DHIS v1, 2006. DHIS v2, 2010.	• First pilot by European Union project • Ministry of Health (MOH)	1 million	No information
Burkina Faso	DHIS v2, planning, 2009; rollout, 2011.	• Swedish Cooperation Fund	16 million	Pilot/planning national deployment
The Gambia	DHIS v2, 2009.	• University of Oslo (UIO)	1 million	No information
Ghana	DHIS v2, planning, 2010; rollout, 2011.	• MOH/Ghana Health Service	24 million	Pilot/planning national deployment
India	DHIS v1, in pilots 2001. DHIS v2, 2006.	• UIO • National and State authorities	680 million	Regional node National deployment

District Health Management Information Systems Country Deployments

Country	District Health Management Information Systems (DHIS) Version and Implementation Start Date	Funders	Estimated Coverage	Deployment Status • Regional node • Self-sustaining • National deployment • Vertical deployment • Pilot/planning national deployment • No information
Kenya	DHIS v2, 2010.	• Danish International Development Agency (DANIDA) • United States Agency for International Development (USAID) • MOH • Macro International • World Bank	40 million	Pilot/planning national deployment
Liberia	DHIS v1.4, 2008. DHIS v2, 2010.	• Merlin UK • MOH • GAVI • USAID/Rebuilding Basic Health Services • World Bank • United Nations	3.6 million	National deployment

District Health Management Information Systems Country Deployments

Country	District Health Management Information Systems (DHIS) Version and Implementation Start Date	Funders	Estimated Coverage	Deployment Status • **Regional node** • **Self-sustaining** • **National deployment** • **Vertical deployment** • **Pilot/planning national deployment** • **No information**
Malawi	DHIS v1.3, 2002. DHIS v2, 2010.	• The Dutch Government • Malawi Government through Health Sector Wide Approach provides support for implementing DHIS v1.3 • UIO	15 million	National deployment
Nigeria	DHIS v1.4, 2006 DHIS v2, 2010.	• Multiple donors	150 million	Vertical deployment Pilot/planning national deployment
Rwanda (Testing)	DHIS v2, 2011.	• MOH	10 million	No information
Sierra Leone	DHIS v2, 2008.	• MOH • Health Metrics Network (HMN) • World Bank • United Nations country team • Global Fund • UIO	5 million	National deployment

District Health Management Information Systems Country Deployments

Country	District Health Management Information Systems (DHIS) Version and Implementation Start Date	Funders	Estimated Coverage	Deployment Status • **Regional node** • **Self-sustaining** • **National deployment** • **Vertical deployment** • **Pilot/planning national deployment** • **No information**
South Africa	DHIS v1.4, 1997. DHIS v2, 2002.	• Norad • USAID (Equity project under Management Sciences for Health) • Centers for Disease Control and Prevention (CDC) • Local and central health authorities	49 million	Regional node Self-sustaining National deployment
Sri Lanka	DHIS v2, 2010.	• Master Programme in International Education and Development, UIO	21.5 million	Pilot/planning national deployment
Tajikistan	DHIS v2, pilot, 2009; rollout, 2011.	• Asian Development Bank • European Commission	8 million	Pilot/planning national deployment

District Health Management Information Systems Country Deployments

Country	District Health Management Information Systems (DHIS) Version and Implementation Start Date	Funders	Estimated Coverage	Deployment Status • **Regional node** • **Self-sustaining** • **National deployment** • **Vertical deployment** • **Pilot/planning national deployment** • **No information**
Tanzania	DHIS v1, pilots in two districts, 2003. DHIS v2, rollout, 2011.	• Norwegian and Dutch funding		Vertical deployment Pilot/planning national deployment
Togo	DHIS v2, planning, 2010; pilots in two districts, 2011.	• UIO	6 million	Pilot/planning national deployment
Uganda	DHIS v2, 2011.	• CDC	33 million	Pilot/planning national deployment
Vietnam	DHIS v2, 2006.	• UIO	89 million	Pilot/planning national deployment
West African Health Organization	DHIS v2, 2011.	• Will seek partner funding		Planning regional deployment
Zanzibar	DHIS v1, 2006. DHIS v2, 2011.	• DANIDA	1 million	No information

Project Comparisons

To understand business models for software products to support health information systems, we examined a group of five "peer" products to the District Health Information System (DHIS). This was done by a combination of onsite interviews, email questionnaires, a desk review, and background knowledge. The systems examined were DevInfo (analytics for development statistics), OpenMRS (clinical medical records), iHRIS (human resources management), ETR (electronic register for tuberculosis patients), and VSSM (vaccine stock and supply management). These systems present a diversity of business models and give points of contrast with HISP, as opposed to direct guidance on alternate models that the Health Information Systems Programme (HISP) could adopt. One commonality for all of these systems is that donor support has been critical for the development of the core software product, even in the cases where the product has been made available as open source software.

DevInfo is funded primarily through the United Nations (UN), both with direct support for product development and with sale of services to UN organizations. OpenMRS is a very successful open source project for building clinical medical records. OpenMRS has broad donor support with several professional software developers managing the open source project. There are many independent deployments of OpenMRS which require local customization. iHRIS is a human resource management system for health systems in low-resource settings. The system was produced by a very large United States Agency for International Development (USAID) project, the Capacity Project, and is currently sustained by the Capacity Plus project. The iHRIS software was released as open-source software. ETR is an electronic tuberculosis register that was initially developed with support by the Centers for Disease Control and Prevention (CDC) and then was transferred to a private company in South Africa for maintenance. This system is in use in a few African countries, although it is not clear how much support is available. VSSM is a vaccine stock management program for tracking vaccines and supplies at the central and district level. This is a project managed by a single individual who would get World Health Organizations funding for extensions of the system, and particular country deployments.

Of the five projects, OpenMRS and iHRIS are the closest to DHIS in providing flexible tools to address health business processes. It is natural to consider OpenMRS, iHRIS, and DHIS being deployed together with some level of integration, and various health systems are considering doing this. All three require customization for local deployments and some level of continuous support, so there are necessary service and support roles around them which can either be provided externally or by the health system. VSSM and ETR contrast with DHIS by being specific applications targeting very specific tasks (supply management for vaccines and registration for tuberculosis patients, respectively). One thing to be noted is that by incorporating the name-based tracking, DHIS is moving in the direction of being a platform for broader registration services. DevInfo has a very different type of product—one that targets workers at development agencies instead of the health system. The support model for DevInfo is also different because of its established funding streams through the UN.

DHIS Peer Products Comparison

Organization or Product	HISP	OpenMRS	iHRIS
For the core product, what solution does it provide, and who are the target users?	DHIS software for aggregation, analysis, and reporting of health indicators for health managers.	Open-source medical record system for health providers.	Integrated human resource information system. Human resource management tools for health managers.
What is the scale of adoption?	In use in about 20 countries.	Used worldwide for medical records. Possibly 1,000 installations.	Wide-spread use in Africa.
What is the structure of the organization?	Three main country teams (Norway, India, South Africa), along with smaller country deployment teams and a number of affiliated universities.	There is a small core leadership supporting a fairly broad, open source community.	Created and deployed initially by a large nongovernmental organizations with USAID funding and many partners.
What is the funding model for the organization/ product?	Donor funding for initial country deployments and support of central organization. Support from government health system in mature deployments.	Donor and project funded. Several organizations (with strong fundraising) such as Partners in Health rely on OpenMRS.	Developed as part of the Capacity Project, a US$300,000,000 USAID project. Continued support through the Capacity Plus project.
How is the product marketed?	People from the three main nodes maintain ties with ministries of health and promote DHIS. There are bottom-up efforts to introduce at the district level.	There is a strong community behind OpenMRS, with leadership from Paul Biondich of the Regenstrief Institute.	Introduced as part of a large-scale USAID project. Continued availability as an open source project.

Organization or Product	HISP	OpenMRS	iHRIS
What is the support/training infrastructure?	Training is a central component of HISP with significant effort devoted to health worker training. There are also a number of affiliated university training programs with the goal of building capacity in health information systems.	The primary training around OpenMRS has been developer workshops.	Capacity Plus project is continuing to support training and technical support.
What is the software development approach?	DHIS 1.4 and DHIS 2 are managed as open source projects with the assistance of a small number of professional developers.	There is a strong open source community around OpenMRS, with a small number of project-supported developers running the show.	Developed as part of a large project by a professional team. Code is now available as an open source project with hosting through Launchpad.

Organization or Product	DevInfo	VSSM	ETR
For the core product, what solution does it provide, and who are the target users?	PC-based analysis tools for development statistics. The target users are national-level managers who want to understand data or to publish data to the public.	Vaccine stock and supply management. Manage national and regional stocks of vaccines. Used by national vaccine managers.	Electronic tuberculosis register. Tracking of tuberculosis cases on a district or national level. Used by district and national TB managers.
What is the scale of adoption?	Widely used by UN agencies. Estimated usage by 20,000 people.	Used at the national level in 13 countries.	Introduced to about 10 African countries. Currently used for national reporting in Tanzania.
What is the structure of the organization?	The main organization is in Delhi with about 50 staff, with a few smaller offices worldwide.	Single individual working with programmers.	Program initially developed by CDC then managed by a software company.

Organization or Product	DevInfo	VSSM	ETR
What is the funding model for the organization/ product?	Most of the funding comes from the UN, with direct support for software development, and additional support from UN organizations who are buying services.	WHO support for introduction, then country support for running.	Initial funding from donors for software development.
How is the product marketed?	Tools and services are made available to UN agencies. A small marketing team supports this.	No specific policy.	No specific marketing.

Organization or Product	DevInfo	VSSM	ETR
What is the support/training infrastructure?	There is a training staff along with contract trainers. Training on data use and material development is one of the services provided.	Initial country introduction is a five-day workshop. No maintenance provided.	Very little support now that the software has been introduced.
What is the software development approach?	DevInfo has a proprietary software product which is supported by a team of about 25 developers. Multiple software technologies are used.	Paid developer and then code is made available to the country for further modification.	Proprietary software managed by a company.

Health Information Systems Programme Funding

Funding period	Funder	Project title	Sum NOK	Focus	Purpose (primary source Jorn Braa)
1995-1998	Norad	District Health Information System (DHIS) development	2,500,000	Development/ Deployment	The initial pilot phase in South Africa, covering the first pilot of DHIS.
1998-2002	United States Agency for International Development (USAID)	Equity project run by Management Sciences for Health (MSH)		Deployment	Funded first DHIS rollout in the Eastern Cape Province, thereafter rollout countrywide.
1999-2001	Norwegian Programme for Development (NUFU)/ Norwegian Centre for International Cooperation in Higher Education (SIU)	Health Information System Programme (HISP)—A network program for empowerment of the marginalised in the globalizing world "Inclusion of the excluded"	11,500,000 (9,197,000 from SIU 2002-2007)	Deployment	This is the project that created the HISP Network. During the **first three-year period**, University of the Western Cape, South Africa, was the main partner and the research focuse (1) the development of health information systems (HIS) in South Africa, scaling it to all districts and provinces and develop and establish the "HISP approach" and DHIS as natic standard, and (2) generalizing the South African experiences and include more countries in the research network (i.e., create the HISP network). As a result, HISP was established Mozambique in 1999 and in India in 2000.
2002-2006				Deployment/ Academic	The Eduardo Mondlane University (UEM), Mozambique, became the new main partner and India, through a newly created HISP-India nongovernmental organization, Tanzania (University of Dar es Salaam) and South Africa (University of Western Cape) were the additional partners. Approaches in this second NUFU period were to (1) develop projects a DHIS (still v1) in different countries, (2) develop a PhD program were the students were the driving forces in the country sub-projects, and (3) develop masters programs on HIS integrating the academic fields of public health and Informatics (see next project). The DHIS v2 project was initiated as part of this NUFU project in 2004. The first implementation in Kerala January 2006.
2000-2006	Norad/Norwegian Medicines Agency (NoMA)	Norad-funded masters programs in health	35,000,000	Academic	This is a large program which was closely linked to the development of the HISP Network and the recruitment of HISP activists in Africa and Asia. The masters program in Sri La actively being used for the DHIS v2 work in that country. The programs in Tanzania and Malawi are very important for the DHIS v2 projects in these two countries.
2007-2011					This program started in 2000 at UEM, Mozambique, and University of Western Cape (UWC), South Africa. At UEM, both a masters in public health and a masters in informatics started. The two masters were integrated in that they had shared modules in health informatics and students from both fields worked together on their research theses. From 2005 a course module in health informatics was conducted at University of Dar es Salaam (UDSM), Tanzania, and in 2007, a full master in health informatics was established. At the sam a similar masters was established at the Addis Ababa University (UAA), Ethiopia, and a health information track was established within an existing masters in public health progr the University of Gondar, Ethiopia. The master programs in Malawi and Sri Lanka were established 2008.
2004-2008	Norwegian Embassy	PhD program at Addis Ababa University, Ethiopia	3,800,000	Academic	This program has funded PhD students, research, and HIS implementation in Ethiopia. In 2006 and 2007, this project was the largest HIS implementation project outside South Af within the HISP Network. Full-scale implementation and training in several regions, 10 people employed, 8 PhD students, and 5 masters students. Large amounts of money were directed toward the HIS field, and the competition increased manifold. In Ethiopia UIO was outmaneuvered by John Snow International (JSI) backed by the Centers for Disease C and Prevention and PEPFAR. JSI was then later outmaneuvered by Tulane. The closure of the project caused problems for the Ethiopian PhD students. Two of these have been im as developers in the DHIS v2 project.
2005-2008	EU Building Europe Africa Sollaborative Network for Applying Information Society Technologies in the Health Care Sector (BEANISH)	Building Europe-Africa Collaborative Networks for IST in Health Care, EU 6th Framework Program	6,500,000	Software Development	The project was coordinated by the University of Oslo and had a lot of partners: and in addition had the following partners: • UWC, South Africa • UAA, Ethiopia • Medical College, Malawi • UEM, Mozambique • UDSM, Tanzania • Ministry of Communications, Science and Technology, Botswana • Lund University, Sweden • The International Federation for Information Processing/World Information Technology Forum • The HISP teams in India and Vietnam were additional partners in the open source software development work package. The project's goals were to develop South-South-North networks for research and development of HIS in Africa and to develop the open source DHIS v2 software application. Cor activities were related to development and application of the DHIS v2, and to development of local capacity of both health workers, software developers and managers.
2005-2007	Danish International Development Agency (DANIDA)	Developing HIS in Zanzibar	1,300,000	Deployment	The project worked with the Ministry of Health in Zanzibar and was a full scale HIS development project. Note: this was basically the use case project were DHIS v1.4 was develo and tested. Zanzibar is now implementing the DHIS v2.
2006-2010	SIU	Integrated Masters in Health Informatics- Tanzania and Ethiopia	11,530,299	Academic	UDSM, Tanzania
2007-2011	Norwegian Research Council GLOBVAC Program	Integrated HIS for vaccination	10,000,000	Research & Development	It took over the development of the DHIS v2. The overall aim of the project is to do research on integration of HIS within the fragmented context of global health, where typically, country level, each disease and health service specific health program, such as for HIV/AIDS and vaccination, is running their own HIS with little coordination and integration acr program's vertical structures. The DHIS v2 "data warehouse approach" is born out of this project. Major part of funding goes to PhD students.
2007-2011	SIU	Masters in medical and health informatics: Asia focus	8,525,000	Academic	University of Colombo
2007-2008	SIU	Health Information Systems Programme finalization*	1,045,000	Academic	UEM, Mozambique
2008-2012	SIU	Improving access and quality in maternal health care in Sub Saharan Africa**	5,560,000	Deployment	University of Malawi
2010-2012	Norwegian Research Council GLOBVAC	Program HIS for vaccination	13,000,000	Development	This project is running a large part of the India-HISP project. The GLOBVAC projects provide the major part of the funding of the HISP Network and DHIS v2 development from the end of the EU-BEANISH project until the start of the dir Norad funding (end of 2009).
2009-2013	Norwegian Research Council VERDIKT Program	Global integrated e-Health Infrastructures	12,400,000	Research and Development	This VERDIKT project aims at doing research on integrated and interoperable eHealth infrastructures and to engage in the development of an integrated DHIS v2 architecture. On is to develop the DHIS v2 into the official World Health Organization country data warehouse and geographical information systems tool. Also here, as for all Research Council funds, the main part of the funds is for PhD students.
2009-2010	Norad	Strengthening health information systems as part of Millennium Development Goals 4 and 5—programs in India, Malawi, and Tanzania	7,000,000	Development	Norad has a collaborative agreement with the Institute for Informatics on HIS and DHIS v2 development. Focus on India, Malawi, and Tanzania.
		Total sum	**129,660,299**	In 2011 $US= 23,270,475	

<u>ANNEX 3—Field Work</u>

Health Information Systems Programme (HISP) Evaluation Field Report—India

Richard Anderson, March 1, 2011

Executive Summary

Health Information Systems Programme- (HISP) India has had remarkable success in establishing the District Health Information System (DHIS) software as a tool for national data reporting in 20 states in India and in supporting the use of health indicators for management decision-making at the state and district level. HISP-India recognizes that there are opportunities to leverage its existing strengths in health information systems by taking a broader role in electronic health projects at the state level and is also aware they are in a competitive and political environment that will require strategic decisions be made. The success of HISP-India can be attributed to a broad approach to health information system that includes both capacity development though extensive training and the deployment of a software system that meets broad needs, as well as a tight integration of HISP-India with national and state government health organizations.

Field Evaluation

This field evaluation is a component of an assessment of HISP that PATH is conducting for the Norwegian Agency for Development Cooperation (Norad). The visit took place January 30 through February 11, 2011, and included visits to the HISP-India headquarters and the National Health Systems Resource Centre (NHSRC) in Delhi along with visits to Punjab, Himanchal Pradesh, and Bihar. Meetings included interviews with government officials and health staff at their facilities. Due to limited time, it was not possible to include a visit to Kerala. This was unfortunate, since Kerala is the most mature DHIS deployment in India and would have provided additional information of the program impact. A list of meetings attended appears at the end of this report.

HISP-India Organization

HISP is a global project to strengthen public health systems by improving the collection and use of health indicators. The project was started in the mid-1990's in South Africa, and has grown to include a significant number of countries in Africa and Asia. The project was founded by researchers from Norway and has continued to get substantial support from Norad. HISP is organized as a group of semi-independent nodes with South Africa and India being the two largest nodes for deployment and Norway retaining an important role in software development and education. HISP-India and HISP-Norway maintain a close collaboration while the South African node has significantly more autonomy.

HISP has developed the DHIS software for collecting and aggregating health statistics. The development and deployment of the system has been central to HISP's activities, although it is critical to recognize that HISP is much more than a software development project. There are two separate versions of the DHIS software, DHIS v1.4, which is a Microsoft Access application, and DHIS v2, which is a client-server, Java application.

HISP-India consists of roughly 30 people, with about 15 based in the Delhi office. Others are based in Chandigarh, Shimla, Patna, and Trivandrum. The activities in the Delhi office center on software development and training. The personnel in the state offices are supporting specific HISP projects.

HISP-India History

The activities of HISP-India can be divided into three phases. Between 1999 and 2007 was a pilot phase of introducing the DHIS software in various states. The efforts started slowly but eventually grew to statewide deployments. The early stage of the deployments were hampered by lack of readiness for computer deployment at the district or block level. HISP-India's major growth phase was 2007−2009, with the deployment of DHIS 2 at the state level in about half of India's states and the recognition of DHIS at the national level as a tool for information reporting. The reason that DHIS was able to achieve such sudden prominence was HISP staff were working very closely with national health information systems and were embedded into the NHSRC. (The National Health Systems Resource Centre is a Technical Support Institution inside of the National Rural Health Mission [NRHM]). The current phase of HISP activities is in extending the deployments of DHIS in various states and integrating with other health information systems.

HISP Accomplishments

Considering the size and complexity of India, HISP-India has been remarkably successful. The scale of the deployment is unmatched by any projects of comparable size or funding working in health information systems. Specific accomplishments of HISP-India include:

- Deployment of DHIS v2 software in roughly 20 states including Bihar, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, and West Bengal. The software is used for the monthly reporting of district health indicators to the national portal. The total population of states deploying DHIS v2 is 680,000,000 (based on 2005 populations).
- Successful integration of the HISP organization with the Indian health system. States view HISP-India as a technical organization inside of the NHSRC (and not as an independent nongovernmental organization).
- HISP lead the effort to develop a small set of indicators to be reported to the national government. A set of 63 indicators was established for national reporting in 2007. All states now report these monthly from the district level to the national health information portal.
- A major component of HISP activities has been training on collection and use of health indicators. These trainings have been conducted at all levels—from the sub-center level up to the national level. Following the introduction of the new indicator sets in 2008, HISP conducted 600 separate trainings.
- The quality of reporting has improved dramatically over the last few years—both in reporting rates and accuracy of the reports. Quality control processes are in place at all levels.
- Through the training of health workers and administrators, the health indicators collected by DHIS are being used to evaluate the performance of the public health system at the district and block level.
- HISP has started integrating DHIS with other eHealth systems. In one notable project, 5,000 mobile phones have been deployed in Punjab for daily and monthly reporting. (This project is by far the largest mobile phone deployment for a health application that this evaluator is familiar with).

HISP-India Strengths

There are aspects of the HISP-India organization that need to be highlighted. The emphasis of HISP is on health information systems, it is not just on software. Although DHIS is an important component of HISP, training on the use of indicators and integration into the broader health system are also very important. In terms of budget, training is a much larger than the software efforts. (In India, the training costs are split between the state and national health systems). HISP has a strong working relationship with the national health system through NRHM and NHSRC, as well as with some of the states. The projects in Punjab, Himanchal Pradesh, and Bihar all involve close collaboration with the state health services and include backing from the state NRHM directors. The presence of the DHIS software at the state level where it is being used to aggregate health indicators from block and district levels positions HISP to be involved in broader eHealth initiaties. For example, in Punjab DHIS now supports data collection from mobile devices. The DHIS v2 software is a client/server solution, and the code is now fairly robust. The working system was an important factor in HISP-India's strong growth in 2008−2009. For some states, the fact that DHIS v2 is open source is an advantage based on official policies favoring open source software.

HISP Challenges

The HISP-India project faces a continual challenge because of the competitive environment that they operate in. HISP provides a very low-cost solution for indicator aggregation through the deployment of open source software and by providing training and support at low rates. However, they face competition from other national organizations that would like to expand their mandates, as well as companies who would like to deploy proprietary eHealth solutions. About 20 of the 38 states are using DHIS, although some might drop DHIS for other systems and DHIS may be adopted by other states. The deployment of national-level (or in India, state-level) health information systems is very political, and changes in personnel or introduction of initiatives can lead to cancellation or adoption of systems. There are different goals in collecting and aggregating health statistics. These complicate the deployment and use of health information systems. For example, HISP focuses on the collection and use of indicators for strengthening the health system (i.e., using the data in order to support management decisions at all levels). However, the national statistics organizations have a goal of collecting accurate numbers at the top level, which leads to different goals in data collection.

These challenges are recognized by HISP, and various strategies are in place to maintain the deployment of DHIS in the states. A continued presence and support in the national organizations is critical. Customizing DHIS for state needs, so that it is not just a national reporting tool, is a way to add value to the state deployment. HISP is also expanding to other eHealth initiatives to leverage deployments of DHIS.

DHIS Software

The core product for HISP is the DHIS software. This is data aggregation software that allows entry of health statistics and export of summary reports. It is mature software with a wide range of modules such as a geographic information system and analytics. The software is designed so that it may be customized by the user to handle arbitrary indicator sets. The DHIS v2 software is a client/server system so that there is a single server with a database back end (mySQL) and the system is accessed from a web browser. The earlier version of the software used Microsoft

Access so that files had to be manually moved between the different sites using DHIS. DHIS 2 is used in approximately 20 states in India for reporting to the national level. The majority of these states are now entering information at the block level, which is then sent to the district, and then to the state and national levels. The reporting process with DHIS generally involves multiple levels of data review.

The client/server architecture is appropriate for this type of system in India. One major advantage of this architecture is that only a single computer installation is needed in each state, since block and district installations just use a web browser for access. HISP has done regular readiness studies for different states to assess infrastructure and has developed a readiness tool. Internet accessibility at the district level is generally adequate, although some states still face challenges in getting internet access to the block level. In Bihar, an estimate is that 70 percent of blocks have internet access (this figure is based on a field visit to the Begusarai district, and is lower than initial estimates from the state level). The internet access in Bihar has improved dramatically in the last year, so it is reasonable to expect that the 70 percent figure will improve significantly. Internet access is often through a broadband modem at 500 rupees (US$11.11) per month. The state of Punjab has close to 100 percent internet access at the block level. Since DHIS relies on a central server, it is necessary that this have sufficient capacity and is highly reliable. The servers in Bihar were at the state office and regularly went down;then should be upgraded, possibly with a hosted solution.

DHIS was introduced with support from NHSRC and maintains strong support from that organization. The role of DHIS is to collect data that is then reported monthly to the national portal. States using DHIS collect data at the block level, then submit to the district, and from the district submit to the national portal and to the state level. In the states visited, there were state and district M&E officers reviewing the submissions. Many data quality checks are in place. States can also use DHIS for their own reporting needs. A wide range of custom templates were developed for use in Bihar, such as reports on a deworming program and on DDT spraying.

Name-based Tracking

A recent initiative by HISP is to introduce name-based tracking (nBits) into DHIS. This is a break from the model of aggregating data—but is supported by the overall architecture. The implementation of name-based tracking is to store records keyed by the individual's identifying data. This allows the implementation of registries such as a vaccine registry or a maternal registry. The implementation of the nBits software is complete, and it is being piloted in two districts, Solon, Himanchal Pradesh and Begusarai, Bihar. Other pilots are in the planning stage, including several districts in Uttar Pradesh. The nBits system supports applications such as reminder systems and generation of work lists, and allows reporting of statistics that require name-based tracking, such as the number of women that complete at least three antenatal care visits.

The real effort in the current pilots is in building the initial registers and in recording the existing information from the registers. HISP wants to have a certain amount of historical data in the system. One reason for focusing on the existing paper registers is to understand data quality and what information is actually recorded. When the system is ready to deploy, data will be entered at the block-level primary health center from the maternal register. Training for data recording by the auxiliary nurse midwives will be included in the process.

In Bihar, there is interest in linking the nBits project to the State Unique ID project. The State Unique ID project is being piloted in the Patna district, and discussions are underway about expanding nBits to the Patna district.

nBits has been in competition with a national system for maintaining registries—the Mother and Child Tracking System (MCTS) under development by the National Informatics Centre. The development of MCTS has been slow, and it is not available in many of the states HISP is working in.

eHealth Projects

HISP has a growing number of eHealth projects underway. The organization has adopted a strategy to expand the range of health information systems projects undertaken. This is a natural strategy in that it can leverage many of the organizations strengths, such as expertise in health information systems and training, and the systems can align with the DHIS software. Having connections at the state level and the installed base for DHIS also helps this effort. In addition to the name-based tracking, projects are ongoing on in mobile phone data reporting and OpenMRS.

The cell phone-based data reporting is a natural extension by allowing data to be submitted over the mobile phone instead of coming to the block office to enter the aggregated data. A five-state pilot was conducted in 2009 for data submission by nurse midwives. Based on this, the state of Punjab commissioned a full statewide deployment with 4,000 midwives. A total of 5,000 mobile phones were distributed and are now being used for regular data submission. (Phones were provided to supervisors, in addition to the midwives, accounting for the extra 1,000 phones.) A common model of Nokia phone was distributed running a Java application for data submission. Results were sent using SMS to a server, and then transferred to DHIS. HISP is confronting the standard set of issues these projects face (software updates, lost phones, cell phone plans) but on a much larger scale than other projects. Other major cell phone projects are in the planning stage.

HISP has started a deployment of OpenMRS in Himanchal Pradesh. This is not as natural a fit as mobile phone data entry with DHIS, but there are strategic reasons for OpenMRS to be adopted by HISP. One reason for deploying OpenMRS is to be able to capture health data from the hospital. This data is not captured by the other reporting schemes. The goal is to have all hospital information recorded in OpenMRS and then automatically exported to DHIS. A second reason for deploying OpenMRS is to build ties between OpenMRS and HISP, as well as capacity on the HISP team to work with OpenMRS.

Input From National Level

One of the key interviews in the assessment was with T. Sundararaman, Executive Director of NHSRC. He gave HISP direct credit for establishing the reduced set of indicators that are now reported by all states. He felt that DHIS was important software to be used in data reporting but did not want all states to be using it; this results in multiple systems being in use. In being open source, DHIS provides an import low-cost solution so that the government does not get locked into high-cost proprietary systems.

The NHSRC runs a national portal which receives the district data from the states—where states either submit from DHIS or from another system. States using DHIS have a mechanism for review of data by the state level before it is submitted from the district. In theory, DHIS could

have been used at the national level—but the choice was made to have a custom system developed for receipt of national data.

Recommendations

HISP India has the opportunity to be a leading force in health information systems in India, but faces a competitive and political environment. The most import step for HISP-India will be to continue efforts to strategically map out a business plan for supporting health information systems while building on the DHIS v2 platforms. Components of this include:

- Developing a business plan that builds on the multiple strengths of HISP-India: delivery of training, connections at state and national levels, placement of the DHIS platform, and expertise in health information systems and eHealth.
- Expand information services in selected states, evaluating the costs and benefits of focusing on particular technologies.
- Align with other eHealth organizations and donors to work cooperatively in states and at the national level.
- Continue to strengthen financial practices.

In addition, there are several additional recommendations for HISP-India coming out of the field evaluation:

- Determine how the Norway India Partnership Initiative (NIPI) and HISP activities can achieve better alignment. NIPI is supporting projects in locations where HISP is active, yet there are very few connections between NIPI and HISP.
- HISP-India should continue to support regional expansion in Sri Lanka and Bangladesh, and possibly other neighboring countries.
- The work of HISP is not as well known as it should be. For example, HISP is involved in on of the largest deployments of mobile phones for health, yet very few people are aware of this. HISP's profile could be improved by expanded publication, evaluation studies of their deployments, and a better web presence.

The DHIS deployment depends on having sufficient server capacity. HISP-India should increase its in house expertise on hardware and network performance in order to be able to supply appropriate advice and troubleshooting support to the states.

Itinerary

Date	City	Interviewed	Where	Subject
31-Jan	Delhi	John Lewis, HISP	HISP office	Overview of HISP activities
1-Feb	Delhi	John Lewis, HISP	HISP office	DHIS Software
	Delhi	Kris Oswalt, CEO DevInfo	DevInfo	Overview of DevInfo
2-Feb	Chandigarh	Neha Joshi, HISP	Taxi from Airport	Punjab mHealth
3-Feb	Chandigarh	Arunima Mukerjee, HISP	Hotel	HISP in Punjab

Date	City	Interviewed	Where	Subject
3-Feb	Chandigarh	Ms. Vanundhara, Punjab State Manager, M&E	NRHM Punjab Office	Reporting process
	Chandigarh	B. Purusharta, Punjab NRHM Mission Director	NRHM Punjab Office	mHealth in Punjab
	Chandigarh	Dr. Sridhar, Civil Surgeon, Mohali District	District Hospital	District perspective on DHIS
	Chandigarh	Dr. Meena, Block SMO, Derra Bassi	District Hospital	Block perspective on DHIS
	Chandigarh	Data Entry Clerk, Dera Bassi	District Hospital	DHIS data entry
	Chandigarh	ANM Meeting	District Hospital	Midwife feedback on phone deployment
	Chandigarh	B. Purusharta, et al.	Resaurant, Chandigarh	Punjab mHealth discussion
	Chandigarh	Satish Chandra, State DHSW, Principal Secretary	State DHSW Office	Technology vision for Punjab
4-Feb	Shimla	HISP Staff	Shimla Office	Overview of Shimla activities
	Shimla	Rakesh Kanwar, Mission Director for HP, NRHM	HP NRHM Office	Health information systems in Shimla
	Shimla	Data Entry Clerk, Ripin Hospital	Ripin Hospital	Data entry for DHIS
	Shimla	Ripin Hospital, OpenMRS Deployment	Ripin Hospital	OpenMRS
	Shimla	HISP Staff	Shimla Office	nBits demo
	Shimla	Arunima Mukerjee, HISP	Shimla Office	HISP background
5-Feb	Shimla	Sundeep Sahay, HISP	Shimla	Introductory meeting
8-Feb	Patna	Arvind Kumar, Data Officer	State Health Society, Patna	HISP in Bihar
	Patna	Sanjay Kumar, Exectuive Directory, State Health Society, Bihar	State Health Society, Patna	HISP in Bihar
	Patna	Santhosh Mathew, Principal Secretary, Rural Development, Bihar	Rural Development Office	Bihar implementation of unique ID
	Patna	Anup Kumar, Smaarftech	Smaarftech Office	unique ID

Date	City	Interviewed	Where	Subject
9-Feb	Patna	Abujeet, Janvid, HISP	Begusarai	nBits work in Bihar
	Patna	Mr. Ranjan, District M&E Officer, Begusarai	Begusarai District Hospital	Data reporting
	Patna	Dr. Akela, Civil Surgeon, Begusarai District	Begusarai District Hospital	Use of DHIS data
	Patna	Data Entry Operator	Barauni PHC	Data entry for DHIS
	Patna	CommCare Intern	Barauni PHC	CommCare Pilot with CARE
	Patna	Ajit Shingh (Bihar NRHM), Shamik Trehan (CARE), Sundeep Sahay (HISP)	Restaurant, Patna	HMIS in Bihar
10-Feb	Patna	Smaarftech	Smaarftech Office	Unique ID
	Patna	Sanjay Kumar, ED, Bihar Health Society	State Health Society	Visit summary
	Patna	Abirjeet, HISP	Restaurant, Patna	HISP
11-Feb	Delhi	Inger Sangnes, Dr. Ashfaq Bhat	Norwegian Embassy	HISP overview
	Delhi	John Lewis, Sundeep Sahay, HISP	HISP Office, Delhi	Summary of HISP activities

HISP Evaluation Field Report—Eastern Africa (Kenya, Tanzania, and Zanzibar)

Executive Summary

In 2003, District Health Information Systems (DHIS) was introduced in two districts of Tanzania as a pilot by the University of Dar es Salaam (UDSM) Department of Computer Science. Over the years additional partners have adopted DHIS v2 and deployed it into 50 of 100 districts. However, DHIS deployment is still considered to be a pilot by the authors despite Ministry of Health and Social Welfare (MOHSW) endorsing it as the software of choice for health management information systems (HMIS). Data and reports from DHIS are not widely used for decision-making, and data submission to regional and national levels is still a manual, paper-based system.

The University of Oslo (UIO) has had a permanent presence in Tanzania since 2009 in order to provide support to UDSM and strengthen it to take on a Masters of Science (MSc) Health Informatics program. UIO also provides financial support to UDSM and participates in joint MSc and PhD research. UIO also supports UDSM in the development of DHIS.

The basic requirements for health information systems in Tanzania are the timely availability of accurate data, simple data extraction, and report generation at all levels of the health system. Deployments of DHIS have yet to achieve report generation at all levels of the health system. However, the DHIS software has the potential of fulfilling all these requirements if the system is fully implemented.

Adoption of DHIS in Tanzania has been extremely slow; this is a result of lack of coordination among implementing partners, the lack of qualified workers in the districts to maintain and provide technical support, and the lack of harmonization of HMIS tools. There is a large number of partners that are funding health information systems work in Tanzania including Centers for Disease Control and Prevention (CDC), the Netherlands Embassy, Japan International Cooperative Agency (JICA), Ifakara Health Institute (IHI), the Global Fund, the Clinton Health Access Initiative (CHAI), and Norad. There is a need to harmonize HMIS systems and to increase coordination among implementing partners. To address this problem we recommend that MOHSW take on the leadership and coordination role in the adaption of DHIS in Tanzania. This will improve synergy and aid in a more effective use of funds.

Additionally, DHIS has yet to be used to its full potential, districts are only using DHIS as a data entry system and not taking advantage of the analytical capability that exists in DHIS. Even with this sole focus on data entry, the lack of a central server at the MOHSW means districts have to submit their HMIS reports using paper, moderating the efficiencies gained by using an electronic health information system.

Tanzania—Overview and Achievements

In 2003, UDSM's Computer Science Department requested permission from MOHSW to pilot the system in some of the districts. MOHSW gave an authorization to the UDSM to conduct a pilot program in the Kibaha and Bagamoyo districts in the Pwani region. In this pilot DHIS v1.4 was deployed and tested for one year. At the conclusion of the pilot program, MOHSW was not convinced that they should adopt DHIS as a system to use for HMIS reporting, and there was no plan to deploy a different system in its place.

In 2007, the Norwegian government as a part of the Norway Tanzania Partnership Initiative, supported an initiative aimed to improve maternal, newborn, and child health in Tanzania. The two components of this initiative were pay for performance funding schemes and strengthening of the HMIS system. The Norwegian government made a decision to use DHIS and to channel their HMIS funding through UIO. It was not clear from our interviews if the MOHSW provided input into the decision regarding funding or use of DHIS.

As a means of implementing the initiative, a consortium was formed with members from MOHSW, UDSM, Muhimbili University of Health and Allied Sciences, IHI, and UIO. A memorandum of understanding was signed between UDSM and MOHSW on behalf of consortium members in 2007. The consortium then drafted a project document that was to be presented to the Norwegian government and partners. The project document went through a number of reviews for two years without any agreement among stakeholders. One of the major reasons for disagreement was the suggestion that funding be channeled through IHI—an arrangement that MOHSW was not in agreement with. Additionally, the project failed to achieve traction due to the lack of leadership and technical ability at the MOHSW to lead a project of such magnitude. This project and consortium eventually became part of the Monitoring and Evaluation Strengthening Initiative (MESI) proposal.

A continuation of the consortium's project document resulted in the MESI proposal. MESI, launched in October 2010, is mainly the same consortium of funding and implementing partners, and is now lead by the MOHSW with funding also channeled through the MOHSW. This initiative has made impressive strides in harmonizing a new set of 43 national-level indicators.

In 2008, JICA decided to adopt DHIS v2 in the districts of the Pwani region and contracted UDSM to provide technical support to implement it. JICA's main focus was on sexually transmitted infections and voluntary counseling and testing (STI/VCT). In 2009, the Norwegian Embassy, through UIO, provided additional funding to UDSM in order to expand DHIS to include data from other programs and routine HMIS in the Pwani region. This funding was used by UDSM to customize DHIS v2, analyze new requirements, develop training materials, and provide supportive supervision to the Pwani region.

Also in 2009, UDSM provided technical support to CHAI to implement DHIS v2 in the Mtwara and Lindi regions. Technical support included the customization of DHIS v2 and development of the capacity of CHAI staff in their head office in Dar es Salaam. In June 2010, IHI also decided to adopt DHIS v2 and deployed it in 27 districts across Tanzania with funding from CDC. They also contracted UDSM to do the customization of DHIS v2, to develop capacity of its national team, and to help train teams at all of the district sites. IHI included in the DHIS deployment routine HMIS- and program-specific reports including reproductive and child health, HIV, malaria, and immunization.See Figure 1 for an illustration of the DHIS development timeline for 2007 to 2011.
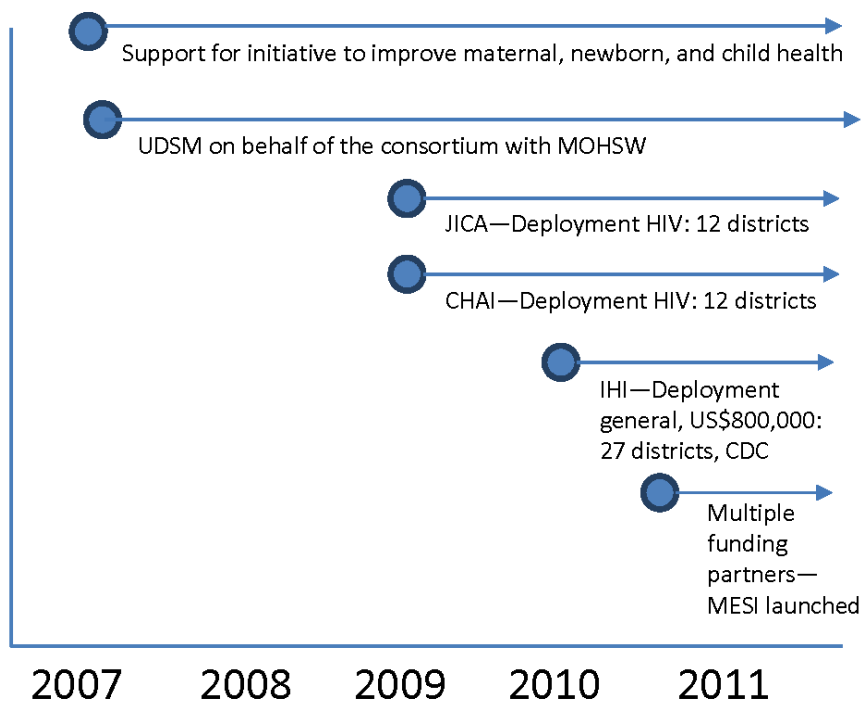
Figure 1. Development timeline.

All partners chose DHIS v2 because UDSM had already piloted the system in the country, proof of concept had been achieved, and local technical support was in place. Additionally, no competition with DHIS v2 existed nor any alternative feasible solutions known.

HISP's project office is funded by UIO and is hosted by UDSM. The team consists of four software developers and a project leader employed by UDSM which provide technical support to implementing partners, training to end users, and also helps to customize DHIS to fulfill country-specific requirements without making changes to the core DHIS. The HISP strategy in Tanzania is to build capacity at the national level and participate in the implementation of MESI. MESI's consortium involves MOHSW leadership, ownership, and sustainability with technical and financial support from funding and implementing partners. As a part of the consortium, HISP role will be to provide technical support to the test districts. To achieve this, HISP-Tanzania staff will provide training to implementing partners at national level who will in turn provide direct technical support to their districts. Lack of financial and human resources to provide support to all implementing districts is the main reason for the adoption of this strategy. HISP-Tanzania are members of the monitoring and evaluation (M&E) working group of MOHSW but do not have anyone embedded in the ministry; as a result, the only connection they have with the MOHSW is through meetings and consultation as members of M&E working group.

The Role of the University of Oslo

UIO has had a presence in Tanzania since 2009, with the aim of supporting UDSM in capacity development of national teams, strengthening UDSM to take on the MSc Health Informatics course, and doing joint research with UDSM at the MSc and PhD levels. The main funding sources for UIO are from Norad, the Norwegian government, and the Norwegian embassy.

UIO could increase its contribution to the support of the HMIS strengthening initiative in Tanzania by taking a leading role to assist the Tanzanian MOHSW in strengthening the HMIS system in addition to concentrating on the deployment of DHIS and running the MSc course. This can be achieved by acting as a bridge between MOHSW (whose main interest is improving HMIS) and UDSM (who have developed expertise in the implementation of DHIS).

Relevance

JICA and CHAI deployed DHIS in order to improve the reporting of specific indicators that they were interested in. CHAI's main interest was in HIV data and JICA wanted STI/VCT data. When the system was taken to the districts, the district health teams requested that routine HMIS be included in the system. This change was made and the DHIS, which included routine HMIS and program data, was deployed to the districts. CHAI and JICA asked the DHIS team to customize DHIS in order to include the requested data sources. In contrast, IHI was interested in routine HMIS from the beginning, so all indicators were included when the system was initially deployed. All system customization was done at the national level with the implementing partner; no local customization was done in the districts.

The use of DHIS in Tanzania is still considered to be in a pilot phase as it is only deployed in 50 of 150 districts. It is too early to say whether the implementation is a success or not, but the potential for success is there, and a plan for nationwide rollout was submitted to the MOHSW senior management for approval in October 2010. Some of the districts, Mtwara rural, Kibaha, and Ruangwa, said that they use data and reports from DHIS for planning purposes. This information is used, for example, to identify areas of interventions that the district needs to concentrate on in the coming year. However, there was no proof of printouts that came out of DHIS that have been used for this purpose. IHI districts are yet to produce any reports from DHIS, and the reason that was given was lack of population data used to generate reports (denominators). Once the denominators are available they will start generating reports for decision-making.

Districts with DHIS deployments are optimistic about the potential of DHIS to improve HMIS at all levels of the health system. The HMIS system is still facing a challenge, as the data being collected is considered to be inaccurate and incomplete. There is no harmonization of the HMIS system in Tanzania as programs are collecting their own data. This results in the collection of duplicate information by different programs and becomes an added burden to data collectors. When asked how they think DHIS can help, the following responses were given:

- DHIS enables the district to have faster access to data that is more accurate. In this way the district is able to make informed decisions and make those decisions more quickly.
- DHIS simplifies data availability and report generation. It also increases data accuracy by reducing human errors which may be caused by manual data collection.

The basic requirements for health information systems in Tanzania are the timely availability of accurate data, the simplification of data extraction, and report generation at all levels of the health system. Currently, DHIS fulfills some of these requirements, and it has the potential of fulfilling all these requirements if the system could be made fully functional.

Effectiveness

The discussion for country deployment was initiated by UDSM when they requested permission from MOHSW to pilot DHIS. After the permission was granted, UDSM started the process by doing a situational analysis in order to identify the available human resources and infrastructure that exist in the districts. The situational analysis was not done to identify the needs to be addressed or requirements for DHIS, instead it was to get an idea of the resources that would be required for successful implementation of DHIS in the district.

The HISP team has contributed to some extent to the HMIS strengthening efforts in Tanzania. They participated in the development of indicators for HMIS reporting, data flow guidelines, development, and writing of MESI, and they are now involved in the design and development of the data warehouse for the MOHSW. HISP has also contributed in the development of local capacity and the development and implementation of the MSc Health Informatics course at UDSM.

DHIS is not yet used to its full potential. Most districts are only using DHIS as a data entry system and not taking advantage of the analytical capability that exists in DHIS. Also, due to lack of a central server at MOHSW, districts still send HMIS data using the paper.

Sustainability

Adoption of DHIS in Tanzania has been slow covering only 50 of 150 districts; as a result, deployment is still considered by the authors to be a pilot despite the MOHSW endorsing it as the software of choice for HMIS. Data and reports from DHIS are not widely used for decision-making, and data submission to regional and national levels is still a manual, paper-based system. In addition though not conclusive, the publicly listed "Basic Health Indicators" on the MOHSW website which should be feed by DHIS reported information include 27 indicators—none updated more recently than 1998—with critical Millennium Development Goals 4 and 5 maternal and newborn health indicators such as health personnel at birth updated in 1985. The slow adoption stems from several factors: a lack of strong national leadership by the MOHSW resulting in poor coordination among implementing partners, lack of qualified workers in health districts to provide technical support for the system, existence of the Health Management Information System of Tanzania (MTUHA)—an older nonstandardized HMIS tool that is no longer relevant in the current environment, and lack of harmonization of reporting tools from different programs. Activities are already in process to accelerate DHIS adoption with the development of a nationally unified and harmonized indicator set as a part of MESI. Critical to its success will be strong leadership and internalization by the MOHSW to guide coordination among implementing and funding partners and guarantee long-term sustainability. In addition to Norad funding, there are a number of partners that are also funding HIS work in Tanzania (e.g., CDC, the Netherlands Embassy, the Norwegian Embassy, JICA, and the Global Fund). For this funding to work synergistically, there is a need for MOHSW to take a leading role so that these funds are used effectively in HMIS strengthening.

There is a need to have someone who will dedicate time to do data entry of HMIS forms in the district in order to operate the DHIS system effectively. At present, implementing partners have hired a dedicated data entry person in each district whose main role is to enter HMIS data. The districts and MOHSW have shown interest in absorbing them into their budgets once implementing partner funding runs out. These data entry workers together with an HMIS focal person in the district are then trained at the national level on how to use the system before they are sent to the districts. UDSM has hired a number of developers and trainers who can perform local customization of DHIS and provide training to technical support teams. Most of the developers and trainers are the product of the MSc Health Informatics course run by UDSM.

Tanzania has decided to deploy DHIS in an offline mode, which means each district has its own locally installed DHIS system and database. The DHIS team recommends that the DHIS application and database servers run on a Linux environment. This means each districts needs to have at least two computers, one to act as a local server and another as a client, a requirement that only IHI was able to fulfill. This type of deployment is expensive and will prove to be a large challenge when it comes to maintenance and support of the equipment. Zanzibar and Kenya adopted an online mode where there is one central server that all districts connect to in order to enter their information. The biggest challenge of this mode is connectivity and the availability of reliable power at the central level. The advantage of this mode is easier maintenance; changes and updates are done in one place negating the need to travel around the country and update district systems.

Zanzibar—Overview and Achievements

In 2004, the Danish International Development Agency (DANIDA) supported the setup of Zanzibar's MOHSW HMIS. In 2005, after harmonizing forms, achieving acceptance from all stakeholders, and agreeing to conduct annual indicator reviews, DHIS v1.4 was set up. This system was deployed to all six districts in Zanzibar and included all domains and routine HMIS.

In order to make sure there is local technical support, DANIDA developed capacity at the MOHSW and encouraged the use of local consultants. To develop capacity at the MOHSW they hired people with computing backgrounds and placed them at the MOHSW. Along with the technical support from HISP Norway and UIO, these people are the driving force of HMIS strengthening and DHIS deployment in Zanzibar.

Zanzibar has started the deployment of DHIS v2; the rollout is planned to take place in 2011 after running in parallel with DHIS v1.4 for three months. The MOHSW decided to adopt the online mode of the system. The central server will be located at the MOHSW and all districts and district hospitals will enter data directly to the central server. For this to be successful, they have to improve their network infrastructure; this requires connecting their district offices, district hospitals, and health centers to the Internet. They are also installing backup power supply at the MOHSW and reliable Internet service.

One issue faced with the deployment of an HMIS system was that a culture of data use did not exist at all levels of the health system. To address this issue, data use training packages were created, and the first training was completed in June 2010. The second phase of this training was approved in December 2010. DANIDA is planning to build data management expertise at all levels so that health facilities and districts are able to manage their own data and to analyze and translate their own information.

Observation: Zanzibar deployed DHIS after they established a strong and harmonized HMIS system. MOHSW is also taking a leadership role in the deployment of DHIS and making sure the HMIS system is updated annually with participation of all programs and partners. This has increased usability and ownership.

Kenya—Overview and Achievements

In October 2010, following a demonstration by HISP Norway of DHIS v2 in Nairobi, a decision by the Kenya MOHSW was made to make DHIS their HMIS system of choice. This required significant customization of the DHIS from version v2.0.4 to v2.0.6 in order to accommodate Kenyan requirements. The Kenyan MOHSW is piloting DHIS v2 in 13 districts. Another 10 districts, using their own resources, decided to also use DHIS in their districts. African regional HISP nodes do not have a presence in Kenya so support is provided by HISP Norway.

HMIS strengthening in Kenya started in 2005 when MOHSW started the process of integration of tools and indicators. During this process they reduced the number of registers from 45 to 11 and integrated and harmonized summary tools. This process was finalized in 2008 after consultations and agreement among all partners.

In 2009, the Kenyan MOHSW deployed an Excel-based system that allowed all districts to submit data to the central level using Excel through FTP. This simple system enabled Kenya's HMIS to generate the annual health-sector report within one year, an improvement over the previous two-year time frame. In the same year they performed an assessment of all software applications used in the health sector in order to identify a system to deploy for their HMIS and wrote a health information system strategic plan and policy. The implementation plan was completed in early 2010.

HMIS strengthening and DHIS requirements specification and deployment are led by the MOHSW HMIS unit in Kenya. They specify the requirements and send these requirements to the DHIS team in Norway who implement these changes and return them to Kenya for testing. Kenya decided to have a central server where all district clinics or hospitals with Internet access can log in, enter their own data, and generate reports. The MOHSW made sure that all districts are connected to the Internet and have a backup connection —a general packet radio service modem they can use if their main connection is not running. This facilitates the system deployment as no installation on district machines is required, and training can be provided remotely—reducing deployment cost and time.

Observations: HMIS strengthening and DHIS deployment is driven and lead by the Kenyan MOHSW HMIS unit. This unit has provided additional requirements for DHIS, including requirements for role-based access, user management, and inclusion of a community health worker level. Currently, the lowest level supported by DHIS v2 is the clinic; in Kenya the lowest level is community health worker which is situated below the clinic. The HISP team in Norway is currently working on implementing these requirements. The HMIS unit is responsible for providing support to the records information officers who are responsible for HMIS at the district level; to do this they are trained to perform simple troubleshooting. The ownership and availability of technical support create an avenue for DHIS deployment in Kenya to be sustainable.

Deployment of DHIS followed the strengthening of the Kenyan paper-based HMIS. Kenyan stakeholders began with the most critical piece—harmonizing indicators and tools. As a result, these tools and indicators can be used by all stakeholders to collect routine health information, and programs can use what is collected through the HMIS instead of their own forms. In this case DHIS was deployed to support a strong and harmonized HMIS and make it more efficient.

Conclusions

DHIS is a robust, flexible tool that has demonstrated its effectiveness at scale in a number of deployments. The success of DHIS primarily depends upon a good HMIS system, a strong, authoritative HMIS team at the MOHSW, and rationalization of the HMIS system prior to digitalization with DHIS. In this role the MOHSW should be able to stipulate requirements and provide guidance and direction to implementing partners as was demonstrated in Kenya. By doing so, the product is internalized and the country takes ownership.

Recommendations

- The focus for strengthening HMIS systems should go beyond the deployment of DHIS. The use of DHIS is critical, but the first step is to concentrate on the overhaul of the HMIS system and involve all partners. HISP should assist in the systematic review of HMIS by involving all stakeholders in Tanzania instead of just concentrating on the deployment of DHIS. This approach was used in Zanzibar. Zanzibar's MOHSW successfully deployed the DHIS system, and it is used as the main source for reports at all levels of the health system.
- HISP should help in strengthening the HMIS unit at the MOHSW. This could be achieved by basing a technical assistant at the ministry to provide technical assistance and identify and develop a team that will participate in the revamping of HMIS and eventually sustain the system. This team can be composed of people from within the MOHSW or recruited from outside.
- With MESI still in the planning stages, HISP should take advantage of this opportunity by taking on a leadership role in the development of the final MESI proposal and its implementation.
- A local HISP team does not guarantee the success of DHIS, as demonstrated in Kenya and Zanzibar. In both countries the requirements were specified by the MOHSW HMIS team, and the HISP team in Norway was contracted to customize the system based on the specified requirements.
- MOHSW should avoid the mistake of implementing DHIS without first revamping the HMIS tools. In harmonizing the tools and indicators, duplication and redundancy is reduced. Introducing a computer system to integrate into the existing HMIS environment will not yield the expected improved results. The process should involve mapping and harmonizing national indicators; get it right on paper, then perfect and improve the efficiency of the system by digitalizing it.

Itinerary

Date	City	Interviewed	Where	Title
24-Jan	Mtwara	Mohamed Mang'una	District Medical Office	DMO
	Mtwara	Nassor Salim	District Medical Office	DHIIS Focal Person
25-Jan	Ruangwa	Dr. Malekano	DHIS Office	Ag. District Medical
	Ruangwa	Richard	DHIS Office	DHIS Data Enry Clerk
27-Jan	Arusha	Japhet Mkilya	DHIS Office	DHIS Focal Person
	Arusha	Mary Malya	DHIS Office	District HMIS Focal Person
	Dar es Salaam	Jackline Patric	CHAI	DHIS M&E Officer
	Dar es Salaam	Tuzie Edwin	CHAI	DHIS Coordinator
	Dar es Salaam	Dr. Ipuge	CHAI	Director
2-Feb 3-Feb	Kondoa Dar es Salaam	Makunga Mgetta Faustine Rwegobora	DHIS Office IHI Office	DHIS Focal Person DHIS Coordinator IHI
	Dar es Salaam	Advocatus Kakorozya	IHI Office	DHIS Technical Support Officer
4-Feb	Dar es Salaam	Honest Kimaro	HISP Project Office	HISP Tanzania Coordinator
	Dar es Salaam	Arthur Heywood	HISP Project Office	UIO
	Dar es Salaam	Bou Peters	DANIDA Office	Senior Health Advisor—MOHSW
	Dar es Salaam	Nobiro Kadol	JICA Offices	Chief Advisor NACP/JICA DHIS Phase 2
	Dar es Salaam	Nishimura	JICA Offices	DHIS Focal Person JICA
10-Feb	Zanzibar	Seleman Ally	Conference Room	Deputy Head HMIS Unit MOHSW
	Zanzibar	Arhur Heywood	Conference Room	UIO
11-Feb	Nairobi	Samuel Cheburet	HMIS Office MOHSW	Health Records and Information Officer (MOH)
	Nairobi	Jeremiah Mumo	HMIS Office MOHSW	Health Records and Information Officer (MOH)

Date	City	Interviewed	Where	Title
11-Feb	Nairobi	Gladys Echesa	HMIS Office MoHSW	Health Records and Information Officer (MOH)
	Machakos	Jecinta Mbindio	Machakos District Office	Distrit Health Records and Information Officer (Machakos District)
16-Feb	Dar es Salaam	Rik Peeperkorn	Netherands Embassy	First Secretary of Health- Netherlands Embassy Tanzania
18-Feb	Dar es Salaam	Claud Kumalija	HMIS Office MOHSW	Head HMIS Unit MOHSW
9-March	Dar es Salaam	Hanne Tilrem	Royal Norwegian Embassy	First Secretary

Norwegian Agency for Development Cooperation (Norad)

Global Health and AIDS Department

Tender Document
Open Competitive Tendering

Procurement of Consultancy Services
"Review of the Health Information System Program (HISP)"

Our ref: 1001245 (P360)

Tender Document	This document serves as an open invitation-for-tender to firms that are interested in providing consultancy services for the assignment outlined in this document. This document consists of the following contents:
	
	Part 1. Tender specification
	Part 2. Terms of Reference (TOR)
	Part 3. Annexes
	    1 Specifications for preparing the technical proposal
	    2 Specifications for preparing the tender
	    3 Guidelines for reports and field-work
	    4. Standard Contract

Our references	Reference number: 1001245 (P360) DOFFIN (Database for public procurements) dated 15.10.2010 TED (Tenders Electronic Daily) dated15.10.2010
Your reference	
Assignment	**Review of the Health Information System Programme (HISP)**
Client	Norwegian Agency for Development Cooperation (Norad), Ruseløkkvn. 26, P.O.B. 8034 Dep, N-0030 Oslo, Norway
Contact point	Global Health and AIDS Department Email: post-AHHA@norad.no Fax: +47 22 24 20 31
Attn:	Senior Adviser Lene Jeanette Lothe

Part 1: Tender Specification

1. Short description of the assignment

The purpose of the review is to independently document and assess the achievements of the Health Information System Programme (HISP). The evaluation shall be conducted as a combination of a desk review and field work in two countries (India and Tanzania). The evaluation shall result in recommendations for how to structure future support for HISP from Norad and potentially other donors.

2. Administrative Conditions

Procurement procedure

The procurement will be carried out as an open competitive tender in accordance with Part 1 and Part II of the regulations of 7 April 2006 No 402 relating to public procurement. This process does not allow negotiations between the parties and the providers must therefore present their final tender within the deadline. The estimated value of the assignment is less

than NOK 1 000 000,-, and Norad is therefore not obliged to publish the competition in TED. We have nevertheless chosen to publish the competition in TED, in addition to DOFFIN, to reach as many candidates as possible.

Deadlines and time schedule
The time-schedule for the assignment outlined in this tender is as follows.

Activity	Deadlines
Announcement of the tender	Friday 15.10.10
Deadline for clarifications related to the tender documents	Friday 29.10.10, 12:99
Deadline for submission of tenders	Monday 15.11.10, 12:00 hrs (Norwegian time)
Validity of the tender	3 months from the deadline of submission
Opening of the tender	Monday 15.11.10, 12:00 hrs. (Norwegian time)
Notification of the award decision	Tuesday 23.11.10
Signing of contract	Tuesday 07.12.10
Inception report	Monday 20.12.10
Draft final report	Monday 28.02.11
Final report	Friday 18.03.11
Publication, distribution, presentation seminar	Tuesday 22.03.11

Clarifications of the tender document
All enquiries regarding this tender document shall be addressed in writing to Norad, attn: the Health and AIDS department, by email: post-AHHA@norad.no. Enquiries should refer to: "**Review of the Health Information System Programme (HISP**)" All enquiries will be answered and distributed anonymised to all the firms who have requested the tender documents. Any corrections, supplements or changes to the tender document will be sent by email to all firms who have requested the tender document.

Tender submission
Tenders should be in the physical possession of the client by the deadline mentioned in the time-schedule. Submission of tenders by e-mail or fax is not allowed.

Tender shall be produced in English and structured according to the format given in Part 3, *Annex 2 Specifications for preparing the tender* of this document. Missing information in the tender or material non-conformity with the specified structure may result in rejection of the tender.

The tender shall be submitted in *duplicate*. Original tender and the copy shall be bound in separate ring binders. Individual sheets inside the binders shall not be stapled. Each binder shall be marked with the tenderer's name and binder number. The binders shall be packed in suitable wrapping marked "Tender: **Review of the Health Information System Programme (HISP)" DO NOT OPEN".**

Public access to information

Following the selection of the successful tenderer, the tenders and the tender logbook will, upon request, be made accessible to the public, ref. the public Information Act of 19 May 2006 No 16.

If the tenderer wishes that business information of a sensitive nature be exempt from public disclosure, the tenderer *shall submit an additional copy* of the tender in which such information is blacked out for public disclosure. The client reserves the right to take the final decision concerning public disclosure of the tender.

The tender can be submitted by post or delivered by courier to Norwegian Agency for Development Cooperation (Norad) Attn: Global Health and AIDS Department	
Postal address: P.O. Box 8034 Dep, N-0030 Oslo, Norway	Delivery address: Norad's reception desk (6th floor), Ruseløkkveien 26, 0251 Oslo, Norway

Norad does not accept tenders submitted through e-mail or fax.

Opening of the tender
Tenders will be opened in Norad's offices by at least two representatives of the client. Norad reserves the right to reject tenders that are overdue or deficient. Tenders will not be returned by the client.

Possibility for several legal entities to submit a joint tender
Firms may associate to enhance their qualifications. In such cases, there shall be one main contractor for the assignment. The main contractor may make use of sub-contractors for completion of a part of the assignment. The main contractor, however, will remain liable to Norad with reference to the whole contract. The main contractor shall submit a *letter of association* signed by the sub-contractor, confirming the commitment of the sub-contractor to the assignment.

Commercial terms
The conditions specified in this document including the annexes shall apply for this assignment. The participation costs incurred by tenderers in connection with the preparation and delivery of the tender will not be reimbursed by Norad.

Conflict of interest
Neither the tenderer, nor any of the members of the evaluation team, shall have any existing or potential conflict of interest during the course of undertaking the tendered assignment. By conflict of interest is meant, in particular, that neither the tenderer nor any individual member of the evaluation team has been involved in the planning or implementation of any parts of the object under evaluation, nor has, or has had any financial or similar interest in the object of the evaluation which can affect the outcome of the evaluation.

Any conflict of interest which may potentially harm the independence of the evaluation shall be explicitly disclosed by the tenderer, providing detailed information on the character and scope of association with either object of evaluation, or persons involved in the intervention. In such cases the tenderer must also elaborate on how this conflict of interest would be handled by the tenderer.

Based on the information provided by the tenderer, the Evaluation Department will make the final decision regarding the tenderer's conflict of interest.

3. Qualification requirements
Tenderers shall submit the following documents along with their tenders:

Technical competence
   i.   CVs not exceeding 5 pages of the team leader and of members of the evaluation team.
   ii.   A list of the most important evaluation services performed/deliveries made by the tenderer, during the last three years, specifying dates/duration, value, and the clients.
   iii. Contact details for three references from clients with previous contracting experience with the tenderer or the team leader. Contracts should have been allocated through a competitive process for the relevant assignments.

Quality assurance system - CVs not exceeding 5 pages of the quality control personnel

Legal documentation
   i.   A company registration certificate. (From "Brønnøysundregisteret" for Norwegian firms)
   ii.   A self-declaration stating that the tenderer meets the statutory requirements in the field of health, safety and the environment (HSE declaration).

Tax documentation
Tax certificate/certificates in accordance with the legislation of the country in which the tenderer has its head office. The documents should show, that the tenderer is
   i.   Registered for declaration and payment of value added tax or a similar sales tax.
   ii.   Free from debts regarding taxes and social security contributions.

Norwegian tenderers shall enclose <u>two</u> tax certificates (form RF-1244 from the Directorate of Taxes); one issued by the local tax collection office (*kemnerkontoret*) **and** the other issued by the collector of taxes in the county (*fylkets skattefogdkontor*) in which the tenderer has its head office.

Financial documentation
   i.   A declaration stating the tenderer's total turnover in the last three financial years.
   ii.   Solvency assessment supporting creditworthiness of the tenderer, or credit rating by a registered financial institution. Acceptance of the documentation is at the discretion of Norad.

In case several legal entities submit a joint tender, legal, tax and financial documentation shall be submitted for the main contractor for the assignment.

4. Requirements

The evaluation team shall have experience in assessing and/or supporting health information systems in developing countries, and undertaking multi-disciplinary evaluations.

The evaluation shall be conducted as a combination of a desk review and field work in two countries (India and Tanzania). The evaluation shall result in recommendations for how to structure future support for HISP from Norad and potentially other donors. The final report should be submitted by the 18.03.11

5. Award criteria

The contract will be awarded to the economically most favourable tender assessed on the basis of following criteria:

	CRITERIA	POINTS
1	COMPETENCE Assessment shall be based on Team Leader's and Team members academic qualifications, and knowledge and experience with: o Health Information Systems o Development Cooperation o Evaluation principles, methods and standards in general Included herein is an assessment of Team composition in meeting following requirements o Academic qualifications in health sciences, computer sciences, statistical analysis or management sciences o Experience in the area of Health Information Systems in developing countries. Experience from India, Malawi and/or Tanzania is considered an advantage Tendering firm shall be credited for its experience during last three years with o Undertaking multi-disciplinary evaluations o Reviews and evaluations contracted through a competitive process The proposed team must cover following language skills: o Team leader and team collectively: ▪ English – Written, reading and spoken	30
2	APPROACH AND METHODOLOGY Assessment shall be based on the tenderers's: o Understanding of the purpose, role and subject matter of the assignment o Proposed design for the study, methodological choices, strategy with respect to concretisation of the issues, and as far as possible indicators and data sources to be used to answer the main questions posed in this assignment. Proposals shall be credited for well founded comments or alternative suggestions where relevant to methodological specifications, issues and questions outlined in the ToR.	30

3	PRICE Tenderer's Score = (Lowest offer / Tenderer's offer) * (max. points for price criterion)	30
4	QUALITY ASSURANCE Assessment shall be based on the tenderers's QA system and competence and experience of the proposed QA personnel.	5
5	AVAILABILITY Tenders offering delivery within the time schedule specified in the tender receive full score on this criterion.	5

The criteria will be applied to assess the information provided by the tenderer in the technical proposal outlined in the tender**.**

6. Technical Proposal

The Terms of Reference (ToR) in Part 2 of this document specify the details of this assignment. The tenderer is expected to elaborate a technical proposal on the basis of the information in the ToR. Technical proposals shall be prepared in accordance with the format given in *Part 3, Annex 1 Specifications for preparing technical proposal*.

Terms of Reference for Review of the Health Information System Programme (HISP)

Background

The achievement of the health related MDGs will depend upon the effectiveness and efficiency of health systems. The Health information system (HIS) remains the backbone for providing information to track progress for improving the different health system components and monitoring the MDG goals. On the ground, however, HIS development in developing countries has proved to be difficult due to organizational complexity, fragmented and uncoordinated organizational structures all maintaining their own HIS, unrealistic ambitions, and issues related to maintenance and sustainability. Poor availability and quality of data and a following poor knowledge and "culture" of use of information for planning and decision-making characterize HIS in many countries.

The Health Information Systems Programme (HISP) is a South-South-North network focusing on information systems and open source software for public health care. HISP aims to improve health care in developing countries through the combination of research on and implementation of Health Information Systems. Initiated by and coordinated from the Global Infrastructures Research Group at Intitute of Informatics, University of Oslo, the network has since 1994 been involved in many countries in the "Global South".

Starting in South Africa as a project to reform the public health information system HISP has later extended activities from a pilot project in three Cape Town health districts to a global South-South-North network active in around 15 countries/states with over 200 million people in Africa and Asia. Common for all of them is the interplay between technology and local institutional and social factors. The goal is to work towards improved information use to tackle public health challenges, through enabling local managers to use reliable and good quality data. This will help them make informed decisions that will save resources and improve health services

The primary focus for HISP is developing and implementing integrated District Health Management Information Systems (DHIS) for routine data, semi-permanent data, and survey data. The DHIS has been customized to requirements in many countries and the user interface has been translated into many languages and alphabets; for example Indian languages and scripts/alphabets such as Malayalam, Telugu and Hindi, Portuguese, Spanish, Russian, Mongolian, Vietnamese and French. The Information, Communication and Technology (ICT) solutions, materials, and experiences developed by HISP are shared based on "free and open source Software" principles. Around 70% of overall HISP effort goes into training, with an estimated 7-8,000 health workers and managers trained in South Africa alone.

With financial support from Norad, the University of Oslo (UIO) initiated its collaboration in the HISP project in 1995 and contributed to the development of the District Health

Information Systems and software application (DHIS v1[1]) in South Africa and the creation of HISP training programmes at the University of Western Cape. During the 1990s, several research projects and training programmes were carried out with this objective. As a result of this cooperative effort between the health authorities and academia, the first Master programmes were born in South Africa and Mozambique in 2001, under the auspices of the former Norad Fellowship Programme. These programmes are still running. In 2005 the project was extended to Tanzania, where the UIO started up with a course at Master level. Today there is an independent Master programme in Tanzania. The goal is that the new Master programmes will be a contribution to the further expansion of the HISP approach to using communication and information technology to support health structures.

Over the last years HISP has been receiving grants from several institutions, including

1) Direct project support from Norad's Health and Aids department to strengthen HMIS in three countries where Norway is supporting programs to reduce maternal and child mortality (India, Tanzania and Malawi) (2009-2010)
2) NOMA[2] and NUFU[3] grants from Norad's program support for higher education (1995-2008)
3) Grants from the Research Council of Norway (GLOBVAC and VERDIKT 2006-2012)
4) European Union (Beanish) (2005-2007)

The various funding streams and reporting channels (ref above) have impeded a holistic understanding of HISP's activities and achievements and may have resulted in unstable and fragmented financing.

The evaluation object

The Health Information System Programme (HISP) is organized as a network that comprises Universities, Ministries of Health, NGOs, and companies. The key network nodes are the University of Oslo, HISP-South Africa and HISP-India.

The Institute of Informatics (IFI) at the University of Oslo performs coordination functions of the global south-north-south HISP-network and focus on Open Source DHIS v2 development and implementation. IFI also performs technical backstopping for national HISP nodes in developing countries to support their activities in customizing and implementing software applications such as the DHIS v1 and v2 and its interoperability with other open source software applications such as the iHRIS and OpenMRS.

At the national level, - local universities (in Africa) or the NGO HISP India, implement training master courses and supporting PHD studies with support from IFI/UIO. The partner universities in Malawi and Tanzania have established links with its respective Ministries of

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[1] The DHIS v1 software is developed in South Africa since 1998 and is being introduced in many countries. DHIS v1 is based on MS Office. Since 2005, the University of Oslo has been coordinating the development of the web based and fully open source based DHIS v2 (www.dhis2.org) application which has been taken up and implemented in many countries with India being the main collaborator and "test-bed". DHIS v2 is also the focal point in the collaboration between WHO and the University of Oslo. The WHO OpenHealthMapper GIS application is being developed as a module in DHIS v2. The two software platforms have contributed to the development of two relatively independent HISP-implementation networks; while Oslo/India is focusing on DHIS v2 HISP South Africa is focusing on DHIS v1.

[2] NOMA Norads program for masterstudium, Norad's Programme for Master Studies
[3] NUFU Nasjonalt program for utviklingsrelatert forsking og utdanning (Norwegian Programme for Development, Research and Education)

Health to support the ministries' activities to strengthen HMIS, often involving implementing the DHIS software. In some countries DHIS has been implemented at national level, while other countries are in the phase of piloting the DHIS software as part of a larger national process to improve HIS.

Purpose of evaluation

The purpose of the review is to independently document and assess the achievements of the Health Information System Programme (HISP). The evaluation shall result in recommendations for how to structure future support for HISP from Norad and potentially other contributing institutions.

Objectives of the evaluation

The evaluation has several objectives:

1. Document the Health Information System Programmes' achievements to date (effectiveness) within the areas of
    1. Individual and institutional capacity building in the area of implementing an operating health information systems
    2. Implementation and use of DHIS v1 and DHIS v2 software at country level.
    3. Impact on overall HIS/HMS structures as well as quality and culture of use of information systems for program management and policymaking.
2. Assess the role of the Institute of Informatics (IFI) at the University of Oslo in the HISP network and in achieving results.
3. Assess the extent to which achievements to date address and meet needs of partner countries (*relevance*).
4. Assess the *efficiency* of the Health Information System Programme in terms of achieving desired results.
5. Assess the use of financial resources from different Norwegian channels (NOMA, NUFU, NRC) focusing on interfaces, leverage, and potential challenges including reporting and attribution. Assess the wider context and opportunities for HISP at global and country level with particular focus on creating synergies with other major actors in the area of HIS strengthening and capacity building.
6. Recommend what changes, if any, ought to be made to current business model and strategy to ensure that future interventions are
    1. Effective means towards contributing to strengthen HIS
    2. tailored to needs (*relevant*),
    3. being more effectively implemented (*efficient*) and
    4. lead to improved prospects for *sustainability*.
7. Provide recommendations in terms of continued support from Norad and potentially other financiers to the HISP.

Scope

The main focus of the assessment should be on India, Tanzania Malawi and Nigeria. However, brief overviews of achievement in Ethiopia, Mali, Sierra Leone and Viet Nam should also be included.

The timeframe of the activities and achievements to be assessed are between 2000-2010.

Methods/evaluation tasks

1) Obtain an overview of the evaluation object; its design, goals and objectives, implementation arrangements, types of activities, stakeholders, target groups, programme areas and relevant M&E systems and plans in place.
2) Review existing relevant academic research and evaluations that might be of relevance to the exercise.
3) Review the tools and the material (software and training material) that has been produced, and promoted by the HISP network.
4) Fieldwork and evaluation through site visits in two countries - according to approved inception report.
5) Perform analysis, assessments and provide recommendations as described in the objectives of the evaluation

The consultants are expected to adhere to the OECD/DAC evaluation quality standards.
Data collection will be done in collaboration with/facilitated by the Global Health and AIDS Department in Norad and the institute of Informatics (IFI) at the University of Oslo.
Norad's Global Health and Aids department and IFI will also facilitate contact with Norwegian embassies and partner institutions at country level as needed.

The assignment should be done by two or more consultants within a frame of 10-15 consultants' weeks.

Reporting requirements

1. Deliver an inception report of max 4 pages. The inception report shall include a plan for fieldwork.
2. Written report of maximum 50 pages, including a 2 page executive summary with key findings and recommendations.

Part 3: ANNEXES

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ANNEX 1
Specifications for Preparing Technical Proposal

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Technical proposal *not exceeding 15 pages* should provide the following information:

Competence -Qualifications and Technical Competence
The technical proposal should provide:

- Information about the experience and technical competence of the tenderer firm, its sub contractors (where relevant), and the evaluation team to demonstrate that they satisfy the qualification and competence requirements specified in the ToR for this evaluation.

- A summary of the competencies of the team members shall be provided in a tabular form as follows:

	Evaluation Team				
	Leader	**Member**	**Member**	**Member**	**Member**
Name					
Affiliation (Main employer)					
Country of residence					
Competence					
Academic					
Discipline					
Evaluation					
Sector					
Development Cooperation					
Country/region					
Other					
Language fluency					
English					
Norwegian					
Other					

- Detailed CVs not exceeding 5 pages should be attached in the annex to the tender.

Approach and Methodology
- The tenderer's understanding of the purpose, role and subject matter of the assignment.
- The proposed design for the study, methodological choices, strategy with respect to concretisation of the issues, and as far as possible indicators and data sources to be used to answer the main questions posed in this assignment.
- Tenderers are invited to make well founded comments or alternative suggestions where relevant to methodological specifications, issues and questions outlined in the ToR.

Quality Assurance System
- A description of the tenderer's quality assurance system to ensure that the assignment will be performed in accordance with the technical proposal and plans outlined in the tender. The description should outline the tenderer's policy concerning control of scientific quality of the deliverables, together with routines with respect to document control, , auditing of inputs, reporting of deviations from agreed plans and corrections thereof and communication with the client

Price

The tenderer shall quote a total price for the assignment including an estimate of travel and subsistence costs related to field work involving case project/programme visits. All fees and costs shall be quoted in NOK, exclusive of VAT, and the total price shall specify:
- The hourly fee, and hours for each member of the staff proposed for the assignment.
- Travel and subsistence costs including an estimate of field work travel costs
- Other costs if any.

Guidelines for travel and subsistence costs for field work

Detailed travel budgets for field work shall be submitted along with the inception report and will be subject to approval by Norad prior to the start of field visits. Cheapest alternative shall be chosen, e.g. Economy/Excursion tickets with regards to air travel related to field work. Accommodation and per-diem related to project/programme visits shall be covered by the Client. in accordance with the Norwegian Government's Travel Regulations available at the website www.odin.no/mod/ (only in Norwegian). Under the current regulations accommodation cost is reimbursed on cost basis subject to maximum night allowance rates for the concerned country. If accommodation is provided by the Client, no allowance for accommodation is granted. If the rates for per diem and night allowance are changed during the travel, the prevailing rate at any time applies.

Expenses for travels within countries selected for field work shall be covered at actual costs, unless otherwise agreed.

Availability

The technical proposal should include a tentative *work-plan* that also gives a specification of the time set out for each member of the team for the fulfilment of the assignment. The division of work between the team members should be in line with the competencies of the individual team members. The tentative work-plan should reflect timely completion of the deliverables in the assignment.

The time-schedule for the project is fixed as given in *Part I, Section 2 Administrative Conditions* of this document. Tenderers may however, propose a revised time-schedule for project deliverables. Tenders offering delivery within the specified time- scheduled will be credited according to the availability criterion as specified in *Part I Section 4- Award criteria* in this document.

ANNEX 2

Specifications for preparing the tender

Tenders shall be structured as follows:

Part A. Covering Letter and Declarations

A covering letter for the tender (with the signature of an authorised person on the front page) declaring that:
- the tenderer accepts all the conditions specified in this tender document. Reservations if any to any of the conditions must be explicitly stated in the declaration, specifying the relevant condition and the terms of the reservation.
- that neither the tenderer, nor any of the members of the evaluation team have any existing, or potential <u>conflict of interest</u> in undertaking the tendered assignment.

Part B. Technical Proposal
- Prepared according to the specification in *Part 3, Annex 1* of this document.

Annexes
- All the documentation specified in *Part I Tender specification*, S*ection 3 Qualification requirements,* of this document must be enclosed.

ANNEX 3
Guidelines for Reports and Field Work

3.1 Guidelines for Inception Report and Field Work
The inception report shall give a detailed description of the research strategy and methodology, data collection and sources, the analytical approach and indicator framework, preferably with a prototype of the analysis to be performed in the study. The report will also give a summary of the information collected to date. Information gaps will be identified and strategy to fill the gaps, including (if relevant), the plans for the **field-work** will be outlined. The inception report will specify the list of informants to be contacted in the case countries, the methods to be used to collect required information, preliminary draft of the questions to be asked of the informants, and itinerary for the field visit.

A detailed **work plan**, specifying the roles and responsibilities for each evaluation team member, and a **preliminary outline of the final report** format will be included as an appendix in the inception report.

It is the obligation of the selected firm and the team-leader to ensure that ethical standards are maintained in conduct of the field-work, and data collection is conducted under free and informed consent of the key informants.

3.2 Guidelines for Final Evaluation Report
The final report shall normally not exceed 50 pages, excluding the annexes. The final report shall be developed in two phases: a draft version, and the final version. The draft version shall contain all the main elements and major arguments, findings, conclusions and recommendations that are to appear in the final report. The final report shall be prepared subsequent to the approval of the draft version by Norad. The consultant is expected to adhere to the DAC Evaluation Quality Standards[4] and the same will be reflected in the report. (a special reference is made to the incorporation of stakeholders' comments, § 8.1).

The report shall convey insights in an informative, clear and concise manner. Use of abbreviations and acronyms, footnotes and professional terminology shall be limited to the minimum, and explanations shall be given for all such terms used in the report. The structure of the reports shall be as follows:

- **Front page/title page**
  The front page shall contain the title of the evaluation.
- **Acknowledgements**
  This page shall provide the following information
  - Name of the firm(s) responsible for the report
  - Name of the team leader and the team members
  - Division of work between the team members
  - Reference group (stakeholders) members where relevant
  - A declaration stating "

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[4] See http://www.oecd.org/dataoecd/34/21/38686856.pdf

"This report is the product of its authors, and 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 Norad".

- **Table of Contents**
- Acronyms and abbreviations
- **Executive Summary**
- The executive summary shall be a maximum of one tenth of the length of the main report excluding its annexes. The overall objective shall be to convey the main points to a non-technical reader. The summary shall function as an independent excerpt free of references to other parts of the report. Use of acronyms, abbreviations, and technical terms shall be minimised in the summary.
- The executive summary shall consist of four sections; namely introduction, findings, conclusions and recommendations. A separate paragraph shall be used to present each main finding, conclusion and recommendation. The paragraph shall start with a simple declarative sentence in bold font that presents the subject matter in the paragraph. Supporting or explanatory sentences shall be included where necessary. The main findings, conclusions and recommendations shall be presented *in the same order as they appear in the report.* Limitations of the analysis shall be clearly identified wherever relevant.Chapter 1.Introduction or Background

  The main purpose of this chapter is to provide information which is important for the reader to understand the report. The introduction shall state the purpose, objectives, main questions, scope, and main users of the evaluation. This shall be followed by a presentation of t*he object of study / evaluation. . Included herein is* the background information related to chronology, stakeholders, organisation, budgets, and policy documents. The chapter shall conclude with a brief literature review of the relevant project and program cycle documents related to the object of evaluation.

- Chapter 2 Methodology and analytical framework

  This chapter should provide a detail description of the research strategy, method and indicator framework used in the evaluation. All data and survey instruments shall be provided in annex 1 of the report. Norad is committed to making its studies and evaluations publicly available and it is important that the details provided in this chapter and annex 1, are sufficient to enable the replication and extension of results by other researchers.

- **Chapters presenting findings**

  Findings: A body paragraph shall be allocated for each finding. The finding shall be presented as a clear topic sentence. This shall be followed by presentation of the relevant data, quotations, references, and analysis that shows how and why the evidence presented supports the position taken in the topic sentence. Included herein is also the presentation of the comparisons with other studies, significant trends if any, *uncertainties, and limitations* relevant for the analysis presented.

  Chapter presenting conclusions and recommendations

  The chapter shall consist of two sections:

Conclusions: A body paragraph shall be allocated for each conclusion. The conclusion shall be presented as a clear and direct topic sentence. This shall be followed by supporting sentences that clearly show how the conclusion has been deduced, and which findings are relevant in deriving the conclusion.

Recommendations: A body paragraph shall be allocated for each recommendation. The recommendation shall clearly outline the directions and actions that should be taken keeping in view the findings and the conclusions. It is essential that the actions suggested follow from the findings and conclusions presented in the report. As far as possible the recommendations should reflect on the implementation issues related to the concerned recommendation.

- **Annexes**
  - Annex 1: Definitions, data and survey instruments
  - Annex 2 : Other information on need basis
  - Annex 3: Details of the field work elaborating the itinerary and the list of informants consulted
  - Annex 4: Terms of Reference (TOR)

  - **References**

  The references shall preferably follow Oxford's Manual of Style: In the text, the last name of the author, followed by the year of publishing, shall be presented in parenthesis. At the very end of the report, the references shall be presented in alphabetical order, according to the author's name and year of publishing as referred to in the text.

Guidelines for quality assurance of the report

The final report shall normally not exceed 50 pages, excluding the annexes. The text shall preferably be written in Microsoft Word. The font of the body matter shall be Times New Roman 12 points or equal. The margins shall be 2.5 cm. The report shall be delivered edited, language vetted, and proofread and ready for publication. The reports shall be submitted to the Evaluation Department electronically.

It is the obligation of the selected firm and the quality assurance personnel proposed for the assignment to ensure:

- Table of contents is complete
- All acronyms are explained
- Executive summary is accessible to the non technical reader
- Method
  - Clear statement of the analytical framework
  - All assumptions and limitations clearly stated
- Data
  - Clear documentation of the data collection procedures
  - All relevant data presented and summarised
  - All calculations clearly documented and checked
  - All data sources clearly referenced
  - All biographical references complete
- Analysis
  - All conclusions supported by well documented data and evidence

- o Clear and complete statement of the limitations
- o Sensitivity of the conclusion to the assumptions is clarified
- The Report
  - o Responds to TOR
  - o Responds to comments to inception report and draft version
  - o Response to stakeholder comments as per DAC quality evaluation standards
  - o Acceptable grammar, style and organisation
  - o Quality assurance is complete and explains deviations if any

Reference List

Annotated Bibliographies

1. Asangansi IE, Adejoro OO, Farri O, Makinde O. Computer use among doctors in Africa: Survey of trainees in a Nigerian teaching hospital. *Journal of Health Informatics in Developing Countries*. 2008;2(1):10–14.
    Type: Journal
    Keywords: health informatics | Nigeria | Africa
    Country: Nigeria
    Author Affiliation: Biohealthmatics African Network Initiative; University College Hospital Ibadan Nigeria, Nigeria; University of Ibadan, Ibadan, Nigeria
    Abstract: The field of medicine and medical practice requires the use of computers for support in information processing, decision making and records keeping. The success of information and communications technology applications in health is dependent on the level of computer use by health professionals especially doctors. This questionnaire-based study assessed the level of computer and internet use by doctors in a Nigerian Teaching Hospital as well as their perception of the medical recording system in their place of practice. The study is planned to be carried out similarly in other centres across Africa; this survey will serve as a pilot.

2. Berg EA. *The challenges of implementing a health information system in Vietnam* [master's thesis]. Oslo: University of Oslo; 2007.
    Type: Thesis/Dissertation
    Keywords: action research | implementation | information systems | sustainability
    Country: Vietnam
    Author Affiliation: University of Oslo, Norway—Department of Informatics
    Abstract: The thesis is based on an action research project where the author participated in the implementation of the health information system District Health Information Software (DHIS). The project was a part of the Health Information System Programme (HISP) network that aims to improve health information systems in developing countries.

    The author participated in the HISP Vietnam project following an action research approach where fieldwork was conducted in Vietnam with the aim of successfully implementing DHIS v2 in one province while training users and coordinating with the rest of the nodes in the HISP network. Findings were discussed during the implementation efforts based on relevant literature about other HISP-related efforts.

    The argument is that the efforts in the province are dependent on more participation, resources, and commitment from the locals in order for the project to be sustainable in the province.

3. Braa J. A data warehouse approach can manage multiple data sets. *Bulletin of the World Health Organization*. August 2005; 83(8):638–639.
    Type: Journal
    Keywords: data collection | delivery of health care | development | health system | information system | information systems | management | management information systems | organization & administration | results | situation analysis | South Africa
    Country: South Africa
    Author Affiliation: Department of Informatics, University of Oslo

4. Braa J. *IST and Health Information Systems in Developing Countries:Building Europe Africa Collaborative Network for Applying IST in Health Care Sector, BEANISH 2005-2008.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2010.
   Type: Report
   Keywords: implementation | milestones
   Country: Botswana | Ethiopia | India | Malawi | Mozambique | Nigeria | South Africa | Tanzania | Thailand | Vietnam | Zambia | Zanzibar
   Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 BEANISH Project.
   Abstract: The Building Europe Africa Collaborative Network for Applying Information Society Technologies (ISTs) in the Health Care Sector (BEANISH) project is aimed at developing global collaborative networks around the application of ISTs for health. This final report provides implementation milestones throughout the collaborative network. Sections include: integration of systems; status of national health information systems (HIS) in the BEANISH countries; assessment; open source development; capacity development and sustainability; networks and synergies; developing HIS in developing countries—recommendations; impact of District Health Information software beyond BEANISH in Africa and Asia.

5. Braa J, Hanseth O, Heywood A. Developing health information systems in developing countries: The flexible standards strategy. *MIS Quarterly.* 2007;31(2):381–402.
   Type: Journal
   Keywords: developing countries | flexible standards | health sector | information infrastructure | Information Systems | scaling | sustainability
   Country: Ethiopia | South Africa | Thailand
   Author Affiliation: University of Oslo, Norway—Department of Informatics
   Abstract: The development of appropriate, integrated, and scalable information systems in the health sector in developing countries has been difficult to achieve and is likely to remain elusive in the face of continued fragmented funding of health programs, particularly related to the HIV/AIDS epidemic. In this article, the authors propose a strategy for developing information infrastructures in general and in particular for the health care sector in developing countries. Complexity science is used to explain the challenges that need to be addressed, in particular the need for standards that can adapt to a changing health care environment, and propose the concept of flexible standards as a key element in a sustainable infrastructure development strategy. Drawing on case material from a number of developing countries, a case is built around the use of flexible standards as attractors, arguing that if they are well defined and simple, they will be able to adapt to the frequent changes that are experienced in the complex health environment. A number of paradoxes are highlighted as useful strategies, integrated independence being one that encourages experimentation and heterogeneity to develop and share innovative solutions while still conforming to simple standards. The article provides theoretical concepts to support standardization processes in complex systems and to suggest an approach to implement health standards in developing-country settings that is sensitive to the local context, allows change to occur through small steps, and provides a mechanism for scaling information systems.

6. Braa J, Hedberg C. *Developing District-Based Health Care Information Systems: The South African Experience.* Oslo, Norway: University of Oslo; 2000.
   Type: Report
   Keywords: pilot districts | requirements | systems development
   Country: South Africa
   Author Affiliation: University of Oslo, Norway—Department of Informatics
   Abstract: The work presented is based on research carried out in the Health Information System Programme- (HISP) South America since the advent of democracy in 1994. HISP started out as a bottom-up process in three pilot districts and is today (2000) a driving force behind district-based health information systems (HIS) development in South Africa. HISP is a collaborative research and development program comprising the University of the Western Cape, the University of Cape Town (both South Africa), Universidad Eduardo Mondlane (Mozambique), the University of Oslo (Norway), and the Departments of Health in South Africa and Mozambique.

    In its first phase (1995 to 1998), HISP aimed at developing district HIS to support the emerging decentralized administrative structures in three pilot districts in Cape Town. The National Department of Health adopted strategies, processes, and software developed in the pilot districts in early 1999. These are currently being rolled out to all districts in the country (second phase, 1999 to 2001). Similar processes have also started in Mozambique, and groups in other sub-Saharan countries are assessing whether the open source software from HISP can be adapted to their requirements.

7. Braa J, Hedberg C. The struggle for developing district health information systems in South Africa. *Information Society*. 2002;18(3):113–127.
   Type: Journal
   Keywords: health information systems | health information system | information systems | information system | South Africa | action research | management | health sector | development | integration | results
   Country: South Africa
   Author Affiliation: University of Oslo, Oslo, Norway; University of the Western Cape and University of Cape Town, Cape Town, South Africa
   Abstract: This article describes the initial period (1994-2001) of an ongoing action research project to develop health information systems to support district management in South Africa. The reconstruction of the health sector in postapartheid South Africa striving for equity in health service delivery and building of a decentralized structure based on health districts. In terms of information systems (IS) development, this reform process translates into standardization of health data in ways that inscribe the goals of the new South Africa by enhancing local control and integration of information handling. The authors describe their approach to action research and use concepts from actor-network and structuration theories in analyzing the case material. In the detailed description and analysis of the process of IS development provided, they focus on the need to balance standardization and local exibility (localization); standardization is thus seen as bottom-up alignment of an array of heterogeneous actors. Building on a social system model of information systems, they conceptualize the IS design strategy developed and used as the cultivation of processes whereby these actors are translating and aligning their interests. They develop a modular hierarchy of global and local

datasets as a framework within which the tensions between standardization and localization may be understood and addressed. Finally, they discuss the possible relevance of the results of the research in other countries.

8. Braa J, Heywood A, Sahay S, Hedberg C. *Final Assessment of HIS Status in Partner Countries.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2008.
Type: Report
Keywords: assessment tool | challenges | information systems | integration
Country: Botswana | Ethiopia | India | Malawi | Mozambique | South Africa | Tanzania | Thailand | Vietnam | Zanzibar
Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 BEANISH Project.
Abstract: This report is submitted by the authors in fulfillment of the assignment for the Health Metric Network funded by the Department for International Development and in collaboration with the EU-Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector project. The objective of the assignment was to develop an assessment tool that could be used both for diagnosing and planning with respect to health information systems (HIS) and its operating environment and achievements across and also within different countries.

More specifically, the objective of this exercise was fourfold:

1. To provide an internationally standardized tool to allow baseline assessment of the country's HIS with its strengths and weaknesses.
2. To provide a basis for a country HIS development plan, with short-term (1 year), medium-term (3 years), and long-term (10 years) targets/milestones.
3. To provide a methodology to enable regular monitoring of progress through periodic assessment (e.g., every 3 years)
4. To promote the identification of national extensions to this assessment tool where needed to assess specific national HIS development issues.

Broadly, the development of the assessment tool involved looking at the following components of HIS:

- Determine the performance of the various sub-systems and overall HIS, and the level of functional integration.
- Assess performance of HIS with respect to data quality, collection, processing, analysis and the use of information.
- Identify on-going development processes and major problems/shortcomings as well as identify options for addressing such issues.
  Develop local skills to perform similar assessments in the future.
- Provide clear criteria by which country information systems can be evaluated.

The aim of this document is twofold:

1. To describe the methodology employed in the design, development, and testing of the HIS assessment tool.
2. To describe the application of this tool in particular contexts and more generally.

Given this, the report is structured in the following sections:

Section 1: Methodology for tool development.
Section 2: Testing of the tool in different contexts.
Section 3: Cross-country discussion of HIS-related issues.
Section 4: The challenge of integration.

9. Braa J, Heywood A, Shung King M. District-level information systems: Two cases from South Africa. *Methods of Information in Medicine*. 1997;36(2):115–121.
    Type: Journal
    Keywords: data collection | delivery of health care | development | health system | information system | Information Systems | management | management information systems | organization and administration | results | situation analysis | South Africa
    Country: South Africa
    Author Affiliation: Norwegian Computing Centre, Department of Community Health; University of Cape Town; Public Health Program, University of the Western Cape; Department of Community Health, University of Cape Town, South Africa
    Abstract: The health system in South Africa has to date been fragmented and centralized. The priority of the new government is to establish an integrated and decentralized district health system of which a key element is the development of district health and management information systems (H & MIS). This paper presents experiences from two projects in the Western Cape in which a process to establish a district-based H & MIS was initiated and a situation analysis of the information systems was done. The two projects applied different research methods but the results show with remarkable consistency that much time is used on data collection, but information is not used at local level. The projects have applied different approaches towards developing a district H & MIS but in both important pre-requisites for a successful, action-led H & MIS include local ownership and motivation, a process based around existing local management structures and the active involvement of the community.

10. Braa J, Macome E, Mavimbe JC, Nhampossa JL, Costa JLD, et al. A study of the actual and potential usage of information and communication technology at district and provincial levels in Mozambique with a focus on the health sector. *Electronic Journal of Information Systems in Developing Countries*. 2001;5(2):1–29.
    Type: Journal
    Keywords: usage | health sector | results | management | health system | computers | development | information systems | information system | health information system | health information systems | systems development | ministry of health
    Country: Mozambique
    Author Affiliation: University of Oslo; Universidade Eduardo Mondlane, Mozambique; Ministry of Health, Mozambique
    Abstract: The article presents results from a study on the use and appropriation of information and communication technologies (ICT) in Mozambique with a focus on the health sector. The three provinces of Gaza, Inhambane, and Niassa were surveyed and two questionnaires addressing (1) computer users and their ability to manage ICT, and (2) health workers and their handling of health information were used. Based on this study appropriate strategies for developing an ICT-infrastructure with the needs of the health sector as points of departure are discussed. The study is born out of a program to strengthen and further develop the health information and management systems at district and provincial levels as part of a process to

support decentralization of the health system in Mozambique. The study shows that computers and Internet are rapidly being spread to the provincial capitals and major districts in Mozambique. A main problem identified is the lack of ICT-skills and education and poorly developed infrastructure and networks of support. There are very few formal ICT companies providing hardware, and even less, software support. Maintenance and learning about ICT are to a large extent going on within informal networks of computer users in the provinces.

A main finding in this study is that development of ICT capacity and information systems at district and provincial levels in Mozambique needs to be an integrated effort across sectors. A district health information system cannot be developed in a void.

A general recommendation is to develop educational programmes ranging from training of ICT entrepreneurs and health workers and managers, to masters and PhD programmes in ICT and health information systems. A specific recommendation related to health information systems development is to focus on the district level and to develop a strategy which encompasses and integrates all districts, both the advanced districts with computers and the majority of the districts where there are no computers.

11. Braa J, Monteiro E, Sahay S. Networks of action: Sustainable health information systems across developing countries. *MIS Quarterly.* 2004;28(3):337–362.
   Type: Journal
   Keywords: action research | developing countries | information systems | scaling | sustainability
   Country: China | Cuba | Ethiopia | India | Malawi | Mongolia | Mozambique | Nigeria | South Africa | Tanzania
   Author Affiliation: University of Oslo, Norway—Department of Informatics
   Abstract: This paper asks the question: Why do so many action research efforts fail to persist over time? The approach to this question—the problem of sustainability—is built upon a perspective on action research identifying the pivotal importance of networks. More precisely, local action research interventions need to be conceptualized and approached as one element in a larger network of action in order to ensure sustainability. A vital aspect of the perspective is that local interventions depend heavily on the support of similar action research efforts in other locations. This is essential for the necessary processes of learning and experience sharing. The authors suggest that the scaling (i.e., spreading) of intervention is a prerequisite, not a luxury, for sustainable action research. Empirically, the authors base their analysis on an ongoing, large-scale action research project within the health care sector (called the Health Information System Programme [HISP]) in a number of developing countries. HISP provides a fruitful occasion to investigate key criteria for their approach to action research, namely sustainability, scalability, and capacity, to be politically relevant to the participants. The authors contribute to three discourses: (1) models of action research, (2) lessons for health information systems in developing countries, and (3) more generally, information system implementations that are dispersed, large-scale, and have scarce resources.

12. Braa J, Muquinge H. *Building Collaborative Networks in Africa on Health Information Systems and Open Source Software Development—Experiences from the HISP/BEANISH Network.* 2006.
   Type: Report
   Keywords: human resources | information systems | key challenges

Country: Botswana | Ethiopia | India | Malawi | Mozambique | South Africa | Tanzania | Vietnam
Author Affiliation: University of Oslo, Norway—Department of Informatics; Universidade Eduardo Mondlane, Mozambique
Abstract: The development and running of efficient and appropriate health information systems (HIS) while urgently needed are difficult to achieve and depend heavily on skill and human resources which tend to be in short supply African countries. One way to address the human resource problem in this area is to develop cross-country collaboration for sharing of resources, best practices, software, and learning. The Health Information System Programme/ Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector network (HISP/BEANISH) is made up of a number of African and Asian countries and is developed with such aims. The focus of this network is to develop cross-country collaboration on research and development in the area of HIS and free/open source software as well as on the development of educational programs. This article will describe and discuss experiences from the HISP/BEANISH network and pinpoint some key challenges.

13. Braa J, Staring K, Mengiste MAS, et al. *DHIS 1.4 Developed, Tested and Piloted in Botswana, Ethiopia, and Tanzania: Status Report per December 2006.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2006.
    Type: Report
    Keywords: implementation
    Country: Botswana | Ethiopia | Namibia | South Africa | Swaziland | Tanzania | Zambia
    Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 BEANISH Project
    Abstract: This report briefly describes and outlines the implementation of District Health Information Software v1.4. The report makes special note of implementation in Ethiopia, Tanzania, and South Africa, followed by brief mention of implementation in other target countries.

14. Braa J, Staring K, Titlestad O. *Reports on All Ongoing DHIS Pilot and Implementation Activities from the Countries of the African BEANISH Partners and Affiliated Partners in Asia: Status per December 2006.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2006.
    Type: Report
    Keywords: implementation
    Country: Botswana | Ethiopia | India | Liberia | Malawi | Mozambique | Namibia | Nigeria | Sierra Leone | South Africa | Swaziland | Tajikistan | Tanzania | Vietnam | Zambia | Zanzibar
    Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 BEANISH Project

15. Brucker OF. *Internationalization and localization—A case study from HISP* [master's thesis]. Oslo: University of Oslo; 2007.
    Type: Thesis/Dissertation
    Keywords: action research | developing countries | distributed development | implementation | open source | software design
    Country: Vietnam
    Author Affiliation: University of Oslo, Norway—Department of Informatics

Abstract: Translation of computer software is commonly separated into two key terms, internationalization (i18n) as an enabling factor and localization (l10n) as the process of translating the software to be suitable for a specific context. With an emphasis on distributed development and software design, the author presented the internationalization and localization efforts of a health information system situated in the context of developing countries.

 Through an action research approach, which includes a 4-month field study in Vietnam, the author investigates the use of open source software (OSS) in developing countries. In collaboration with a Vietnamese team, the first internationalization solution for the second generation of District Health Information Software (DHIS) v2 was developed and the software was localized for Ho Chi Minh City. DHIS v2 is an OSS project and a product of Health Information System Programme, which is an organization dedicated to improving health care in developing countries. Based on the author's discoveries, the establishment of localization teams in developing countries and their integration into a global OSS project is discussed.

The author points to a shift of focus on internationalization and localization as processes of isolating culture-specific data to a broader perspective on how organizational structures and technology can be adapted to support such change. Modularization and how general solutions can be reached are discussed based on cases from the development of DHIS v2 and a digital divide between developing nations and OSS communities in the effective use of communication technology is identified.

Internationalization is traditionally situated at the presentation layer of applications. Based on an implementation in the DHIS v2 project, the author presents an aspect-oriented concept for enabling internationalization on the lower layers of software projects and how this concept can be aligned with existing installations.

16. Byrne E, Sahay S. Generalizations from an interpretative study: The case from a South African community-based health information system. *South African Computer Journal*. 2007;38:8–20.
Type: Journal
Keywords: generalizations | interpretive research | health information systems | South Africa | information system
Country: South Africa
Author Affiliation: Department of Informatics, University of Pretoria; Department of Informatics at the University of Oslo, Norway
Abstract: This paper explores the making of generalizations from interpretive research by examining the process of developing a community-based information system (IS) in a rural area in South Africa. Lee and Baskerville's framework of four categories, and Walsham's four types, of generalizations form a framework that is used in this case study. Using the concept of the Ideal Speech Situation two empirical to theoretical generalizations are made: the re-conceptualization of participation and the need to generate common ground in which free and open dialogue between those who use, and those who are affected by the IS, is made possible. The main argument of this paper, using the generalizations made from this single case study, is that generalizations from interpretive research can be made and that much valuable contribution in the IS field is lost because IS researchers fail to make these generalizations.

17. Byrne E, Sahay S. Participatory design for social development: A South African case study on community-based health information systems. *Journal for Information Technology for Development*. 2007;13(1):71–94.
   Type: Journal
   Keywords: development | health information system | health information systems | health information systems | participatory design | social development | community-basedinformation systems | South Africa | information system | information systems
   Country: South Africa
   Author Affiliation: Department of Informatics, University of Pretoria, South Africa; Department of Informatics, University in Oslo
   Abstract: In this paper, the role of participation within the domains of information system (IS) research and social development is analyzed. Specifically, the authors examine how the process of IS development, and the IS itself, can reflect and shape the status of social development. Traditionally, participatory design (PD) research in IS has focused on business contexts in the Western world, with minimal application to developing country settings, especially in the context of social development. This paper seeks to contribute to developing these understandings and bases its analysis on a case study of a community-based health IS in South Africa.

   The case study involved the design and development of a community-based child health IS in a rural area of South Africa. Nationally, the formal district health IS in South Africa includes data only on those people who access health services through the health facilities. The premise behind developing a community-based child health IS was to include all the people living in that district in the district health IS.
   Analysis of the case study reveals three ways in which traditional PD needs re-conceptualization. First, it is not only the users of the IS who should participate, but also those individuals who are affected by the IS, even when those individuals have no direct interaction with the system itself. Second, whereas there is some recognition in PD literature of the need for the participation of people at different levels vertically distributed within an organization, there has been little recognition of the value of involving actors outside the organization or sector. Third, the capacity of the users and those impacted by the system needs to be developed to ensure effective participation in the IS design and development processes. These three approaches to PD in IS, whose purpose is to contribute to social development, are essential components of a participatory strategy.

18. Chandna O, Hedberg C. *Developing and Implementing an Integrated Health Information System (HIS) at District and National Levels in Botswana.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2005.
   Type: Report
   Keywords: implementation | information systems | integration | ministry of health
   Country: Botswana
   Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 BEANISH Project
   Abstract: The purpose of this project was to implement an integrated health information system (HIS) at district and national levels in Botswana during 30 months starting in April 2005. The HIS was based on the indicators and targets from the existing systems of data sources in the Ministry of Health, Botswana. The proposed system required minimum changes

in the existing systems in the short term, and in the long term the HIS was expected to facilitate increased integration and more rational data and information flows.

19. Chilundo B. *Integrating information systems of disease-specific health programmes in low income countries: The case study of Mozambique*. [PhD thesis]. Oslo: University of Oslo; 2004.
Type: Thesis/Dissertation
Keywords: information system | low-income countries | Mozambique | health care | programs | policy | requirements | results | vertical | health sector | integration | IS | management | health system | challenges | IT | recommendations
Country: Mozambique
Author Affiliation: University of Oslo, Oslo, Norway
Abstract: Health care services in low-income countries are usually provided through a combination of activities performed by several health programs. Most of these health programs are supported mainly by external aid agencies (donors), being vulnerable to donor's policy. Mandatory requirements to demonstrate funding accountability and short term results have often led donor's promoting vertical health programs, not integrated with the overall health structures. Typically, each of these vertical programs has an independent decision-making structure and an individual information system, thus leading to duplication of efforts and limiting the scope of the national decision-makers. The recognition of these problems has in recent years contributed to national governments and major donors to promote health sector reform including integration of the existing vertical programs. However, given the resources constraints of low-income countries, there is a need to keep attention in priority problems (through vertical programs) while considering their integration to the overall structure in the long run. One key aspect of conciliating these aspects includes the need to strengthen and integrate existing information systems both from vertical and integrated programs so that information can be available at a given level, allowing for better planning and effective management of the national health system as a whole.

20. Chilundo B, Aanestad M. Negotiating multiple rationalities in the process of integrating the information systems of disease-specific health programmes. *Electronic Journal of Information Systems in Developing Countries*. 2004;20(2):1–28.
Type: Journal
Keywords: information systems | developing countries
Country: Mozambique
Author Affiliation: University of Oslo; Eduardo Mondlane University, Mozambique
Abstract: The topic of this paper is the integration of different information systems, and in this case study the authors analyze information systems in the Mozambican health care sector. The context is a health care sector reform that involves the integration of separate, stand-alone, or so-called vertical health programs. These programs are usually disease-specific (i.e., targeted towards malaria, HIV/AIDS, or other major diseases). The reporting and monitoring systems for the activities within these programs are organized differently, in terms of which data elements are collected, to whom and how frequently they are reported etc., but in general they are all paper-based, at least at the peripheral level. The multitude of different systems places an unnecessary high workload on the health care personnel who do the initial data collection. However, the practical challenges related to the integration of the diverse information systems have not yet been the focus for the decision makers. Their aim with this paper is to describe

some of the differences between the systems. Their claim is that these differences are not arbitrary. On the contrary, they may be significant indicators of different realities and different interests. Integration of these systems will thus not be a purely technical or practical issue, but will entail a political negotiation of interests. The authors employ the notions of multiple rationalities as a theoretical tool to discuss this issue. In particular we find tensions between rationalities on the ground (i.e., in the health care facilities) and on the top, among the policy makers, the government, and the donor organizations.

21. Damtew ZA, Kaasbøll, JJ. Target-setting procedures for immunisation services in Ethiopia: Discrepancies between plans and reality. *Journal of Health Management*. 2011;13(1):39–58.
Type: Journal
Keywords: census | population | health extension workers | immunization | institutional rules | management
Country: Ethiopia
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: This study identifies the problems related with target setting for immunization service in Ethiopia. The authors adopted qualitative case study and drew concepts from institutional theory to collect data and analyze their findings. The findings showed that the plan of district health offices depends on the population data projected from census. Peripheral-level health workers, on the other hand, enumerate the number of population in their respective localities. Subsequently, the ambiguity occurs from mismatch between the target from census and number of eligible children counted by health workers. Health facilities are expected to follow the target given from district health offices, which is higher than the local count in most cases. They found most peripheral-level health workers considered that the inflated target given from the projected census lowers their achievements, since their performance should be calculated against the given target. This in turn affects the incentive given, thus, has implication on job satisfaction and performance. The need of considering the reality at the ground, rather than following only the formal institutional rules is emphasized in order to address the identified impediments.

22. Damtew ZA, Miscione G, Mekonnen S, Østmo E, Staring K, et al. Globe-trotting health information systems. *Journal of Health Informatics in Developing Countries*. 2010;24(1):27–38.
Type: Journal
Keywords: Botswana | Ethiopia | India | developing countries | development | health information system | health information systems | implementation | information system | information systems | IT | systems development
Country: Botswana, Ethiopia, India
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway; Department of Urban and Regional Planning and Geo-Information Management, International Institute for Geo-Information Science and Earth Observation, The Netherlands; Universidade de São Paulo, Faculdade de Economia Administração e Contabilidade, Brasil
Abstract: Cases from an international network, active in health information systems development and implementation in "developing countries," are presented in order to show a variety of interplays between the same information technology (IT) agency and varying local settings. By using the same institutional lens, a theoretically informed view of empirical data is provided. Trajectories of implementation in Ethiopia, Botswana, and India present two

different, and often diverging, levels of contextualization of the IT artefact: in the local context and in the (possibly emerging) organizational field of health information systems in "developing countries."

By discussing the emergence of an organizational field of health information systems across "developing countries," but so far not showing many traces of isomorphism, this paper aims at enlarging the empirical basis of what is considered relevant in information systems research.

23. Day C. *South Africa: Monitoring Health System Performance at Subnational Level.* South Africa: Health Systems Trust; 2009.
Type: Report
Keywords: assessment | information systems
Country: South Africa
Author Affiliation: Health Systems Trust, South Africa
Abstract: As part of health information system (HIS) strengthening, South Africa undertook a national HIS assessment in March 2009 using the Health Metrics Network framework. These results were based on scoring by the participants present, and each area covered a number of different data sources which may have been of different adequacy making it difficult to generate an accurate result; however it does give an overall feel for perceptions of the adequacy of data sources. In general, surveys and StatsSA sources received higher ratings, while health and resource records were generally found to be problematic.

24. Day C, Hedberg C. Health indicators. *South African Health Review*. 2003/2004:349–420.
Type: Journal
Keywords: indicators | health information system | information system | DHIS
Country:
Author Affiliation: Health Systems Trust; Health Information Systems Programme
Abstract: Since most of the review this year has focused on presentation of a wide range of health and related indicators, the purpose of this chapter is to provide a quick reference to a selection of key indicators, provincial maps and district population estimates and numbers of health facilities. In addition a selection of the most recent data and geographical information system maps from the District Health Information System are included, together with some observations on progress with health information systems. More data and detailed reference material which could not be included in the print version may be obtained from the Health Statistics section of the Health Systems Trust website at http://www.hst.org.za/healthstats/.

25. de Timóteo Mavimbe JC. *Understanding the global and local interplay of standards: The case of the Expanded Program on Immunization in Mozambique*. [PhD thesis]. Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Keywords: immunization | Mozambique | standards
Country: Mozambique
Author Affiliation: University of Oslo, Oslo, Norway

26. de Timóteo Mavimbe JC, Bjune G. Cold chain management: Knowledge and practices at primary health care facilities in Niassa, Mozambique. *Ethiopian Journal of Health and Development*. 2007;21(2):130–135.

Type: Journal
Keywords: management | health care | IT | data collection | results
Country: Mosambique
Author Affiliation: Faculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique; Faculty of Mathematics and Natural Sciences, Department of Informatics, University of Oslo, Oslo, Norway; Faculty of Medicine, Department of General Practice and Community Medicine, Section of International Health, University of Oslo, Oslo, Norway
Abstract: To maintain vaccines perfectly conserved from its manufacture through administration requires an adequate could chain infrastructure. At the end of the chain, primary health care providers must have adequate knowledge to manage the cold chain.
The study describes an observed audit of the Expanded Program on Immunization (EPI) in Niassa province of Mozambique. Data collection methods included questionnaires, observations and document analysis in 44 health facilities, 12 of which in district capitals, and the remaining 32 in peripheral health facilities in Niassa province. The results show that the principal explanatory variable for the inadequacies of the system was the location of the health facility as health workers in the peripheral health facilities were in general less educated, had less work experience and their knowledge of cold chain was not as per required levels to support effective cold chain management. The study strongly indicates the need to improve and integrate the knowledge and practices on cold chain management, especially to the peripheral level workers, by providing them with adequate training and supervision, and demonstrating how that can be effectively integrated with practice.

27. de Timóteo Mavimbe JC, Muquinguea HN, Braa J, Bjunec G. Immunization coverage in Mozambique: From concepts to decision- making. *Health Policy*. 2005;79:92–100.
Type: Journal
Keywords: attitude of health personnel | challenges | community health planning | data collection | data interpretation, statistical | databases, factual | decision making, organizational | demography | education | EPI | immunization coverage | targets achievement | population data sources | decision-making | health management | health facility administrators | health knowledge,attitudes, practice | health planning | health policy | health services needs and demand | health services research | humans | immunization | immunization programs | IT | management | Mozambique | organization and administration | organizational innovation | organizational objectives | policy | policy making | professional role | program evaluation | psychology | quality indicators, health care | questionnaires | rural health services | statistics and numerical data
Country: Mozambique
Author Affiliation: Eduardo Mondlane University, Maputo, Mozambique; Department of Informatics, University of Oslo, Oslo, Norway; Department of General Practice and Community Medicine, Section for International Health, University of Oslo, Norway
Abstract: Immunization is an effective strategy to reduce morbidity and mortality among children. This recognition has led many countries to concentrate efforts in establishing desirable achievements in the form of immunization coverage figures. However, less focus has been placed on effort made by different countries to attain high immunization coverage. During August 2002, 14 district health directors in a remote province of Mozambique (Niassa) were interviewed. The objective was to ascertain the construction of immunization coverage and how they implement the desired program strategies in order to improve the health status of the region. The authors found that most managers regarded the immunization coverage as data and

thus high coverage as an end in itself, rather than as a reflection of the reality. They also found that there are uncertainties in population data which makes it difficult to plan activities below the level of a district. They argue further that the innovative distinction between the views proposed on the immunization coverage, provided them with an insight of the different challenges that district health directors face as leaders of the district health management team in Niassa. Clues on the implications of certain views of immunization coverage for policy and local decision-making in the national and global pursuit of immunization targets are provided.

28. Department of Computer Science. *Experiences in the Strengthening of HMIS in Tanzania.* Tanzania: University of Dar Es Salaam; 2010.
Type: Report
Keywords: challenges | implementation | recommendations
Country: Tanzania
Author Affiliation: University of Dar Es Salaam, Tanzania—Department of Computer Science
Abstract: The report describes the project background, progress, challenges, opportunities, and recommendations of District Health Information Software implementation in Tanzania.

29. D`Mello M. *Understanding selves and identities of information technology professionals: A case study from India*. [PhD thesis]. Oslo: University of Oslo; 2006.
Type: Thesis/Dissertation
Country: India
Author Affiliation: University of Oslo, Oslo, Norway

30. EU 6th Framework Programme Priority 2, BEANISH Project. *Report from Pilot Implementation Botswana: Assessment Report of End-User Acceptance and Satisfaction with the District Health Information System (DHIS) During Pilot Project.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project;2006.
Type: Report
Keywords: data collection | feedback | pilot stage | results
Country: Botswana
Author Affiliation: EU 6th Framework Programme, Priority 2 BEANISH Project
Abstract: The District Health Information Software (DHIS) project is a part of the Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector network project. The pilot stage of the DHIS project was conducted in four health districts: South East, Gaborone, Okavango, and Kgatleng for a period of three months. During this time, data was collected on selected health care programs. A review of the pilot phase of the project was conducted in December 2005. This report includes the review's methodology, results, recommendations, and the questionnaire used to collect feedback from users.

31. Fossum K. *Social construction of legacy systems: A case study from a health information systems development project in Mozambique* [master's thesis]. Oslo: University of Oslo; 2007.
Type: Thesis/Dissertation
Keywords: health information systems | health information system | information systems | information system | systems development | development
Country: Mozambique
Author Affiliation: University of Oslo, Norway—Department of Informatics

Abstract: This thesis is about challenges in information system (IS) development in developing countries contexts, with an emphasis on challenges faced in processes dealing with improvement and replacement of health information system (HIS) empirical data collected from action research interventions in the Mozambican health sector. The work was done under the umbrella of a global action research project, called the Health Information System Programme.

The author argues that typical priorities among stakeholders in centralized developing-country settings as focus on immediate needs rather than long-term solutions and control, and reluctance in support for significant changes may lead to the unintended consequences of creation and maintenance of legacy systems. Lack of communication and consideration of real users' needs among decision-makers is a contributor to this, meaning that centralized contexts may be especially challenged in HIS projects, as the distance between decision-makers and real users typically is substantial organization-wise. The research suggests that the dilemma of introducing small changes with a new IS and at the same time supporting further organizational development may be solved by implementing flexibility in the IS done practically through flexibility in design and by enabling implementation of emerging needs by looking upon systems development as a continuous process through the life time of the IS. By applying different change strategies for different levels of the installed base, getting away from legacy systems problems may be reached in change-resisting social systems.

32. Garrib A, Stoops N, McKenzie A, et al. An evaluation of the District Health Information System in rural South Africa. *South African Medical Journal [SAMJ]*. 2008;98(7):549–552.
Type: Journal
Keywords: assessment | data collection | DHIS | feedback | information systems | key informant interviews | primary care | recommendations
Country: South Africa
Author Affiliation: University of KwaZulu-Natal, South Africa—Africa Centre for Health and Population Studies
Abstract: Background: since reliable health information is essential for the planning and management of health services, the authors investigated the functioning of District Health Information Software (DHIS) in 10 rural clinics. Design and subjects: semi-structured key informant interviews were conducted with clinic managers, supervisors, and district information staff. Data collected over a 12-month period for each clinic were assessed for missing data, data out of minimum and maximum ranges, and validation rule violations. Setting: the investigation was part of a larger study on improving information systems for primary care in rural KwaZulu-Natal. Outcomes: the authors assessed data quality, the use for facility management, perceptions of work burden, and usefulness of the system to clinic staff. Results: a high perceived work burden associated with data collection and collation was found. Some data collation tools were not used as intended. There was good understanding of the data collection and collation process but little analysis, interpretation, or use of data. Feedback to clinics occurred rarely. In the 10 clinics, 2.5% of data values were missing, and 25% of data were outside expected ranges without an explanation provided. Conclusions: the culture of information use essential to an information system having an impact at the local level is weak in these clinics or at the sub-district level. Further training and support is required for the DHIS to function as intended.

33. Hanmer L. Criteria for the evaluation of district health information systems. *International Journal of Medical Informatics.* 1999;56(1-3):161–168.
    Type: Journal
    Keywords: evaluation criteria
    Country: South Africa
    Author Affiliation: South African Medical Research Council, South Africa
    Abstract: A comprehensive set of evaluation criteria for District Health Information Software (DHIS) in South Africa have been developed. The criteria are organized in the following eight categories: (1) philosophy and objectives, (2) policy and procedures, (3) functionality, (4) facilities and equipment, (5) DHIS management and staffing, (6) user/patient interaction, (7) staff development and education, and (8) evaluation and quality improvement. A handbook of evaluation criteria has been compiled by restating the evaluation criteria to include mechanisms for measuring whether or not criteria have been met.

34. Hamre GA, Kaasbøll JJ. Motivation and demotivation: A case study of the Malawian health management information system. *Electronic Journal of Health Informatics.* 2008;3(2):1–11.
    Type: Journal
    Keywords: developing countries | health information system | developing countries | human resources | motivation | secondary work | health management information system | human resources | information system | integration | management | management information systems
    Country: Malawi
    Author Affiliation:
    Abstract: This paper addresses the problems of using health management information systems (HMIS) in developing countries due to the critical shortage of qualified and motivated human resources. The study employed qualitative research methods in an interpretive in-depth case study, and the study was carried out in two districts in Malawi. Analyses are based on motivational theory and the six categories of good and bad critical motivational incidents defined by Machungwa and Schmitt. Gasser's theory of integration of computing and routine work was applied to address the secondary, and supportive, nature of HMIS computing work. This research suggests that motivational items identified by Machungwa and Schmitt are chiefly relevant to the Malawian context, but since the HMIS work is of a secondary type compared to core health activities, the work motivation that comes from work itself has little motivating effects. Supervision visits and a recognition scheme were social arenas which motivated the health workers.

35. Health Information Systems Programme—South Africa. *An Overview of the District Health Information Software DHIS: A description of core functionalities in the DHIS software and rationale for use.* East London, South Africa: Health Information Systems Programme; 2009.
    Type: Report
    Keywords: DHIS | HISP | software development process
    Country: India | South Africa
    Author Affiliation: Health Information Systems Programme-South Africa
    Abstract: This report serves to provide potential users with an overview of how the District Health Information Software (DHIS) functions and some of its features that have contributed to its successful deployment in over 15 countries. It also describes how the software has emerged as a collaborative product between health care workers in these countries and Health Information System Programme (HISP) software and information system development teams in

South Africa, Norway, India and Vietnam. All users want to be assured that a system that is to be deployed country-wide must be sustainable, even in resource-constrained countries. The last section of this overview describes the software development process and the envisaged future development of the system.

This report has four sections, the three main sections are sections 2 through 4. In section 2 the philosophical standpoint that drives the software is described.

Section 3 provides an overview of the software itself and describes how data is appended to health facilities through the definition of an organizational hierarchy, data elements, and indicators. It also reviews measures to ensure that data quality is of a high standard and describes the reporting functionalities of the software.

Section 4 details the DHIS software development by describing the HISP international network and the software development process that has resulted in the DHIS suite. It also details the expected future developments and how these will continue to evolve through the growing HISP network.

36. Heywood A. *HMIS Pilot Project Pwani Region: Thoughts on the Past 6 Months-2010.* Tanzania: University of Dar Es Salaam; 2010.
Type: Report
Keywords: challenges | implementation | recommendations | usage
Country: Tanzania
Author Affiliation: University of Dar Es Salaam, Tanzania—Computer Science Department; University of Oslo, Norway—Department of Informatics
Abstract: This report describes the situation of health management information systems and District Health Information Software (DHIS) implementation in Tanzania. In addition to outlining the coordination of the implementation efforts, the report also describes some of the resulting challenges and obstacles regarding the uptake and use of DHIS in particular the weak collection and processing of data and poor analysis, interpretation and use. The author concludes with the way forward, including improved regional support, standardized reports, practical training, and potential use of mobile phones.

37. Igira FT. *The interplay between transformation in everyday work practices and IS design and implementation processes: Empirical experiences from the health information systems in Tanzania.* Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Keywords: data collection | ethnographic methods | information systems
Country: Tanzania
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: Studies recognizing that practices always contain an element of transformation are limited, not even in the integration of work practices and systems design. To address this shortcoming this thesis focuses on exploring the interplay between transformation in everyday work practices and information system (IS) design and implementation processes. It is an interpretive and critical study initially informed by perspectives from Cultural Historical Activity Theory (CHAT) and Developmental Work Research. It builds on four papers based on a study in two health care organizations in Tanzania Mainland and Zanzibar during the period of January 2005 to January 2007. It involves a study of everyday health workers' work practices as well as health information system (HIS) developmental trajectory under the Health Information

System Programme initiatives. The study is an analysis of transformation in work practices that occur without and due to the effects from the IS design and implementation process and how they impact each other. The aim is to contribute to a firmer and broader understanding of IS design and implementation processes within health care organizations and how to improve these processes.

The thesis focuses on two main questions: (1) What are the tensions that characterize transformation in everyday work practices of health workers and how do these tensions influence the design and implementation of IS, and (2) what were the significant influences on transformation of work practices during the IS design and implementation process?

Data collection was qualitative based on ethnographic methods: a combination of formal semi-structured interviews, informal interviews and discussions (during workshops and trainings), participant observation (during formal and informal interviews, workshops and trainings), and documents analysis. Data analysis was interpretive basing on the author's capacity to conceptualize the gathered data in relation to the research objectives and questions. Data collection and analysis were intertwined such that analysis occurred as the data was collected leading to further data collection and analysis. The author initially used theoretical perspectives from CHAT as their primary analytical tool through which themes were created. However, the data collection and analysis involved openness and sensitivity to data and unexpected elements that became known as the study progressed. In this regard, the author used additional theoretical perspectives from situated action, the temporal theory of agency, and information infrastructure studies to complement their analysis of the empirical data in a CHAT sense.

The findings of the study are divided into four main aspects: (1) tensions and transformation in work practices, (2) the interplay between technology materiality, context, and the temporal view of human agency, (3) participation and how to participate in the IS design and implementation processes, and (4) improving HIS design and implementation processes.

The thesis provides both theoretical and practical contribution to the IS field in general and the HIS design and implementation processes in particular. The basis for the theoretical contribution is a diversity of the theoretical perspectives and their combination in analyzing the empirical material. In this regard, the thesis contributes to existing theoretical approaches to the study of work practices in IS research by emphasizing the following: (1) situational work practices as a way to understand the tensions between the needs of an individual as part of different collective activity systems, (2) practical contingencies affecting action in the present, and (3) conceptualization of aspects of work practices that are taken from one activity system to another during its expansive development.

Practical contributions include: (1) studying current work practices with change thinking and (2) contextualization of participatory design approaches in non-western countries. While the practical contributions are more relevant for health care settings, which are characterized by dynamics in work practices, the author did see the potential of their applicability to other settings where work practices are based on commonly shared routines and procedures involving practices that are not easily made visible.

38. Igira FT. The situatedness of work practices and organizational culture: Implications for information systems innovation uptake. *Journal of Information Technology*. 2008;23(2):79–88.
Type: Journal
Keywords: cultural historical activity theory | information systems | innovation uptake | organizational culture | situated action | work practices
Country: Tanzania
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: This paper addresses the themes of work practices and organizational culture as situated actions and the implications for information systems innovation uptake. It reports on research being conducted in Tanzania that brings an ethnographic research approach to understanding relations between local health care practices and health information systems (HIS) development, by asking how health workers' practices and everyday actions are influenced by the context of their specific situation. The research is being conducted in the context of a globally distributed open source software project to introduce and enhance HIS in developing countries. Drawing on cultural historical activity theory, the study highlights the need for understanding each information system user and each organization's specific and detailed work processes, and how situational and organizational factors may come together with the HIS innovation processes in meeting the challenges discussed. In order to establish fully the potential of activity theory to HIS innovation processes, situatedness of work practices focusing on the organization context is emphasized.

39. Igira F, Aanestad M. Living with contradictions: Complementing activity theory with the notion of "installed base" to address the historical dimension of transformation. *Mind, Culture, and Activity*. 2009;16(3):209–233.
Type: Journal
Keywords: computer system design | foreign countries | health services | information systems | organizational design | organizational development | time perspective
Country: Tanzania
Author Affiliation: University of Oslo, Oslo, Norway
Abstract: This article addresses the historical dimension of the relation between information systems innovation and organizational transformation. The authors analyse findings from a study of ongoing transformations in the health care sector in Zanzibar, Tanzania. The process is described with a particular focus on instances where some contradictions in the old activity system were not resolved but inherited by the new activity system. To address this, the authors complement the activity theory framework with the notion of "installed base" from studies of information infrastructures. This helps to illuminate the theme of unresolved and continuing contradictions, and thus contribute to the concept of historicity in CHAT-informed studies.

40. Jacucci E. *Exploring tensions in information systems standardization*. Oslo: University of Oslo; 2006.
Type: Thesis/Dissertation
Keywords: information systems | information system
Country: South Africa
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: This thesis presents an interpretive study of standardization processes related to the development and implementation of information systems (IS). Standards and standardization

processes are ever more important and pervasive in IS. Standards range from technical specifications of communication protocols to informal organizational agreements and guidelines. Their scope ranges from the boundaries of a small organizational unit to international standardization committees. Today the development of any information system is made of, based on, related to, or linked to standards. The development process itself can be seen as a standardization process.

This thesis tries to deepen the understanding of the dynamics of IS development as standardization. In particular it tries to address a class of problems which has been already identified by previous empirical research and which manifest as paradoxes, side effects, and non-closure of standardization projects. The research presented here aims at dwelling into this class of problems with the attempt to identify theoretical as well as practical issues which can provide a relevant explanation of the observed dynamics. Based on an empirical base constructed over two case studies from the health care sector in Norway and in South Africa, the author conducted an analysis of standardization processes and formalized a set of theoretical and practical implications.

From a theoretical point of view the thesis makes three contributions: (1) it contributes to the understanding of the complexities related to standardization processes by developing the concept of tensions, (2) it points to the need and provides an example of how to link micro and macro theorization of standardization processes, and (3) it contributes to the discussion on the relation between standards and modernity by pointing to the need to include and understand the multiple modernities of contemporary society.

Finally, based on these findings and on the theoretical contributions, the thesis aimed to provide a set of recommendations regarding aspects to take into consideration when addressing the management of such tensions in order to improve the outcome of standardization processes.

41. Jacucci E, Shaw V, Braa J. Standardization of health information systems in South Africa: The challenge of local sustainability, information technology for development. 2006;12(3): 225–239.
Type: Journal
Keywords: district health information system | standardization | sustainability | implementation | development | health information systems | information system | challenges | developing countries | standards | South Africa | management
Country: South Africa
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway; Health Information Systems Programme, School of Public Health, University of Western Cape, Cape Town, South Africa
Abstract: The implementation and development of routine health information systems continue to provide a number of challenges for managers—the more so in developing countries where resources are scarce and human resource and technical skills limited. This article conceptualizes the interdependence between the local adaptation and appropriation of global standards, and the value that this adds to the global standard through improved quality of data. These processes reinforce one another in the creation of sustainable information systems. The article draws upon a case study of a rural hospital in South Africa. A successful change process is documented, wherein the organization, through innovative management and leadership, actively and successfully appropriated the national standard. The case study is used to highlight

three main messages, namely, that standards should be able to be locally appropriated, that the creation of networks helps to support the local adaptation of standards, and that the layering of information systems is important to encourage the use of information and helps to improve data quality.

42. Jakobsen E, Johansen AKH. *"All I want is a system that works"—Evaluation of the health information system in Cape Town, South Africa: using an information audit to capture views from the grass roots level* [master's thesis]. Oslo: University of Oslo; 2004.
Type: Thesis/Dissertation
Keywords: computers | evaluation | information audit | information system | IT equipment | primary health care clinics
Country: South Africa
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: This thesis presents a study of the health information system as seen from the facility level in Cape Town, South Africa. During the fieldwork, the authors tested, adapted, and evaluated an information audit within primary health care clinics. The audit was meant to be a basis for future annual evaluations of the status of the health information system. It covered areas such as training and support of staff, use of information, feedback from higher levels, data collection process, and staff's perceptions of the information system. The thesis described in detail the audit development process and the authors' recommendations to the equipment situation in health care facilities in Cape Town.

In addition to the work on the audits, the authors conducted a thorough investigation of the status of computers and other important equipment that handled data and information. This work resulted in a report on the status of computers and Internet technology equipment in district hospitals, 24-hour units, and community health centers in Cape Town. This report was requested by the provincial administration of Western Cape because of their need to budget for new equipment in the curative facilities. The authors acknowledged the benefits of their computer specification for managers when planning and equipping their facilities and it was included as a separate part of the information audit.

The thesis also includes an analysis and discussion of the results from the paper-based information audits that were conducted, and the analysis is presented as a general evaluation of the health information system at the facility level.

The authors found that the majority of workers at the facility level, 60%, have a positive attitude toward the information system, even if the majority states that there is still room for improvement in many areas. Of the facilities, 50% have no working computers. Of the facility workers, 40 % reported that they have not been able to make any use of the training they received on information and computers. Only 22% could provide examples of information usage in the facilities.

In the evaluation process, the authors found that it was important to keep the questionnaires short and simple. They also found that the personnel at the facility level were important factors in the evaluation, as they were closest to the collection of data. In the authors' opinion, the facilities should not be left out of the process because of their important role in the health information system.

43. Jani JV, Jani IV, Barreto J, Sahay S. The role of recorded and verbal information in health information systems: A case study of the Expanded Program on Immunization in Mozambique. *Ethiopian Journal of Health Development*. 2007;21(2):136–141.
    Type: Journal
    Keywords: health information systems | health information system | information systems | immunization | Mozambique | developing countries | IT | integration | education
    Country: Mosambique
    Author Affiliation: Department of Immunology, Instituto Nacional de Saude, Maputo, Mozambique; Department of General Practice and Community Medicine, University of Oslo, Norway; Department of Informatics, University of Oslo, Oslo, Norway

Abstract: There is ongoing interest in strengthening the informational component of the Expanded Program on Immunization as a means to enhance the efficacy of service delivery. As developing country governments make significant investments in strengthening health information systems, benefits obtained from these initiatives tend to be below their potential. To improve this, it is argued that such systems need to take into account both formal (documented) and informal forms of information.

This study measures the accuracy of people-based information with information recorded in the "Road to Health Card." 840 mothers were screened in a cross-sectional study. Information about measles immunization status as documented in the Road to Health Card was compared to mothers' verbal information. The pattern of these answers among mothers presenting the card was compared with those among mothers without the card. Measles vaccine information was 95.7% sensitive and 80.0% specific. Measles vaccination positive answer was 10.0% higher among mothers without the card. In the sample of mothers without the vaccination card, only 2.0% never received a card, 53.0% had forgotten to bring it, and the remaining 44.0% had lost it. A key implication of these findings is the need to develop a mother-specific information system that is based at the facility, and an integration of the verbal and tacit information sources while designing the information system. Further recommendation concerns the need to have more targeted information and education programs about the importance of the Road to Health Cards, especially focused for less educated mothers.

44. Jarre J. *Implementing a health system in India* [master's thesis]. Oslo: University of Oslo; 2007.
    Type: Thesis/Dissertation
    Keywords: action research | implementation | information system | integration | political support | scaling | sustainability
    Country: India
    Author Affiliation: University of Oslo, Norway—Department of Informatics

Abstract: Health information systems (HIS) are used to collect and analyze health data in order to support the improvement of health care services. Public health care in third-world countries is often based on a poorly functioning HIS. Simply put, data collection processes tend to be extensive, often of poor quality, and typically failing to be used for practical purposes such as for effectively allocating resources. Thus, exploring ways of improving existing HIS is evidently a fruitful approach to strengthen public health care. As a part of health-sector reform, governments in many developing countries are in the process of strengthening their HIS through the introduction of computer-based systems.

This thesis describes and discusses the implementation of the Health Information System Programme in the Indian state of Andhra Pradesh. The study was done using an action research

approach over a five-month period spread over two years. The challenges were to work with political, infrastructural, human resources, geographical, and cultural issues to get the system developed, implemented, and institutionalized. The results show that to institutionalize a HIS into the everyday workings of the health department in Andhra Pradesh, it is important to recognize the interdependency between scaling and sustainability. Scaling indicates the need for the HIS to reach a certain geographic and functional scope so as to become of interest to the higher levels. Small pilot projects have problems in reaching such scale, and will, therefore, end up more as interesting academic exercises unless they manage to reach a certain scope and scale.

Theoretically, concepts from information infrastructure theory have been used to better analyze the complexities of scaling and sustainability and their interdependencies. An important research focus has been to explore how the smaller-scale project in India that was studied could be extended—scaled up—so as to become of interest to health managers at different levels and thereby, eventually, become institutionalized. Three key processes have been identified to achieve the goal of institutionalization. These are the processes of cultivation, the creation of gateways to enable integration between the "installed base" and the "new system" and the choice relating to the level at which data entry and report generation should take place. To achieve institutionalization, in addition to the above focus on these processes, equal emphasis needs to be also placed on obtaining political support, thus emphasizing the need to combine top-down and bottom-up strategies.

45. Kaasbøll JJ, Galimoto MS, Hamre GA, Sandvand J. Competencies and learning for management information systems. *Journal of Information, Information Technology, and Organizations.* 2010;5:85–100.
Type: Journal
Keywords: computer literacy | information system | information system adoption | information systems | management | management information systems | organizational learning | support | user competence | user training
Country: Malawi
Author Affiliation: University of Oslo, Oslo, Norway; Norwegian University of Science and Technology, Trondheim, Norway; Inmeta Consulting, Oslo, Norway
Abstract: Previous research has established that users need competence in both computing and the context of the software. Information systems often fail due to low competence among users, and no study is known to provide a systematic account of the user competence needed. This research concerns competence needs among prospective users of a computerized management information system (IS) where there is no operational computer-based IS from which to obtain data. The study shows that three subject matter areas of user competence are needed for people who will use computerized IS knowledge on how the domain is represented, work competence, and computer literacy. Work competence is mainly practice based, while the domain related knowledge and computer literacy are based on explicit concepts, grounded in science or technology. User training should therefore start with practice in the case of work competence, while presentation of principles, concepts, and structures would constitute a better starting point when teaching computer literacy and how the domain is represented.

46. Kimaro H. *Decentralization and sustainability of ICT based health information systems in developing countries: A case study from Tanzania.* [PhD thesis]. Oslo: University of Oslo; 2006.

Type: Thesis/Dissertation
Keywords: developing countries | health information system | information system | sustainability | Tanzania
Country: Tanzania
Author Affiliation: University of Oslo, Oslo, Norway

47. Kimaro HC. *HMIS/DHIS—HRHIS Presentation delivered to UDSM DoCs Staff on 3rd February, 2010.* Tanzania: University of Dar Es Salaam; 2010.
Type: Report
Keywords: core activities | health information software | health system | human resources | implementation
Author Affiliation: University of Dar Es Salaam, Tanzania—Computer Science Department
Abstract: Presentation delivered to the University of Dar Es Salaam Department of Computer Science staff. It describes background information and coordination efforts among the various participating partners, including the project management and administration of the Health Information System Programme (HISP) and District Health Information Software (DHIS) within HISP. It details the work to date and implementation of DHIS v1.3, v1.4, and v2.0. It explains the resources the University of Dar Es Salaam is contributing to the project. Described are the core activities: analysis and design; training, workshops, and documentation; software development; and implementation. It includes a graphic organization chart of Tanzania's health system and how the DHIS and HISP work configures with the system. It also devotes a considerable section describing the human resources for health information software implementation.

48. Kimaro HC. *HMIS Strengthening Project 2009-2013: DHIS Implementation in Coast Region & Preparation of HMIS/DHIS Training Material—M&E Stakeholders' Meeting Organized by MOHSW at UDSM on 11th February, 2010.* Tanzania: University of Dar Es Salaam; 2010.
Type: Report
Keywords: implementation | requirements analysis | training materials | user support
Country: Tanzania
Author Affiliation: University of Dar Es Salaam, Tanzania—Computer Science Department
Abstract: This presentation explains the background and core activities of the District Health Information Software (DHIS) implementation in the Coast Regions of Tanzania. It describes the progress related to the implementation, specifically user support and the preparation of health management information system/DHIS training material. In addition, it describes the improvements of DHIS v2 and associated requirements analysis.

49. Kimaro HC. Strategies for developing human resource capacity to support sustainability of ICT-based health information systems: A case study from Tanzania. *The Electronic Journal of Information Systems in Developing Countries.* 2006;26(2):1–23.
Type: Journal
Keywords: developing countries | health information system | health information systems | health sector | HIS | human resource capacity | ICT literacy | information system | information systems | support | sustainability
Country: Tanzania
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: Information and communication technologies (ICTs) are typically introduced in organizations with the promise to help manage resources, increase efficiency, increase work

productivity and reduce workload. In the context of developing countries, the lure of these promises is magnified given the existing conditions and inefficiencies. International aid agencies play an important role in shaping this promise. However, introduction and use of ICTs in developing countries has proven problematic due to failures or unsustainability resulting from many factors. One important factor is the lack of appropriate human resources both with respect to quantity and quality. This paper emphasizes that human resource capacity building in developing countries is an urgent issue of concern for the sustainability of ICTs. Drawing on concepts of sustainability, ICT literacy, and human capacity building, this paper analyzes challenges related to human resources in health information systems (HIS) and ICTs in the health sector of Tanzania and suggests some strategies to address the problem. Specifically, the paper focuses on initiation of ICT based HIS in the context of the health sector and argues for human resources with a mix of skills to understand the meaning of data, information, and the use of computers.

50. Kimaro HC, Mengiste SA, Aanestad M. Redesigning health information systems in developing vountries: The need for local flexibility and distributed control. *Journal of Public Administration and Development*. 2007;28:18–29.
    Type: Journal
    Keywords: decentralisation | distributed control | Ethiopia | flexibility | health information system | health information systems | information system | information systems | Tanzania | HIS | health care | developing countries | requirements | results | standards | health services | IT | recommendations
    Country: Ethiopia, Tanzania
    Author Affiliation: University of Dar es Salaam, Dar es Salaam, Tanzania; University of Oslo, Oslo, Norway
    Abstract: Despite widespread aims to strengthen the health information system (HIS) as a tool for decentralized health care, there is a strong tendency in most developing countries that the HIS continues to reflect the central level's needs and requirements. The traditional design approach with little or no end user involvement results in a centralized HIS with an extensive, somewhat inappropriate, but also inflexible set of standards. Consequently, the HIS is not very useful for the wished for decentralization of health services, and there is an urgent need to redesign the existing HIS in order to make it locally relevant and appropriately decentralized. Based on a comparative case analysis of the HIS in Tanzania and Ethiopia, the authors offer practical recommendations on the way to achieve this redesign. A central design goal should be to achieve a balance between centralized control and local autonomy. Some degree of control over a decentralized HIS, including budgets and the use of resources, should be delegated to the district administration. In order to achieve the aim of a locally relevant, well-working HIS, it is necessary that appropriate authority, capacity and decentralized allocation of resources for HIS will be developed at the district and sub-district levels.

51. Kimaro HC, Nhampossa JL. Analyzing the problem of unsustainable health information systems in less-developed economies: Case studies from Tanzania and Mozambique. *Information Technology for Development*. 2005;11(3):273–298.
    Type: Journal
    Keywords: development | health information system | health information systems | HIS | human resource capacity | implementation | information system | integration | IT | Ministry of Health |

Mozambique | policy | software development | sustainability | systems development | Tanzania
Country: Mozambique, Tanzania
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: Most of donor-supported information technology (IT)-based projects developed or implemented in less-developed economies (LDEs) end up as complete or partial failures or unsustainable. Notably, a number of intra-organizational and external factors are associated with this problem, including inadequate infrastructure and human resource capacity, fragmented donor policy, and lack of policies to manage the sustainability problem. Accordingly, IT initiatives are often donor-driven, top-down, and hijacked by top managers who (normally) do not have adequate skills, but have enormous power to enforce such initiatives across organizational hierarchies.In analyzing the concepts from sustainability and institutionalization, key insights towards a better understanding of the problem of unsustainability are developed. It is argued that health information systems (HIS) become sustainable if they are institutionalized in the sense of being integrated into the everyday routine of the user organization. However, a sustainable HIS should also be flexible enough to allow changes as the user needs change. Moreover, introduction of a new HIS is not only a technical change, but requires the cultivation and institutionalization of a new kind of culture. Through a comparative case analysis of the HIS development and implementation processes in Tanzania and Mozambique, the authors have identified two sets of relationships, between the Ministry of Health (MOH) and donor agencies and between the MOH and software development agencies as critical and contributing factors to the unsustainability of a HIS. Given this setting, they highlight three key strategies for dealing with the problem of unsustainability in LDEs: (a) integration of a HIS, (b) local shaping of new cultures, and (c) cultivation approach to systems development.

52. Kimaro HC, Sahay S. An institutional perspective on the process of decentralization of health information systems: Case study from Tanzania. *Information Technology for Development*. 2006;13(4):363–390.
Type: Journal
Keywords: health information systems | information system | Tanzania
Country: Tanzania
Author Affiliation: University of Oslo, Department of Informatics, Oslo, Norway
Abstract: Attempts to decentralize Health Information Systems (HIS) are ongoing in various developing countries as a part of health sector reforms. Donor communities in particular have often insisted on decentralization of health care systems as a mechanism to encourage quality and sustainability of health services and availability of timely resources at local levels by removing layers of bureaucracy. The decentralization of HIS along with the system of health care delivery is emphasized to support the efficiency and management of health services by incorporating local use of information in decision making and planning. However, these goals of decentralization are not easily achieved because of the complexity of the institutional context in which the decentralization is being carried out. Drawing from institutional theory, the authors study the process of decentralizing HIS in Tanzania. They identify three key sets of institutional influences on the HIS originating from the political administrative, health management, and health service delivery systems. Through an ongoing empirical analysis, they identify the gaps between the formal rules that govern the reform process and the informal constraints that operate on the ground and "keep the show going." The existence of these gaps contributes to the ineffective results obtained through the reform process. The need for both vertical and horizontal alignment is emphasized as an approach to addressing these gaps in the future.

53. Kimaro HC, Titlestad OH. Challenges of user participation in the design of a computer-based system: the possibility of participatory customization in low-income countries. *Journal of Health Informatics in Developing Countries.* 2008;2(1):1–9.
Type: Journal
Keywords: low income countries | participatory customization | systems development
Country: Cuba | India | Mozambique | South Africa | Tanzania
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: Participatory design is generally regarded as an effective approach in systems development to overcome challenges such as changing contexts, difficulties of capturing users' needs, and problems of achieving systems' acceptance. However, user participation is associated with certain contextual assumptions or beliefs from its origin in the West that are not always applicable in the context of low-income countries. The initial technical capability of users, motivation and desire to participate, availability of resources, and long-term support mechanisms are often taken for granted in the West, but in many cases not present in the context of low-income countries. In the Western setting, due to favorable socioeconomic and political conditions and the presence of skilled users, an approach to design of systems from scratch with user participation tend to give quality systems. However, in a low-resource setting where the intended users have limited computer skills, there is a need to put an extra effort into training and to find alternative approaches to achieve participation in system design. In such a setting, the authors argue that participatory customization, a process where the users in collaboration with the developers adapt an already developed or partly developed system to meet the needs of their own workplace, can be a better approach. In this paper the authors approach participatory customization in low-income countries by looking in detail at the customization of District Health Information Software in two pilot health districts in Tanzania. The Tanzanian project is part of a global research initiative (the Health Information System Programme), and in order to put forward more general approaches for low-income countries, the authors compare their findings from Tanzania with similar customization processes in Cuba, India, Mozambique and South Africa.

54. Kimaro HC, Twaakyondo HM. Analyzing the hindrance to the use of information and technology for improving efficiency of health care delivery system in Tanzania. *Tanzania Health Research Bulletin.* 2005;7(3):189–197.
Type: Journal
Keywords: health sector | IT | lessons learned
Country: Tanzania
Author Affiliation: University of Dar es Salaam, Tanzania—Department of Computer Science
Abstract: Information technologies (IT) have been described as offering tremendous opportunity to improve health services as well as in meeting broader developmental goals which have an impact on health. Through the use of IT, health care sectors can potentially plan, monitor, and evaluate health services as well as communicate more effectively within and across organizational hierarchies. However, a number of studies suggest several hindrances where the use of IT to bring critical change in the health sector of Tanzania has been problematic. Despite the lack of appropriate use of the existing IT resources in the health sector, donors and government have continued helping the health sector to acquire up-to-date IT resources while placing little emphasis on long-term IT training, data management, and effective use of information resulting in wasted resources, hence little improvement in health services delivery. This study is based on the Health Information System Programme (HISP), an

action research project aimed at improving health information system in developing countries with the use of IT and information for local action. Under the project, the District Health Information Software which is customizable, open source, and freely distributed has been implemented in five pilot districts in Tanzania. The lessons learned from the HISP project and other levels of the health sector in general indicate the lack of skills for data interpretation and use, policy guidelines on information and human capacity building as well as a lack of a flexible system.

55. Kossi EK, Saebo JI, Titlestad O, Tohouri RR, Braa J. *Integrating health information systems in Sierra Leone*. Oslo: University of Oslo, Norway; 2009.
Type: Thesis/Dissertation
Keywords: alternative technologies | integration | open source | solar power | technical solution
Country: Sierra Leone
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: This paper presents an ongoing project in Sierra Leone to integrate HIS at the district and national level through a novel approach. Employing solar-powered low-energy computers running Linux, a wide consortium of local and international actors have tried to counter the severe problems of electricity supply breakdowns and computer viruses. The paper discusses the experiences from this effort, as well as the integration process itself, and the corresponding capacity-building strategies. The findings so far suggest that alternative technologies, namely solar power and open source software, can be fruitful to apply in such infrastructural settings as Sierra Leone presents. Furthermore, the technical solution to an intermediary step toward integration shows some promising results.

56. Kumar SP, Sahay S, Lewis J. Building participatory HIS networks: A case study from Kerala, India. *Information and Organization*. 2009;19(2):63–83.
Type: Journal
Keywords: health information systems | HIS | India | Kerala | participatory design | participatory networks
Country: India
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: This paper addresses the challenge of developing participatory networks to support the design, development and implementation of health information systems (HIS) in the context of public health in Kerala, India. It is argued given the nature and complexity of HIS, there is the need to bring together our understanding of participation from two streams of development theory and IS design and development. While development theory provides interesting insights on how to enable participatory processes, they tend to not consider technology. Further, traditional participatory design in information systems research has its origins in Western workplaces, often quite divorced from the context of public health in developing countries. In trying to combine these two streams of learning, the authors propose and develop the concept of participatory networks. Drawing upon an ongoing empirical analysis of an action research effort to introduce, scale and sustain health information systems in Kerala, this paper elaborates on the nature of participatory networks that come into play, and the various mechanisms and purposes of participation with the different network partners. In the discussion section, four areas of re-conceptualization of participation in the context of HIS in developing countries are identified: (1) creation of participatory networks; (2) increased context sensitivity; (3) focus on

outputs of participation, not just inputs and techniques; and, (4) focus on structural aspects of participation, not just behavioral issues.

57. Lungo J. *Design-reality gaps in open source information systems development*. Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Keywords: open source | IT | policy | development | information systems | information system | developing countries | action research | implementation | challenges
Country: Tanzania
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: The core concept of free and open source software (FOSS) is that full access to software source code must be granted in order to give individuals the freedom to create, use, and distribute software. It emphasizes the logic of nondiscrimination to create conditions for free action and thought. This makes FOSS to be reminiscent of the Ujamaa policy of Tanzania which argues for all members of the society to have equal rights and equal opportunities.

This thesis presents a theoretical and empirically informed analysis of FOSS development in information systems (IS) using cases from the health and education sectors in Tanzania. It focuses on the interplay between the socio-technical conditions of IS in developing countries and the FOSS development approach. The research design was based on participatory action research. The objectives were to illuminate the design-reality gaps in FOSS development in the context of developing countries.

Three archetypal situations that exacerbate the reality of FOSS implementation in developing countries were identified as developer-sponsor, global developer-local developer, and local developer-local user gaps. The thesis recommends that implementing FOSS in IS requires substantial investment on localizing the software, training users, and developing support networks. The advantage of FOSS development in developing countries centers on the formation of sustainable collaborative networks through sharing of software and knowledge. These networks are important in helping a developing country to support the day-to-day customization and managing of FOSS products. Based on the findings of this study, an alternative conceptualization of FOSS development which emphasizes co-located project organizations as a coping strategy to meet the challenges of social-technical influences is advisable. This is a different approach from working on virtual teams, as the literature presents the development and organization approaches of FOSS.

58. Lungo JH. The reliability and usability of district health information software: case studies from Tanzania. *Tanzania Journal of Health Research.* 2008;10(1):39–45.
Type: Journal
Keywords: implementation | qualitative data | recommendations | usage
Country: Tanzania
Author Affiliation: University of Dar Es Salaam, Tanzania—Department of Computer Science
Abstract: District Health Information Software (DHIS) from the Health Information System Programme (HISP) based in South Africa is widely implemented in many developing countries as a health data analysis tool. Through the HISP-Tanzania project, DHIS was piloted in five districts in Tanzania. The objective of this study was to qualify and quantify the extent to which district health workers consider the adaptation of the DHIS software to the needs of the routine health management information system. In a period of 14 months (from June 2003 to August

2004) data were collected from health workers trained to use the software through a triangulation of various qualitative data collection techniques including interview, questionnaire, participant observations, and retrospective testing. The software was evaluated in terms of reliability, usability, and user satisfaction. In general the reliability of the software was rated high, but its usability was rated to be low. The software was found not to accommodate some health data from various health programs, and there was a mismatch between the implemented online data entry forms/reports and their respective paper-based forms/reports. The study recommends improved design of the DHIS user interface (forms) and reports to replicate the paper-based forms in order to ensure usability and reduce the incidences and impact of human errors in the keying in of health data.

59. Lungo JH, Igira F. Development of health information systems in Zanzibar: Practical implications. *Journal of Health Informatics in Developing Countries.* 2008;2(1):24–32.
Type: Journal
Keywords: DHIS | HISP | information systems | network analysis | open-source | translation process
Country: Tanzania
Author Affiliation: Department of Computer Science University of Dar-es-Salaam; Department of Informatics, University of Oslo, Oslo, Norway
Abstract: The Ministry of Health in Zanzibar has embarked on health information system development with the aim of streamlining health data collection, storage, analysis and reporting in order to attain data-driven informed decision-making. The project involved two aspects: development of essential health data sets and implementation of a computerized data-storage and analysis tool. From January 2005 to December 2007 during the implementation of the project data were collected through a triangulation of qualitative methods: interviews, participant observation, document analysis, software development and training workshops. The study indicates that carefully-planned leadership of a project, clearly-stated goals and distinction between the roles of technical and sponsor networks strengthen an information and communication technologies (ICT) project immeasurably. Lessons drawn include the use of local, culturally-immersed leaders to spearhead the project and the use of flexible open-source software as translators of the primary actor's interest in achieving the goals through enrolling other actors.

60. Lungo J, Sheikh YH, Igara F, et al. *Building Health Management Information System for Zanzibar: Opportunities and Challenges.* 2006.
Type: Report
Keywords: healthcare data management | HMIS review | information systems
Country: Zanzibar
Author Affiliation: University of Dar es Salaam, Tanzania—Computer Science Department; University of Oslo, Norway—Department of Informatics; The State University of Zanzibar, Zanzibar—Department of Computer Science and Information Technology; Ministry of Health and Welfare, Zanzibar
Abstract: A unified, effective, and action-oriented health management information system (HMIS) is very important for health care data management. In November 2004, the Ministry of Health in Zanzibar and its stakeholders conducted a HMIS review. The results revealed that the HMIS is fragmented and does not support data driven decision-making. To address these shortcomings, a roadmap toward development of an HMIS was agreed to as development of

essential datasets and development and implementation of a computer database. The decision was to take District Health Information Software, developed by the Health Information System Programme (HISP) and customize it to fit the context in Zanzibar. HISP is a global project using action research and participatory design approaches to empower the emerging local health management structures and health workers through improved and locally based information systems in a number of developing countries. During the design and implementation process, there were three main challenges: (1) developing effective, need-based and indicator-driven datasets; (2) training of district officers on managing a computer database in the context of poor computer literacy; (3) gradually improving the quality of data and use of information for management. This is an ongoing project and experiences from HISP networks are exploited to address these challenges.

61. Madon S, Sahay S, Sudan R. E-government policy and health information systems implementation in Andhra Pradesh, India: Need for articulation of linkages between the macro and the micro. *Information Society*. 2007;23(5):327–344.
Type: Journal
Keywords: e-government | evaluation | implementation | information systems | millennium development goals | policy
Country: India
Author Affiliation: London Business School, United Kingdom—Information Systems and Innovation Group; University of Oslo, Norway—Department of Informatics; World Bank, ICT Group.
Abstract: In recent years, many different types of e-government projects have been implemented across the developing world. One important application area, especially following the Millennium Development Goals, is the introduction of health information systems to improve the management of health care for development. Despite significant investments in these projects, experience reveals a disjuncture between macro-level policy priorities and micro-level implementation of these programs. The authors use a broad conceptualization of evaluation to synthesize priorities at different levels during the implementation of an e-government project, the Health Information System Programme, in Andhra Pradesh, India. They identified important enabling processes and conditions which serve to connect policy and implementation priorities. The findings suggest that evaluation does help us to understand the disjuncture between policy at the macro level and implementation at the micro level and to identify linkages between the two. Finally, they discuss some of the key institutional issues that need to be addressed to translate the learning derived from the field into policy actions.

62. Macueve GA. *Analyzing challenges and opportunities of the implementation of e‑government initiatives for development through the lens of the capability approach: Case studies from Mozambique*. [PhD thesis]. Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Keywords: challenges | development | e-government | implementation | Mozambique
Country: Mozambique
Author Affiliation: University of Oslo, Oslo, Norway

63. Mate KS, Bennett B, Mphatswe W, Barker P, Rollins N. Challenges for routine health system data management in a large public programme to prevent mother-to-child HIV transmission in South Africa. *Plos One*. 2009;4(5):e5483.
Type: Journal

Abstract: Background: Recent changes to South Africa's prevention of mother-to-child transmission (PMTCT) of HIV guidelines have raised hope that the national goal of reducing perinatal HIV transmission rates to less than 5% can be attained. While programmatic efforts to reach this target are underway, obtaining complete and accurate data from clinical sites to track progress presents a major challenge. The authors assessed the completeness and accuracy of routine PMTCT data submitted to District Health Information Software (DHIS) in 3 districts of Kwazulu-Natal province, South Africa. Methodology/principal findings: the authors surveyed the completeness and accuracy of data reported for six key PMTCT data elements between January and December 2007 from all 316 clinics and hospitals in three districts. Through visits to randomly selected sites, they reconstructed reports for the same six PMTCT data elements from clinic registers and assessed accuracy of the monthly reports previously submitted to the DHIS. Data elements were reported only 50.3% of the time and were "accurate" (i.e., within 10% of reconstructed values) 12.8% of the time. The data element "Antenatal Clients Tested for HIV" was the most accurate data element (i.e., consistent with the reconstructed value) 19.8% of the time, while "HIV PCR testing of baby born to HIV positive mother" was the least accurate with only 5.3% of clinics meeting the definition of accuracy. Conclusions/significance: data collected and reported in the public health system across three large, high HIV-prevalence districts was neither complete nor accurate enough to track process performance or outcomes for PMTCT care. Systematic data evaluation can determine the magnitude of the data reporting failure and guide site-specific improvements in data management. Solutions are currently being developed and tested to improve data quality.

64. Mavimbe JC, Braa J, Bjune G. Assessing immunization data quality from routine reports in Mozambique. *BMC Public Health*. 2005;5(108):1–8.
Abstract: Background: Worldwide immunization coverage shows an increase in the past years but the validity of the official reports for measuring change over time has been questioned. Facing this problem, donor supported initiatives like the Global Alliance for Vaccine and Immunizations, have been putting a lot of effort into assessing the quality of data used, since accurate immunization information is essential for the Expanded Program on Immunization managers to track and improve program performance. The present article, discusses the practices on record keeping, reporting and the support mechanism to ensure data quality in Mozambique.

Methods: A process evaluation study was carried out in Mozambique in one district (Cuamba) in Niassa Province, between January and March 2003. The study was based on semi-structured interviews, participant observation, and review of the data collection materials.

Results: Differences were found for all vaccine types when comparing facility reports with the tally sheets. The same applies when comparing facility reports with district reports. The study also showed that a routine practice during supervision visits was data quality assessment for the outpatient services but none related to data consistency between the tally sheets and the facility report. For the Expanded Program on Immunization, supervisors concentrated more on the consistency checks between data in the facility reports and the number of vaccines received during the same period. Meetings were based on criticism, for example, why health workers did not reach the target. Nothing in terms of data quality was addressed nor validation rules.

Conclusion: In this paper we have argued that the quality of data, and consequently of the information system, must be seen in a broader perspective not focusing only on technicalities (data collection tools and the reporting system) but also on support mechanisms. Implications of a poor data quality system will be reflected in the efficiency of health services facing increased demands, with stagnant or decreasing resources.

65. Mengiste SA. Analysing the challenges of IS implementation in public health institutions of a developing country: The need for flexible strategies. *Journal of Health Informatics in Developing Countries*. 2010;4(1):1–17.
   Type: Journal
   Keywords: challenges | developing countries | Ethiopian health care system | flexible strategies | health information systems | implementation | health information system | information system | health care | Ethiopia | HIS | support | essential data set
   Country: Ethiopia
   Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
   Abstract: This paper explores the challenges of introducing computer-based health information systems in the context of the Ethiopian public health care system. Drawing empirical examples from the process of introducing computer-based health information system (HIS) in two regional states (Amhara and Benishangul-Gumuz) of Ethiopia, this paper analyses the socio-technical challenges influencing the transition toward a new computerized system and suggested the importance of developing context-sensitive strategies to tackle different challenges in different contexts. Building on the notions of installed base and cultivation the paper examines the socio-technical issues and factors that influenced the process of developing, customizing, and implementing computerized HIS in different settings. The findings of this paper revealed that contextual differences in terms of access to infrastructural resources, availability of adequate and qualified manpower, and managerial commitment and support would significantly influence the implementation process. The author argues that, such context-sensitive challenges need to be dealt with through flexible strategies that took in to account the specific context. In this paper, four different flexible strategies: the strategy of gateways, top-down vs bottom-up approaches, flexible essential data sets and clustering have been identified as being useful in implementing computer-based systems in different settings of the Ethiopian public health care system.

66. Mengiste SA. *Shaping technology across social worlds*. Oslo: University of Oslo, Norway; 2010.

Type: Thesis/Dissertation
Keywords: challenges | scaling | developing countries | development | implementation | health information system | information system | data collection | IT | sustainability
Country: Ethiopia
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: This thesis aims to address the challenges of successfully implementing, scaling, and sustaining information and communication technology interventions in developing countries. The thesis argues that an effective learning process is crucial for successful information system (IS) development and implementation. The focus of the thesis is on understanding the dynamics of learning in IS projects with a specific orientation to the need for mutual learning among members of different social worlds.

Theoretically, the work draws on recent attempts to bridge the practice-based and cognitive accounts of learning, based on the concepts of negotiated order and social worlds from Anselm Strauss. Empirically this is studied in the context of a project aiming to introduce a computerized health information systems (HIS) in Ethiopia, where IS developers and public health domain experts collaborated. Specifically, the thesis seeks to explore how tensions and conflicts may trigger learning among different stakeholders within and between multiple social worlds. This thesis describes HIS development, adaptation, and implementation as a complex and dynamic process of change that involved the interaction, communication, and negotiation of several stakeholders from different social worlds with varying interests, commitments, and values. Through the negotiated order of specific learning arenas, diverse stakeholders interacted, communicated, and negotiated on a number of problems and issues including: data collection and reporting tools, existing work practices and routines, the application of computerized system to improve existing practices, and type of skills and knowledge required to develop and sustain the system.

Taking an interpretive approach, the researcher has documented the learning process through semi-structured interviews, informal discussions, and interactions participant observation during meetings, discussions, workshops, seminars, and trainings, as well as document analysis (including official reports, strategic documents, memorandums of understanding, and e-mail conversations). The thesis contributes by introducing a new theoretical lens for conceptualizing HIS development as a process of learning across social worlds. This approach is useful as it improves the understanding of the role of learning in relation to the challenges of scaling, sustainability, and installed base cultivation.

67. Mosse EL. *Understanding the introduction of computer-based health information systems in developing countries: Counter networks, communication practices, and social identity. A case study from Mozambique*. [PhD thesis]. Oslo: University of Oslo; 2005.
Type: Thesis/Dissertation
Keywords: health information systems | developing countries | Mozambique
Country: Mozambique
Author Affiliation: University of Oslo, Oslo, Norway

68. Mosse EL, Sahay S. The role of communication practices in the strengthening of counter networks: Case experiences from the health care sector of Mozambique. *Information Technology for Development*. 2005;11(3):207–225.

Type: Journal
Keywords: counter networks | communication practices | primary health care | developing countries | health care | health information systems | HIS | HISP | information system | Mozambique | primary health care
Country: Mozambique
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway.
Abstract: In this article the authors provide a theoretically informed empirical analysis of the introduction and use of information and communication technology within the primary health care (PHC) sector of Mozambique. The theoretical lens for this analysis is developed from Manuel Castells' (1996, 1997, 2001) ideas on the network society and counter domination. These ideas help them to conceptualize the communicative action required to strengthen the PHC sector as a "counter network," which has the normative aim to strengthen the health information system (HIS) as a key strategy to improve health care delivery. Taking an informational perspective, the role of communication is highlighted as playing an important constitutive basis in the strengthening of this network. These conceptual ideas are applied to the empirical analysis of an ongoing project (the Health Information Systems Programme), and to analyze some key constraints and strategies for strengthening these networks. This study makes key contributions to both the theoretical and practical domains of HIS in developing countries.

69. Muquingue H. *Understanding and improving medical students' exposure to health management in rural settings of Mozambique*. [PhD thesis]. Oslo: University of Oslo; 2009.
Type: Thesis/Dissertation
Country: Mozambique
Author Affiliation: University of Oslo, Oslo, Norway

70. National AIDS Control Programme. *Overview of DHIS Pilot-Testing (Tanzania).* Tanzania: Ministry of Health and Social Welfare; 2010.
Type: Report
Keywords: HIV | monitoring and evaluation | pilot testing | STI | VCT
Country: Tanzania
Author Affiliation: Ministry of Health and Social Welfare, Tanzania—National AIDS Control Programme
Abstract: This report provides an overview of pilot testing for District Health Information Software in the Coast Regions of Tanzania, including: background, rationale for selection, purpose of strengthening monitoring and evaluation for sexually transmitted infections and voluntary counseling and testing services, process for pilot test, and description of deliverables.

71. Nguyen TN. *OSS for health care in developing countries* [master's thesis]. Oslo: University of Oslo; 2007.
Type: Thesis/Dissertation
Keywords: action research | developing countries | development | health care | implementation | open source
Country: Ethiopia | Vietnam
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: This thesis investigates issues related to the development and implementation of open source software (OSS) for health care in developing countries. The aim is to understand why the same OSS technology for health care leads to varying outcomes in different developing countries and how to find effective ways to organize it.

A theoretical perspective inspired by the Social Construction of Technology (SCOT) theory was employed to set a base for the analysis process. A comparative case analysis was carried out over the development and use processes for two OSS applications (District Health Information Software v2 and patient-based systems) that were both developed and used in two developing countries, Ethiopia and Vietnam. Four comparative case studies (across countries and across systems) thus emerged. Social conditions inferred from the SCOT literature that served as the point of departure for the starting point of the author's analysis included (1) team structure and organization, (2) technical capacity, (3) nature of the sector, and (4) technology introduction process.

The study was informed by qualitative methods, and carried out within an action research framework over the period of 2005 to 2006. Through the analysis process, three main categories of social conditions relevant in shaping the outcomes were identified, which are technical infrastructure, organizational arrangements, and development process. Points of departures between the author's theoretical inferences and as seen in the traditional SCOT literature were identified such as the level of internet dependence and the dedication and commitment of developers. These conditions were seen to be specifically relevant to the empirical domain characterized by OSS, developing countries, and health care.

In making these inferences, this thesis makes a contribution to the domain of social analysis of OSS applications. Practically, the research suggests implications in managing OSS projects for health care in developing countries such as emphasizing the role of appropriate team organization and structure, managing the technology introduction process, strengthening the link between development and use, and sensitively cultivating the support from the network.

72. Nhampossa, JL. *Re-thinking technology transfer as technology translation: A case study of health information systems in Mozambique*. [PhD thesis]. Oslo: University of Oslo; 2006.
Type: Thesis/Dissertation
Keywords: action research | challenges | developing countries | development | DHIS | health information system | HIS | ICTs | information system | IS | IT | Mozambique | participation | research design | scaling | situation analysis | South Africa | translation process
Country: Mozambique; South Africa
Author Affiliation: University of Oslo, Oslo, Norway
Abstract: This thesis presents a theoretically and empirically informed analysis of "technology transfer" of a computer-based health information system (HIS) within a South-North-South network involving Mozambique, South Africa and Norway. Technology transfer from the North to the South has historically been problematic, including the domain of information and communication technologies (ICTs) more broadly and HIS in particular. It is argued that the diffusion perspective, the dominant approach employed to technology transfer, is inherently problematic, and there is the urgent need to identify alternative conceptualizations. Against this backdrop, this thesis addresses two research aims: (1) to develop a theoretical conceptualization of technology transfer based on a "translation perspective," and (2) to understand and address the (empirical) challenges shaping the translation process of a computer-based HIS in South-North-South networks.

The theoretical foundation of the thesis is informed by translation perspective offered by actor network theory. The concept of translation is adapted in this thesis to reflect a process of incremental change involving a socio-technical heterogeneous network, which leads to the

development of sustainable network, implying that they are both institutionalized and flexible enough to change as per evolving institutional needs. Given this conceptualization of translation, a theoretical framework is developed which identifies four influences on this translation process, (1) of history: legacy systems and installed base; (2) of the role of adaptation: how software is adapted to the local context; (3) of the role of participation: how users exercise control over HIS; and, (4) of the process of customization: the balance between localization and internationalization.

The empirical foundation of the thesis is a South-North-South collaborative network case study of computer-based HIS adaptation in Mozambique, under an ongoing action research project called Health Information Systems Programme which was initiated in South Africa in 1994 and its subsequent "transfer" to Mozambique in 1998. The thesis examines the various challenges and opportunities that were involved in this process, based on empirical work carried out during the period from 2000 to 2003 in selected districts, provinces, and also at the national level. The research design is characterized by four key features, (1) action research; (2) longitudinal case study; (3) multiple level analysis; and, (4) interpretative approach. The research approach is primarily based on the principles of prototyping, which was applied as four iterative action research cycles: (1) situation analysis; (2) selecting the minimum functionality; (3) matching the prototype with the context; and, (4) scaling up the DHIS.

The research findings are articulated in research papers presented as appendix of the thesis, which address the four themes identified above. In each of these four cases the author tried to elaborate upon the relationship between these conditions and their mutual relationships with respect to the process of translation as conceptualized in this thesis. For example, while working on the task of translating the software, he encountered various problems such as the meaning of words, the length of strings, the interaction with the South African development team. These practical experiences helped him to interpret how the language translation problem influenced and was influenced by the larger process of technology translation. This helped him to define the relation between software adaptation and technology translation as the need for sensitivity whilst moving software from one context by identifying the context free and dependent features of the technology through an ongoing process of cultivation.

The research makes both theoretical and practical contributions to the domain of IS research more generally, and to HIS in developing countries more specifically. Three theoretical contributions arising from the thesis are: an alternative conceptualization of this process as "technology translation" with particular emphasis on building local capacity, expertise, and creating a learning climate required to localize, maintain and evolve the technology over time in manner which is of value for the institution; enabling participation in non-western contexts involves dealing with unique challenges both with respect to the mechanisms and contents of participatory approaches; the need to respect history and take into account legacy information systems, both in technical and institutional terms. The three practical contributions arising from this thesis are: the need to cultivate the installed base using gradual versus radical change strategies; to develop mediating mechanisms to enable participatory processes; and, the need to find a pragmatic balance between internationalization and localization with process rather than product orientation as the underlining objective.

73. Nicholson B, Sahay S. Deinstitutionalization in the context of software exports policymaking in Costa Rica. *Journal of Information Technology*. 2009;24(4):332–342.
Type: Journal
Keywords: Costa Rica | deinstitutionalization | national software export policy | policy | policy making
Country: Costa Rica
Author Affiliation: Manchester Business School, Manchester, UK; Department of Informatics, University of Oslo, Oslo, Norway
Abstract: This paper addresses deinstitutionalization from a longitudinal perspective. Drawing on the case of software exports policymaking in Costa Rica, it analyses deinstitutionalization, paying particular attention to formation of dissensus, understood as lack of unanimity on the value of an activity that is sufficient to destabilize institutional norms and activities. The role of cultural and political factors in deinstitutionalization or persistence is considered. Based on the empirical data, a framework for understanding political and cultural dynamics in deinstitutionalization is proposed.

74. Nyella E, Mndeme M. Power tensions in health information system integration in developing countries: The need for distributed control. *Electronic Journal of Information Systems in Developing Countries*. 2010;43(4):1–19.
Type: Journal
Keywords: developing countries | distributed control | health information systems | information system | integration | programs | standardization | structuration theory | vertical | health sector | HIS | modularization
Country: Tanzania
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway; Department of Computer Science, University of Dar es Salaam, Tanzania
Abstract: As part of health sector reform, most developing countries are in the process of restructuring their health information systems (HIS) by way of standardizing and integrating various vertical reporting systems. Nevertheless, the pressure resulting from the vertical systems supported by donors renders the integration goal challenging and unachievable. While many studies have argued for the heterogeneity of interests and multiple data needs of the donors as the major cause of the problem, this paper argues for more detailed and critical analysis of the problem. To contribute to this, the paper emphasizes the need to understand the main actors involved in the process in terms of the resources and rules available to them and their implication in the HIS integration venture. By drawing on an empirical case study and structuration theory concepts, the paper identified the dialectic power relations between the actors resulting from the asymmetric ownership and control of resources and rules. To alleviate the power tensions, the paper proposed (1) the need to build shared meaning of the integration process through communication approaches (2) and the need to distribute the control of the integrated HIS using modularization approach facilitating "the tapping on" of the resources available to each group of actors.

75. Omar MA, Charimari LS, Pinto A. The district health information system and its potential in the management of district and rural hospitals. *World Hospitals and Health Services*. 1994;30(3):15–20.
Type: Journal
Keywords: assessment | information systems | usage

Country: Zimbabwe
Author Affiliation: Instituto Superiore di Sanita, Italy
Abstract: A study to assess the role that the health information system (HIS) plays in the management of district and rural hospitals in Zvimba district (Zimbabwe) was carried out by the authors between August and October 1993. It revealed that there is an elaborate and well-developed set of tools which mainly collect data on morbidity, mortality, births, coverage, and health activities. Cost and financial data as well as community-based data are not entering the HIS at the peripheral level. Very little analysis and interpretation of data takes place at the rural and district hospitals, therefore limiting the indicators that could be derived. Staff use the raw data they collect mostly for patient care. In terms of processed data, there is little use made of it.

76. Østby TL. *Modularization and demodularization: Levels of a Java web application for open health* [master's thesis]. Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Keywords: modularization | portal | web application | web modules
Country: Non-specific
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: The outset of this thesis was to develop a solution for collecting separately deployable web modules into one seamless web application, a portal. The case study is District Health Information Software v2, a modular web application with a Java back end.

The task included collecting the modules, giving the module web pages a common look, creating a menu system for accessing the modules, and creating common web widgets used by all the modules. As part of the development process, the thesis looks at the various levels of modularization in the Java web application. Modularization can be applied to all levels of an application, from the innermost levels of code organization in methods, through classes and combinations of classes and interfaces, to system modules and complete applications. The thesis focuses on the impact of code organization and the use of Java language constructs in order to promote module flexibility, extensibility, reusability, testability, and forward compatibility. It also looks at how tools and frameworks affect the modularization of applications, and how the case study and developed solutions compare to high level service architectures.

77. Øverland JH. *An open source approach to improving GIS implementations in developing countries* [master's thesis].Oslo: University of Oslo; 2010.
Type: Thesis/Dissertation
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: Geographic information system (GIS) implementations have a tendency to fail in developing countries. This thesis seeks to explore whether a web-based free and open source software (FOSS) development approach can improve chances for sustainable and successful implementations.

To be able to conclude in this matter the author spent 15 months exploring GIS implementations in developing countries such as Sierra Leone and India, as well as reviewing existing GIS software in the market. The author identifies reasons why most GIS implementations in developing countries fail; what limitations are present; and how FOSS can deal with the technical, economical, and practical aspects of them. The author shows that FOSS has become

sufficiently mature and capable to build rich GIS applications in general. On the technical level the author documents a personally developed solution that solves a major issue regarding map data for most developing countries. Additionally, the author shows how technical restrictions to web-based GIS can be worked around.

During this process FOSS frameworks and tools to develop a GIS application for developing countries were used. This application is integrated into District Health Information Software, a flexible open source health information system that has gained a strong foothold in developing countries over the last years. In order to succeed the author used the technical skills and experience acquired through professional training by the founders of the software combined with knowledge from the literature and the developing-country field study presented in this thesis. A demonstration is available at demo.dhis2.org (username admin and password district).

78. Patrick J. *DHIS Implementation: Mtwara and Lindi Regions.* Tanzania: Clinton Health Access Initiative; 2010.
Type: Report
Keywords: challenges | HIV | implementation | situation analysis
Country: Tanzania
Author Affiliation: Clinton Health Access Initiative
Abstract: This presentation describes the District Health Information Software (DHIS) situation in two regions in Tanzania: Mtwara and Lindi. The report details the history of the DHIS implementation and its association with expanding access to HIV/AIDS care and treatment in rural areas. It includes a situation analysis of health management information systems in Mtwara and then goes on to address specific approaches in each region, along with progress, implementation challenges, and ways forward.

79. Puri SK. Integrating scientific with indigenous knowledge: Constructing knowledge alliances for land management in India. *MIS Quarterly*. 2007;31(2):355–379.
Type: Journal
Keywords: boundary objects | development | implementation | India | indigenous knowledge | information system | IT | developing countries | management | participation | rural development | scientific knowledge | support
Country: India
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: Information systems (IS) design and development processes by their very nature involve a multiplicity of knowledge systems, including the technology itself, the methodologies for system development, and knowledge relating to the application domain. When an information system is used to advance socio-economic development in less- developed countries (LDCs), there are additional sources contributing to this multiplicity. In the case of land management applications, it is important to consider the knowledge that communities have of the land they inhabit. This paper stresses the importance of constructing knowledge alliances between these multiple knowledge systems in order to support more effective IS development and implementation. The term knowledge alliance refers not merely to the material characteristics of the knowledge inscribed in technology, but also to the indigenous knowledge of the various communities involved. This includes the social setting that has shaped the practices which are responsible for the communities' production, articulation, and use of knowledge. Two key theoretical concepts, namely boundary objects and participation, are drawn upon both to understand the multiplicity of knowledge systems and to suggest possible

approaches to the creation of effective knowledge alliances. The empirical setting for this analysis is a study of the use of geographical information systems for land management in India. This research is not of merely theoretical significance, but also carries important practical implications for scientists and administrators involved in the development of IS, particularly in LDCs.

80. Puri SK. Technological frames of stakeholders shaping the SDI implementation: A case study from India. *Information Technology for Development.* 2006;12(4):311–331.
Type: Journal
Keywords: implementation | India | NSDI | SCOT | spatial data infrastructures | technological frames | development | IT | developing countries
Country: India
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: The theory of technological frames provides a useful lens to analyze and understand diverse meanings and expectations attached by different stakeholder groups around information and communication technologies (ICTs) sought to be introduced in organizations. These differing perceptions have been found to variously problematize new information system (IS) design and implementation efforts. In this article, the key concepts articulated around technological frames are drawn upon to analyze the meanings, assumptions, and expectations espoused by different stakeholders in context of the development of the National Spatial Data Infrastructure (NSDI) in India. It is argued that the theory of technological frames, with its roots in socio-cognitive and social construction of technology research arenas, helps improve our understanding of the aspects. It is further argued that IS/geographical information system-related research needs to move beyond merely diagnosing the diversity of interpretations towards suggesting how these may be negotiated and resolved. The Indian NSDI setting is accordingly discussed and analyzed in this article. The research findings, however, have a wider applicability, being also germane to similar ICT initiatives being taken in other developing countries.

81. Puri SK. T*he challenges of participation and knowledge in implementing GIS technology: Case studies from India*. [PhD thesis]. Oslo: University of Oslo; 2003.
Type: Thesis/Dissertation
Keywords: challenges | participation | India
Country: India
Author Affiliation: University of Oslo, Oslo, Norway

82. Puri SK, Sahay S. Role of ICTs in participatory development: An Indian experience. *Information Technology for Development*. 2007;13(2):133–160.
Type: Journal
Keywords: community networks | developing countries | development | Gyandoot | ICTs | ICTs in rural development | India | information system | IS | participation | rural development
Country: India
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: Participation of local communities has been important at least in two domains: (1) rural development processes in developing countries and (2) information systems design. The issue of participation becomes especially important in the contemporary contexts in which the use of information and communication technologies (ICTs) is being integrated within rural development initiatives in developing countries, for example in e-governance. This article

attempts to synthesize the issues around participation from both IS and development studies literature in order to identify four key problematic areas: (1) who defines the participation agenda, (2) what capabilities do stakeholders have to participate and how can this be strengthened, (3) what is the role of institutional conditions in enabling effective participation, and (4) how do local participatory processes experiences get integrated into broader networks to become sustainable. These four themes provide a theoretical framework to analyze how the use of ICTs is reconfiguring the dynamics between participation, rural development, and ICTs. This framework is applied in the context of an ICT initiative for rural development in India. Implications for both theory and practice are developed based on the need to judiciously integrate both structural and behavioral approaches to participation.

83. Puri SK, Sahay S, Lewis J. Building participatory HIS networks: A case study from Kerala, India. *Information and Organization*. 2009;19(2):63–83.
Type: Journal
Keywords: health information systems | HIS | India | Kerala | participatory design | participatory networks | support | development | implementation | information system | IT | IS | participation | developing countries | action research
Country: India
Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
Abstract: This paper addresses the challenge of developing participatory networks to support the design, development and implementation of health information systems (HIS) in the context of public health in Kerala, India. It is argued given the nature and complexity of HIS, there is the need to bring together our understanding of participation from two streams of development theory and information system design and development. While development theory provides interesting insights on how to enable participatory processes, they tend to not consider technology. Further, traditional participatory design in information systems research has its origins in Western workplaces, often quite divorced from the context of public health in developing countries. In trying to combine these two streams of learning, we propose and develop the concept of participatory networks. Drawing upon an ongoing empirical analysis of an action research effort to introduce, scale and sustain health information systems in Kerala, this paper elaborates on the nature of participatory networks that come into play, and the various mechanisms and purposes of participation with the different network partners. In the discussion section, four areas of re-conceptualization of participation in the context of HIS in developing countries are identified: (1) creation of participatory networks; (2) increased context sensitivity; (3) focus on outputs of participation, not just inputs and techniques; and, (4) focus on structural aspects of participation, not just behavioral issues.

84. Rohde JE, Shaw V, Hedberg C, Stoops N, Venter S, et al. Information for primary health care: Systems support. *South African Health Review*. 2008:195–209.
Type: Journal
Keywords: primary health care | health care | support | health information system | information system | survey | human resources | is | district health information system | management | health services | evaluation | development | recommendations
Country: South Africa
Abstract: This chapter reviews the role of information in decision making for primary health care. The concepts inherent in a routine health information system, and the measures to supplement that data with population surveys and special studies are discussed. The importance

of investing in human resources is also emphasized in this chapter. Issues such as the need to have adequate staff with appropriate skills to support the health information system are discussed, particularly because health information systems is a new field, which is poorly addressed by undergraduate training courses at present. The District Health Information System software and other information databases are described as the tools that support and inform the use of information for management and supervision at local and district levels. The information system is used for monitoring health services at facility level and is a powerful evaluation tool. Possible priority developments in the health information system are described. The chapter concludes with specific recommendations for strengthening health information systems in South Africa.

85. Saebo JI. *Final Report From BEANISH Activities in Botswana.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2008.
Type: Report
Keywords: evaluation | HIV | implementation
Country: Botswana
Author Affiliation: EU 6th Framework Programme, Priority 2 BEANISH Project
Abstract: This final report on the Building Europe Africa Collaborative Network for Applying Information Society Technologies in the Health Care Sector (BEANISH) activities in Botswana will cover the activities to date since the last quarterly report, as well as an evaluation regarding the objectives as outlined in the Revised Technical Annex. District Health Information Software (DHIS) has been rolled out to all districts as part of the eBHRIMS package for HIV/AIDS monitoring and evaluation. The institutionalization of the collection and reporting is driven forward by the National AIDS Coordination Agency and the Ministry of Local Government. The BEANISH team has been actively involved in the training of the 22 health information officers that are using eBHRIMS and has also assisted in installing and solving technical issues relating to DHIS.

86. Sæbø, J, Kossi, E, Hodne TO, Rolland TR, Braa J. Comparing strategies to integrate health information systems following a data warehouse approach in four countries. *Information Technology for Development—Information Communication Technologies and the Millennium Development Goals.* January 2011;17(1):42–60.
Type: Journal
Keywords: data warehouse | information systems | millennium development goals | political actors | technical solutions
Author Affiliation: *University of Oslo, Norway—Depart*ment of Informati**cs**
Abstract: This paper addresses one of the major obstacles of reaching the Millennium Development Goals (MDGs): inefficient and unreliable information systems. Leading international organizations have called for integrated data warehouses as one of the solutions, but this remains hard to achieve. This paper presents four country cases of standardizing and integrating health data which are all following what is here termed a data warehouse approach; data from across different health programs are organized in one database framework or data warehouse. In all countries, fragmentation of health information in different, partly overlapping subsystems run by different vertical health programs represented a major problem for the efficient use of health information.

While South Africa developed a new integrated system in addition to the existing fragmented subsystems, Batswana, Sierra Leone, and Zanzibar all aimed to encompass all or most of the

data from the existing systems. The three latter countries all followed slightly different approaches, more or less incremental in the approach to standardizing health data, and more or less strict in whether to include "all" data, and whether to solve all inconsistencies among the various data sets included early on. The four cases demonstrate that integration is as much, and maybe more, about aligning organizational-political actors as it is about technical solutions. The technical solutions are, however, important in aligning these actors and in enabling integration. The authors argue that "attractors," technical solutions or standards that achieve a certain level of success and enable the building of momentum, are important in aligning the various political actors. In turn, these attractors need to evolve within the changing context of a growing health information system in order to achieve the scale needed to address the MDGs with full force.

87. Sahay J. *Understanding organisational implementation of (G)IS from a human response development perspective India.* [PhD thesis]. Oslo: University of Oslo; 2006.
   Type: Thesis/Dissertation
   Keywords: implementation | development | India
   Country: India
   Author Affiliation: University of Oslo, Oslo, Norway

88. Sahay S, Lewis J. Strengthening Metis around routine health information systems in developing countries. *Information Technologies and International Development.* 2010;6(3): 67–87.
   Type: Journal
   Keywords: health information systems | information system | developing countries | development
   Country:
   Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
   Abstract: James Scott argues that, in state interventions, there are significant attempts to simplify, standardize, and make legible processes which, by definition, are too complex to realize such changes. Scott also argues that, as a result, many state interventions have led to large-scale tragedies. The alternative provided by Scott is to focus on metis-a form of local and practical knowledge which is aimed at local problem solving. In this paper, Scott's notion of metis is applied to public health information systems in developing countries to examine how the trend of traditional non-use of systems can be corrected. Two sets of implications are developed with respect to metis: the first at the level of system design, and the second relating to institutional agency in creating an environment in which metis can flourish.

89. Sahay S, Monteiro E, Aanestad M. Configurable politics and asymmetric integration: Health e-infrastructures in India. *Journal of the Association for Information Systems.* 2009;10(5):399–414.
   Type: Journal
   Keywords: asymmetric integration | information infrastructure | integration | political actors
   Country: India
   Author Affiliation: University of Oslo, Norway—Department of Informatics
   Abstract: Information Infrastructures typically evolve in an incremental fashion, through partly planned and unplanned processes. A significant mechanism of growth is when previously unconnected systems are integrated, facilitating the transition from networking to inter-networking. Conversely, failure to integrate systems contributes to the lack of evolution of the infrastructure. Integration seems crucial for evolving infrastructures; however, there is little consensus on what it entails, as can be seen when different connotations of "integration" are

unpacked. In contrast to the dominant view of integration as a largely technical concern, the focus is on how political and institutional interests are embedded in efforts to achieve integration. More specifically, the authors explore strategies for institutional integration that take into account uneven distribution of political influence. The paper builds on empirical material from their ongoing (2001 to 2008) involvement with the problem of fragmented information systems in the health care sector in India. The case is seen from the perspective of one small actor offering free, open-source software that is already being used in several other developing countries. Choosing to focus on a small actor highlights the asymmetric power relations among the actors; their actor has no other option than to seek to align with bigger and more influential actors. They analyze the strategies, the configurable politics, and the outcomes of the distinct configurations that emerge from this form of asymmetric integration.

90. Sahay S, Monteiro E, Aanestad M. Toward a political perspective of integration in information systems research: The case of health information systems in India. *Information Technology for Development*. 2009;15(2):83–94.
Type: Journal
Keywords: development | health information system | HISP | India | information system | integration
Country: India
Author Affiliation: University of Oslo, Oslo, Norway; The Norwegian University of Science and Technology
Abstract: There is an urgent need to address the issue of non-integrated health information systems (HIS) in developing countries. The existing literature on information systems (IS) integration, however, is overly optimistic and prescriptive. It is predominantly technical in orientation, often touting new and better technical approaches to deal with the integration challenges. The authors identify and build on critical literature that goes beyond the largely unchallenged consensus that integration is desirable (and doable). They are not arguing against integration per se, but discussing the challenges of actually achieving integration, specifically the political aspects of integration. The empirical material is drawn from an ongoing effort to computerize the health care sector and integrate IS systems in India. They focus on the sociotechnical and political aspects of integration of these systems. Their aims are (1) to address the conceptualization of integration within IS and (2) to provide guidelines for how integration can or should be managed in practice. This article, in understanding the political-technical aspects of integration, has implications not only to health and India, but also to other domains of IS in both developed and developing countries.

91. Sahay S, Sæbø JI, Molla MS, Gizaw AA. Interplay of institutional logics and implications for deinstitutionalization: Case study of HMIS implementation in Tajikistan. *Journal of Information Technology and International Development*. 2010;6(3):19–32.
Type: Journal
Keywords: data collection | deinstitutionalization | development | health care | health information system | health management information system | HISP | implementation | information system | institutional logic | IS | IT | management | primary health care | Tajikistan
Country: Tajikistan
Author Affiliation: University of Oslo, Oslo, Norway
Abstract: This document describes the efforts to reform the health management information system (HMIS) of Tajikistan. The authors were involved in proposing and piloting a

computerized HMIS, based on a complete overhaul of the current data collection tools. This proposal was based on experiences from a global HMIS project (called the Health Information System Programme), and advocated supporting local decision making by employing a flexible, decentralized system to collect, process, and analyze essential primary health care data. Having been a Soviet Republic for 70 years, the institutional logics underlying the current HMIS in Tajikistan were heavily influenced by the tenets of central planning, quite alien to the ideas proposed. This paper explores the institutional logics of what existed and what the authors proposed, and the interplay between them over the course of the project. The implications of this interplay on deinstitutionalization as an implementation strategy is sobering; first, it is clear that a complete deinstitutionalization, amounting to a paradigm shift, is necessary to overcome the differences in institutional logics, but at the same time this account shows how achieving this can be a remarkable challenge in a context of strong, centralized control. This study makes some interesting contributions to the field of information systems (IS). It introduces a study from a country which until now has been almost invisible to the IS community, in contributes to the debate about bottom up and top down implementation, and provides a conceptual framework of institutional logics, their interplay and implications for deinstitutionalization.

92. Sahay S, Walsham G. Research on IS in developing countries: Current landscape and future prospects. *Journal for Information Technology for Development*. 2006;12(1)7–24.
    Type: Journal
    Keywords: challenges | developing countries | development | ICTs | information and communication technologies | information systems research literature | development | developing countries | information system | IS | key challenges
    Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway; Judge Institute of Management, University of Cambridge, Cambridge, UK.
    Abstract: The current landscape of the information systems research literature concerned with developing countries is surveyed by examining a range of research articles published from 2000 onward. These are discussed in terms of the key challenges addressed, including the role of technology, and the methodological and theoretical approaches used. Prospects for future research are discussed, based on a conceptual view as to how to study information and communication technologies (ICTs) in developing countries, to classify existing work, identify gaps, and suggest future opportunities. The authors contribute to the important debate on how ICTs in general, and information systems research in particular, can make a positive difference in the developing countries.

93. Sahay S, Walsham G. Scaling of health information systems in India: Challenges and approaches. *Journal for IT and Development*. 2006;12(3):185–200.
    Type: Journal
    Keywords: challenges | development | globalization | health information system | India | information infrastructure | information system | IT | scaling | IS | primary health care | health care | human resource capacity
    Country: India
    Author Affiliation: Information Systems Group, Department of Informatics, University of Oslo, Oslo, Norway; Judge Business School, University of Cambridge, Cambridge, United Kingdom
    Abstract: This article addresses the issue of scaling of information systems (IS) in both theoretical and empirical terms. Scaling is an important issue in IS, especially in the

contemporary context of globalization, as attempts are ongoing to expand IS in the same context as well as take it into other contexts. Theoretically, an information-infrastructure perspective is drawn on to analyze the challenge of scaling, viewing it not merely as a technical problem, but as a socio-technical one involving a heterogeneous network constituted of technology, people, processes, and the institutional context. Empirically, scaling is analyzed based on experiences from an ongoing project to implement health information systems within the primary health care sector in India. The theoretically informed empirical analysis leads to some preliminary insights relating to the questions of what is being scaled and how it is being scaled. Some conclusions are drawn on theoretical and practical challenges related to scaling, and on implications for human-resource capacity development.

94. Shaw V. *A complexity inspired approach to co-evolutionary hospital management information systems development* [dissertation]. Oslo: University of Oslo; 2009.
Type: Thesis/Dissertation
Keywords: information systems | information system | South Africa | health information systems | health information system | systems development | development | management | implementation | IT | open source | requirements | data collection | HISP
Country: Malawi | Nigeria | South Africa | Zambia
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: This thesis addresses the difficult task of developing sustainable and scalable hospital information systems in resource-constrained (also commonly referred to as developing country) contexts. The thesis reflects on the author's experience working with public-sector health and hospital information systems over ten years in Malawi, Nigeria, South Africa, and Zambia. The research was conducted within the Health Information System Programme (HISP) which originated in 1994 through a partnership between Norad and South African Universities and which is now established as an internationally acknowledged organization specializing in health information systems development in resource-constrained contexts.

The thesis provides rich insight into the context in which hospital management information systems design, development, and implementation takes place in resource-constrained settings. The context is described as exhibiting extreme heterogeneity because of the wide variety of possibilities that must be accommodated to successfully develop hospital information systems in resource-constrained settings. For instance, if a computer is available, it will not function without electricity, and electricity supply may not be reliable. Even if there is electricity, and the computer is available, there may be insufficient staff to operate the computer, and if there is sufficient staff, there is no guarantee that the available staff will be computer literate. These characteristics have a compounding effect on one another, creating imbalances and unexpected effects.

The contributions of the thesis can be briefly summarized as follows. An affordable and gradual approach to hospital information systems design and development is suggested based on developing local skills and systems using available resources and free and open source software. This approach contrasts the usual expensive, off-site development of hospital information systems that does not take into account the peculiarity of local circumstances. The technical design of hospital management information systems needs to incorporate flexibility into all components of the system. Typically for example, data reporting requirements change from year to year, or the data needs for managers at a national level differ from those at a facility level. The paper-based tools for data collection and the software must be able to accommodate these

changes over time. Flexibility is achieved by recognizing discrete components or modules within the information system. Modules can be easily replaced with newer versions, or modified to address local needs, without disrupting the entire system.

Flexibility is also built into the implementation process. Numerous approaches are described to encourage local innovation and development of the information system and overcome skills shortages in the public sector. To counter these shortcomings, it is suggested that public-sector organization (such as a hospital) and nongovernmental organization specializing in health information system design and development (such as HISP) can co-exist as synergistic partners. This is potentially a useful partnership because the organizations have complementary skills and organizational links with different domains of influence. An important outcome of this arrangement is the development of capacity within the public sector through the development of a new cadre of health information practitioners.

95. Shaw V. Health information system reform in South Africa: developing an essential data set. *Bulletin of the World Health Organization.* 2005;83(8):632–636.
Type: Journal
Keywords: essential data set | indicators | information systems | integration | lessons learned | monitoring and evaluation
Country: South Africa
Author Affiliation: University of the Western Cape, South Africa—School of Public Health
Abstract: Health services are increasingly under pressure to develop information systems that are responsive to changing health needs and appropriate to service objectives. Developing an essential data set provides managers with a clearly defined set of indicators for monitoring and evaluating services. This article describes a process that resulted in the creation of an essential data set at the district level. This had a significant impact on neighboring districts and resulted in the development of a regional essential data set, which in turn helped to influence the creation of a provincial and then national essential data set. Four key lessons may be drawn from the process. The development of an essential data set both requires and can contribute to a process that allows the reporting requirements to be adjusted over time in response to changing circumstances. In addition, it contributes to (and requires) the integration of program reporting requirements into a coherent information system. While the case study describes a bottom-up approach, a top-down consultative process is advocated because it establishes a framework within which information needs can be reviewed. Lastly, the use of surveys can aid efforts to keep the essential elements to a minimum. In conclusion, the development of an essential data set contributes to strengthening health services because it necessitates dialogue between program managers and defines indicators to be monitored by them.

96. Skadsem Ø. *Information infrastructure growth: Installers as frontier objects* [master's thesis]. Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Country: India
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: The aim of this thesis is to improve the understanding and management of information infrastructure growth. An open source health information system (HIS) and its constituting participants, users, and projects is proposed as a specific example for researching methods and tools for stimulating this growth. The main focus will be on the aspects of

installation and upgrade of routines/procedures, bearing in mind the open source nature of the project and how this both limits and improves upon the available choices for said tools.

Research has been done as an action research project in two parts. The first was a local effort in a state capital in India including development and implementation of installation and upgrade routines for the HIS in question. The second part was further research and refinement of this work for the global HIS project, (i.e., the local solution scaled up to a generic solution for the project).

The thesis will also discuss how technical solutions interplay with social issues and local capacity, most importantly how simplicity and usability can play an important role in empowering less technically skilled users, incidentally having the potential to reduce the level of capacity building or training needed for each user. Examples here include how simple tools can move the boundaries of the implementation of an information system (IS), as less knowledgeable users gain the ability to push the system to new locations, effectively growing the installed base of the IS. The expansion to new user groups is similarly affected; as such tools can lower the bar of acceptance for new users previously unfamiliar with the IS. An easy and error-free installation is essential for the important first impression, and in this type of system, the ability to easily roll out to a large scale is a crucial selling point in demonstrations for health officials and large interest organizations alike. Additionally, geographical distance between the potential users and the people with the knowledge needed to set up the IS becomes much less relevant when the difference between the groups is marginalized.

97. Staring K, Titlestad OH. *Development as free software: Extending commons based peer production to the south*. Oslo: University of Oslo; 2008.
    Type: Thesis/Dissertation
    Keywords: health information systems | health information system | Information Systems | information system | software development | development | implementation | distributed development | health sector
    Author Affiliation: University of Oslo, Norway—Department of Informatics
    Abstract: This paper examines the concept of commons-based peer production (CBPP) in the context of public health information systems in the South. Based on an analysis of the findings from a global network of software development and implementation, an approach to preserve the importance of local user participation in distributed development is presented. Through practical examples, the authors discuss the applicability of the CBPP model for software production aimed at improving the public health sector in the South and propose the concept of a snowflake topology.

98. Staring K, Titlestad O. *Experiences From DHIS 2 Piloting in India and Vietnam Shared with the African Partners, Published on the Web*. EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2006.
    Type: Report
    Keywords: implementation | lessons learned | usage
    Country: Ethiopia | India | Vietnam
    Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 Beanish Project
    Abstract: The report defines District Health Information Software (DHIS) generally and then describes the distinction between v1 and v2. It details the implementation and usage status of

DHIS v2.0 in the Indian states of Kerala, Gujarat, and Jharkhand, as well as associated experiences and lessons learned. The report goes on to outline the implementation and usage status of DHIS v2.0 in two provinces in Vietnam: Ho Chi Minh City and Hue. An additional section describes the implementation and usage status of DHIS v2.0 in Ethiopia.

99. Store M. *Explore the challenges of providing documentation in open source projects* [master's thesis]. Oslo: University of Oslo; 2007.
Type: Thesis/Dissertation
Keywords: information systems | open source | software documentation
Author Affiliation: University of Oslo—Department of Informatics
Abstract: It is well known that software documentation in open source projects is often poor and incomplete. Open source communities are generally driven by project members doing what they want to do, and because few programmers enjoy writing documentation, many open source projects are poorly documented compared to proprietary projects. This does not mean that documentation is any less important in open source projects, and this thesis looks at why it is so hard to provide good documentation. Findings from this thesis show that even if all project members agree that documentation is important, resource constraints mean that the time and effort necessary to create quality documentation it is not necessarily provided. How lack of documentation is affecting new project members who try to contribute to a project is also described in this thesis. Several new project members found the given documentation to be messy and outdated, making it hard to contribute. Poor documentation can also influence the number of project members willing to contribute to the open source project. The thesis is based on an action research project where the author has participated in the development of a health information system using District Health Information Software v2, within the Health Information System Programme Network.

100. Thorseng AA. *Managing complexity through flexible scaling—a case study of the expansion of a health information system in Botswana* [master's thesis]. Oslo: University of Oslo; 2008.
Type: Thesis/Dissertation
Keywords: health sector | developing countries | human resources | health information system | information system | challenges | scaling | action research | data collection | information infrastructure | health information systems | information systems | IT | integration | management
Country: Botswana
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: To make appropriate decisions regarding medical interventions and financial and human resource allocation in the public health sector, timely, valid and complete health data are important, as resources need to be allocated to the right parts of the health service in a coordinated effort. This is especially relevant for developing countries that experience an increasing burden of disease as well as stagnant or decreasing financial and human resources. However, the reality is that health data is often inaccessible, duplicated, and delayed. A reason for this is a fragmented health information system, where different groups collect the information relevant for themselves without sharing data.

This thesis is a study of the efforts made to create an integrated health information system (HIS) in the public health sector in Botswana. To do so the challenges of expanding, or scaling, the health information system to new locations, functionality and use-patterns have been investigated. Through an action research approach, the empirical data collection was conducted through three periods of field work adding up to three months, spanning over one year.

Theoretically, the thesis builds upon concepts from structuration theory, theory of information infrastructures, and complex adaptive systems. Scaling of the HIS, especially to achieve full geographical coverage, is presented as a necessary push to change the existing fragmented structures and work practices. The author accounts for the heterogeneity of HIS and argue that scaling should be viewed as consisting of four different dimensions that are intrinsically linked; (1) social/organizational, (2) technical/functional, (3) users, and (4) geography.

The case of Botswana has illustrated that changes in one dimension leads to the need to alter all the other dimensions, thus leading to an alteration of complexity. Further, the author argues that the process of scaling is challenging because it requires integration with the installed base in all dimensions. A strategy of mindful scaling and the use of attractors are proposed as a way to be able to scale information systems. In the case of Botswana, the discussion shows that scaling down to scale up—where a reduction in scope is made to free resources to facilitate geographical scaling—might be useful, as it can change the project complexity to one that can be handled by the existing project management.

101. Titlestad O, Hedberg C. *Reports on All Ongoing DHIS Pilot and Implementation Activities From the Countries of the African BEANISH Partners and Affiliated Partners in Asia: Final Version February 2008.* EU 6th Framework Programme, Priority 2 Information Society Technologies BEANISH Project; 2008.
Type: Report
Keywords: implementation | recommendations | usage
Country: Botswana | Ethiopia | India | Liberia | Malawi | Mozambique | Namibia | Nigeria | Sierra Leone | South Africa | Swaziland | Tajikistan | Tanzania | Vietnam | Zambia | Zanzibar
Author Affiliation: University of Oslo, Norway—Department of Informatics; EU 6th Framework Programme, Priority 2 BEANISH Project
Abstract: This report details the implementation and usage status of District Health Information Software (DHIS) v1.4 in partner countries. It also includes a section on the overall status and way forward for this version. The final section is dedicated to the implementation and usage status for DHIS v2.

102. Titlestad OH, Staring KS, Braa J. *Distributed development to enable user participation: Multilevel design in the HISP network.* Oslo: University of Oslo; 2009.
Type: Thesis/Dissertation
Keywords: health information systems | health information system | information systems | information system | challenges | action research | implementation
Author Affiliation: University of Oslo, Norway—Department of Informatics
Abstract: Through the study of a long-term, globally targeted effort to design health information systems in the global south, the authors explore challenges to distributed participation within and across countries and describe efforts at addressing these. Networked action research projects can enable pooling of resources, skills, best practices, and tools, and cross-country collaboration does not have to preclude local ownership, as illustrated by the case material in this article. Specifically highlighted is the need for circulation of people, artifacts, and standards, to both support local practices and foster the capacity of all stakeholders to take active part in the design and implementation of information systems. The deep effects of global technological change call for a multilevel approach bridging local implementations with global research and participatory design efforts and co-evolution of standardized tools.

103. Titlestad OH, Staring K, Braa J. Distributed development to enable user participation: Multilevel design in the HISP Network. *Scandinavian Journal of Information Systems*. 2009; 21(1):27–50.
   Type: Journal
   Keywords: health information systems | health information system | information system | challenges | action research | implementation
   Author Affiliation: Department of Informatics, University of Oslo, Oslo, Norway
   Abstract: Through the study of a long term, globally targeted effort to design health information systems in the global South, the authors explore challenges to distributed participation within and across countries, and describe efforts at addressing these. Networked action research projects can enable pooling of resources, skills, best practices and tools, and cross-country collaboration does not have to preclude local ownership, as illustrated by the case material in this article. They highlight specifically the need for circulation of people, artefacts, and standards, to both support local practices and foster the capacity of all stakeholders to take active part in the design and implementation of information systems. The deep effects of global technological change call for a multilevel approach bridging local implementations with global research and participatory design efforts and co-evolution of standardized tools.

104. Tømmerholt HS. *Global software development: The challenge of communication models* [master's thesis]. Oslo: University of Oslo; 2007.
   Type: Thesis/Dissertation
   Keywords: communication models | software development | source code repository
   Country: Ethiopia | India | Vietnam
   Author Affiliation: University of Oslo, Norway—Department of Informatics
   Abstract: This thesis looks at various communication models in global software development and how they affect the development process. Four models are explored, a hierarchical model, a network model, a community model inspired by free and open source software, and a composite model. The discussion is informed by a case study of one globally distributed development project, the District Health Information Software v2. This project has development nodes in Ethiopia, India, Norway, and Vietnam. The material is based on the analysis of data from a mailing list and commits to a source code repository used in the project and a series of interviews with participants. The author has also participated actively in the project. The analysis shows that participation is much skewed, with the Norwegians dominating the communication and source code production. Some implications are suggested, mainly reducing gaps of understanding between the participants, including language issues, contextual gaps, and problems in understanding the application and its tools and framework.

105. Vo KAT. *Challenges of health information systems programs in developing countries: Success and failure* [master's thesis]. Oslo: University of Oslo; 2009.
   Type: Thesis/Dissertation
   Keywords: challenges | information systems | solutions
   Country: Vietnam
   Author Affiliation: University of Oslo, Norway—Department of Informatics
   Abstract: This thesis examines the challenges of introducing health information systems (HIS) in developing countries, with special focus on the success and failure of two Vietnamese projects (Thua Thien Hue Province and Ho Chi Minh City). The project of Thua Thien Hue

Province—from 2004 to 2008 —and that of Ho Chi Minh City—in 2008—are analyzed using gaps and gap closure techniques (Heeks et al., 1999).

The method applied is the action research approach, and the focus is on the two following research questions:

1. What are the challenges of developing and implementing HIS in Vietnam (2004 to 2008)?
2. Why did the implementation of District Health Information Software (DHIS) not succeed in the Thua Thien Hue Province (2004 to 2008)? A comparison of the cases of Thua Thien Hue Province and Ho Chi Minh City.

After two years of experience and four months of fieldwork in Vietnam, where the author was a facilitator and an intern student of the Health Information System Programme (HISP), the author became involved with the local Vietnamese HISP team developing and implementing three difference versions of DHIS, v1.3, v1.4, and v2.0, in cooperation with the global HISP team.

The findings presented are consistent with the seven gaps and gap closure techniques and consist in a detailed discussion of the challenges of developing and implementing HIS.

The solutions proposed result from a critical examination of the projects, with reference to contributing factors such as the health report system, the technological capabilities and limitations of DHIS, implementation strategy, infrastructure, staff skills, managerial inadequacies, communication and cooperation, and policy monitoring of the local team by the global organization. The lessons learned from the cases of the Thua Thien Hue Province and Ho Chi Mihn City have also been included.

The thesis aims at explaining why some HIS projects in developing countries meet with either success or failure. In this case, why the two specific Vietnamese projects failed. Given the limited time allotted to the thesis in the masters program—one year, including fieldwork and writing—the thesis cannot cover all aspects of the topic and is therefore not exhaustive. A further understanding of the challenges would need additional studies from a greater range of countries.

106. Walsham G, Robey D, Sahay S. Foreword: Special Issue on Information Systems in Developing Countries. *MIS Quarterly: Special Issue on Information Systems in Developing Countries*, 2007;31(2):317–326.
Type: Journal
Keywords: information system | developing countries
Country:
Author Affiliation: University of Cambridge, Cambridge, United Kingdom; Georgia State University, Atlanta Georgia; University of Oslo, Oslo, Norway

107. Williamson L, Stoops N, Heywood A. Developing a District Health Information System in South Africa: A social process or technical solution? *Studies in Health Technology and Informatics.* 2001;84(1):773–777.
Type: Journal
Keywords: information systems | management | primary healthcare services | sustainability | user acceptance
Country: South Africa

Author Affiliation: University of Western Cape, South Africa—Public Health Programme

Abstract: South Africa initiated a national District Health Information Software (DHIS) rollout strategy in the latter half of 1999. Experience has demonstrated that the implementation of an information system as a vehicle for the delivery of accountability in the management of health services demands organizational change within a framework of human resource development and technical support. The aim of training, to empower facility and district staff to use locally generated information to improve coverage and quality of primary health care services, can only be realized if training and innovation for change are appropriately marketed and supported.

The appeal of the Health Information System Programme's software lies in its user acceptance. While computers form a vital tool in providing easily accessible information for decision-making, their use must not be seen as a panacea for all information problems in primary health care services.

Strategies for promoting sustainability of DHIS implementation lie in the social processes of human resource development, changing organizational infrastructure and the use of ongoing evaluation rather than those of technical infrastructure.

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