

Integrated Health Information Systems for vaccination in developing countries

1. Relevance to GAVI, vaccination research and the call for proposals

The proposed project is a cross-disciplinary international consortium for research and development on appropriate Health Information Systems (HIS) and management structures for the support and delivery of effective and equitable vaccination services in low and mid-income countries.

Poor quality of data and information on vaccination services and their coverage at community, health facility and district levels are regarded as major obstacles towards reaching marginalized groups and communities and thereby universal coverage of vaccination. (ref GAVI – find GAVI quote to use). Developing quality information systems on immunisation data is a cornerstone in the GAVI strategy. All countries that receive funds from GAVI are required to perform a Data Quality Audit as a means to verify countries' reported immunization coverage as well as to enhance immunization monitoring and reporting systems (<http://www.gavialliance.org>). However, to develop, implement and sustain appropriate information systems to support immunisation services and the health system more generally is regarded as a considerable research and development challenge (see e.g. <http://www.who.int/healthmetrics>).

The proposed project is therefore directly relevant for the overall goal of the programme which is stated as to provide “improved immunization strategies” in low and mid-income countries with a particular focus on marginalized population groups and to generate knowledge of the effect of vaccination in these groups and areas. Of the specific priorities mentioned in the “Memorandum on strategic priorities”, the proposed project falls within the “Health systems and availability of vaccines” category.

Of the 6 strategic objectives formulated by GAVI, the proposed project is directly relevant to the following two (<http://www.gavialliance.org>):

- Improve access to sustainable immunization services
- Make immunization coverage a centerpiece in international development efforts

In the research, development and implementation of vaccines pipeline, the proposed project falls within the implementation (and sustainability) category.

The practice of immunisation - the scheduling, delivery, monitoring and follow-up procedures - are not merely “practical issues” to be sorted out but should be recognised as a process not stronger than the weakest step. A focus on integration across vertical programmes includes due attention to implementation within each of the programmes in the first place. Integration is thus much broader than the narrow concept of technical integration.

2. Aspects relating to the research project

2.1 Background and status of knowledge

Background to the Health Information Systems Programme

The African-Asian-Norwegian consortium behind the proposed project is called HISP (Health Information Systems Programme). HISP, was initiated as a Norad project (1995-98) in South Africa with the aim of developing health information systems (HIS) to

support the reconstruction of their health services after the apartheid era. The District Health Information Software (DHIS) was developed and used for reporting, and analysis of the routine Primary Health Care (PHC) data, including immunisation data¹. Since that time, HISP has developed into an international forerunner in HIS related research and development, being active in many African (South Africa, Nigeria, Malawi, Mozambique, Tanzania and Zanzibar, Ethiopia, and Botswana) and Asian countries (India and Vietnam)² (see www.hisp.info).

During 1998-2004, USAID funded HISP in South Africa for the further expansion of the HIS across all nine provinces. The Extended Program on Immunisation (EPI), South Africa, agreed in early 2001 to fully include their routine immunisation reporting system in this national effort, including the development of a minimal and essential data set. This was possible, since DHIS served as a data warehouse including all routine and also semi-permanent data. As a result, DHIS was able to provide more reliable and better quality data than what the EPI programme managed through their own “vertical” system. After the EPI programme joined the process, even more resources and attention was aligned, more vertical health programmes joined, and the unified HIS improved further.

In India, HISP started out in one pilot district in Andhra Pradesh in 2000 and have since then developed into a significant research and development consortium engaged in practical HIS development in 5 states. India is a major partner in the consortium behind this research proposal and HISP India has for this purpose partnered with the governments in the states of Andhra Pradesh, Kerala, Jharkhand, Gujarat and Uttaranchal (expected to start shortly) in providing information for immunization management. In Andhra Pradesh, a key aspect of the efforts has been the technical and institutional integration of a name patient system for pregnant mothers and children born, including their vaccination details, with the facility based reporting system enabled through DHIS. Furthermore, linking this system with GIS provided managers with geographical information about which areas had low vaccination coverage, and inputs to strengthen outreach support. Similarly, for the state of Gujarat, HISP has developed an “eligible couple” system to help provide field workers with schedules on where, when and to whom vaccination services are to be provided.

The above are only few of the many examples that HISP has in dealing with the challenge of integration more generally, and specifically related to HIS. Today the South African integrated HIS is regarded as a “best practice” in Africa. The DHIS development has grown from being South Africa based into an international open source development programme involving developers and academics in many of the partner countries mentioned above. The development of the international HISP-network has been enabled by NUFU funding between 1999-2006 and by the EU 6th Framework program for 2005-2007 (called the BEANISH project, see www.hisp.info). The development and running of an integrated international Masters programme in Public Health and Informatics in Mozambique, South Africa, Malawi and Tanzania (supported by Norad 2001-07) and an international PhD programme including 15-20 students from Africa and India are other key building blocks in the research consortium behind this proposal.

¹ Braa J, Hedberg C (2002): The struggle for developing District health information systems in South Africa, *Information Society* Volum 18, No. 3, 2002

² Braa J, Monteiro E, Sahay S (2004): Networks of action: sustainable health information systems across developing countries. *MIS Quarterly*, Vol. 28 No. 3, pp. 337-362

Research challenges and status of knowledge

With the HISP network, Dr Mavimbe from Mozambique has explicitly examined the role of information systems to support the EPI³. He argues that the ineffective HIS, especially due to reasons of lack of standards, poor human resources capacity, lack of knowledge of immunization related concepts (such as of coverage), heavy work load of field workers, and poor infrastructure – both informational and of the cold chain, adversely effect the functioning of the EPI. Similarly, another HISP researcher, Dr Usha Srinath of India, has examined the role of poor data quality arising from various issues such as ambiguity in data definitions, lack of a data dictionary, poor human resource capacity etc, adversely impact the functioning of programs such as the EPI. Similarly, another study within the HISP framework of Dr Jani and Sahay have examined information systems relating to measles, and argued the need to consider verbal information (held in the heads of mothers) along with the formal information system to support better coverage of the vaccine⁴. While in general specific studies relating immunization to vaccination program delivery is not widespread, there is now an increasing recognition that this is required. The above examples of studies by HISP researchers serve as cases in point, especially so emphasized with the need to monitor more effectively the MDGs. In contexts other than immunization, examples of research have pointed to similar challenges such as of fragmentation and poor coordination⁵, organizational complexity⁷, unrealistic ambitions⁸, and problems of sustainability more generally⁹.

We have identified six concrete challenges facing immunization IS, the first five of which related to the implementation within a vertical programme and the last linked to integration across vertical programmes:

1. Data reporting coverage is poor and of low quality. Unless a reporting rate of 60% and above is achieved, data cannot be used for program management. Many countries do not even have systems for identifying what data is reported and what is missing. Many countries use paper based reporting systems, and because data is aggregated at the district level, an analysis across facilities cannot be done, and missing data cannot be assessed. The HISP strategy to counter this challenge is to focus on capturing data from the lowest level of the facility, and provide tools for analysis through drilling down from whatever level to identify areas and periods where vaccination is problematic.

3 Mavimbe JC, Braa J, Bjune G.: Assessing immunization data quality from routine reports in Mozambique, BMC PUBLIC HEALTH 5: Art. No. 108

4 Jani, J.V., Jani, I.V., Arajo, C., Sahay, S., Bareto, J., and Bjune, G. (2006) Assessment of routine surveillance data as a tool to investigate measles outbreaks in Mozambique, BMC Infectious Diseases

5 Braa, J, Hanseth, O, Mohammed, W, Heywood, A, Shaw, V (2007) Developing Health Information Systems in Developing Countries: The Flexible Standards Approach. MIS Quarterly. Forthcoming.

6 Jeppsson and Okuonzi (2000), Vertical or holistic decentralization of the health sector? Experiences from Zambia and Uganda, The International Journal of Health Planning and Management;

7 Jayasuriya R. 1999. Managing information systems for health services in a developing country: a case study using a contextualist framework. International Journal of Information Management 19: 335–49.

8 Heeks, R. "Information Systems and Developing Countries. Failure, success and local improvisations." Information Society, vol. 18, 2002, p. 101-112

⁹ Sahay, S. Miller, J. Roode, D. (2000). Proceedings of the IFIP 9.4 Conference on Socio-economic impact of computers in developing countries - Information flows, local improvisations and work practices, Cape Town, South Africa

2. Target population data is often missing. Immunisation coverage is the key GAVI monitoring indicator, requiring reliable data on the number of infants targeted for immunization as on the numbers where it is actually done. The DHIS provides the possibility of using whatever data is considered appropriate by the health planners, such as the use of the available census data to determine target populations, and calculates indicators using the data provided.

3. Absence of reliable and robust computerized systems for the management and analysis of data. To keep track of reported data from each health facility in a district is complex and labour-intensive. The DHIS which has a footprint of population served of almost 100 million people, 95% of which are people in low and mid income countries, has been used for over 10 years in very rural and primitive conditions with reliable success. The system maintains the integrity of individual facility data, but accommodates aggregation to any number of levels

4. Need to identify useful indicators and mechanisms to monitor vaccination coverage. Measles coverage to children under one year (MDG Indicator) is usually used as a proxy for “fully immunized”. However, there is no guarantee that a child receiving measles vaccination has in fact received all other vaccines as well. To address this problem South Africa has introduced reporting on “fully immunized infants under one year of age”.¹⁰ Alternative approaches are to develop immunisation registries in facilities, sometimes computer based (for example in Andhra Pradesh, India, and Thailand), but mostly paper based..

5. Identifying strategies for improving the use of data for management. Use of health information for local action and management is generally described as being very poor, and local analysis and use of immunisation data is no exception. It requires a certain level of statistical knowledge and structured data management for health workers at facility and district levels to calculate coverage graphs. In settings where skills base is low, resources scarce, and workload high, the most efficient mechanisms to build skills in a sustainable manner need to be identified.

6. Identifying mechanisms to achieve integration with other reporting systems and overall HIS. One of the major problems is the fragmentation of reporting systems driven by vertical programmes. A key strategy of the HISP effort has been to seek mechanisms to integrate reporting systems and HIS within a health system framework. This is important because while vertical programmes may be required as part of an implementation strategy, especially in the initial phases of programme development, health systems management and development require co-ordination and integration of efforts across programmes, especially in resource constrained settings..

These challenges can be summarized in terms of research requirements at three levels:

1st level: the patient level: Management of individual patient information usually centres round the use of immunisation cards which are kept by the child’s mother.

2nd level: the Health Facility and Community Based Health Worker level: Identifying appropriate systems at facility or community based health worker level to identify

¹⁰ Shaw, V. “Health information system reform in South Africa: developing an essential dataset,” *Bulletin of the World Health Organisation* (2005:83), July 2005, pp 632-639.

patients at risk (those missing their immunisations) are more complicated. When it comes to immunisation registries kept and managed by the health facility, there are huge differences between countries. While immunisation registries are seldom used in Africa, they are in use in many countries in Asia. In India, village based health workers are organised to keep immunisation records for all children. For various reasons, however, a substantial part of the children are falling outside this system.

3rd level: Health management and reporting level: Data for management, monitoring and evaluation at each level of the health services. All countries have established routine reporting systems to this end. Ideally each level should use their data to calculate and monitor their immunisation coverage indicators. As noted above, however, in many countries these systems are of rather poor quality. An offshoot of this reporting is the reporting to donor communities. Recently, particularly US based donor organisations, who have been accused of developing reporting systems that serve their specific purposes, at the expense of in-country systems. Reporting to donor communities needs to be identified as an important output of strengthening the in-country reporting mechanism, and not as a means to an end in itself.

Integration is required not only across these levels, but also types of data – routine, survey and infrastructure. Increased integration of the currently largely fragmented country HIS is recommended by international HIS literature as well as by the health Metric Network. It is worth noting in this context that the GAVI Alliance Strategy (2007-10) has taken steps towards increased integration by positioning the Alliance within the broader context of child survival and the MDG 4 “to create the environment necessary to achieve its specific objectives on immunisation”. “Strengthening health systems” is included as a new area of focus in this strategy.

2.3 Methodology

The methodologies adopted for the research are characterized by the following key features and based on the following key propositions:

H1: Effective Information Systems (IS) and systematic use of information and pragmatic perspectives on implementation will significantly increase quality, equity and accessibility of existing vaccines

H2: Better integration of HIS across vertical programmes will significantly enhance the overall information system and the information available for each programme included immunization (quality, equity and accessibility also of immunisation)

- This requires:
 - a) Synergetic cross-disciplinary research (health –informatics-social sciences)
 - b) Intervention and action oriented research carried out in close collaboration with user organization and with cycles of design – feedback - redesign
 - c) South-south learning resulting from multi-site activities, collaboration and reciprocal spill-over effects (technology, models, best practices)

To operationalize the above aims and propositions, the methodology adopted is characterized by the following features:

1. Actionresearch based iterations of design – prototyping – redesign interleaving academic output with practically relevant problems
2. Long term and longitudinal designfollowing and shaping emergent change processes over time.
3. Multilevel analysis across health facilities, national and internation level
4. Comparative design, both intra and inter country, to analyze contextual influences
5. Interpretive case study approach, aiming to make sense of the multiplicity of stakeholders
6. Heterogenous approach where university researchers, doctoral and masters students together with hired staff operate together. .
7. Multi-disciplinary approach to research, across public health, social sciences and informatics.

2.4 Project Plan

The research project has a planned start-up in January 2007 and is intended to run over 5 years, 2007-2011 (milestones in electronic template). The research and practical project implementation will be organised in work packages:

WP 1: Project management. (see later section)

WP 2: Networking. Organise the cross-country collaboration in the consortium; dissemination and sharing of best practices, tools and research results; writing up research; regional (India/Asia and Africa) workshops; web-site for sharing and dissemination of results. With the background in HISP/BEANISH the consortium has already well established structures and routines for cross country collaboration and networking.

WP 3: HIS research and development. Action research in each participating country and state in collaboration with local health authorities aiming at 1) understanding context and problems related to HIS, immunisation and integration, 2) interventions for improving the situation, and 3) evaluating results and improve and continue the interventions (cyclic). The consortium is carrying out research and development on HIS in all participating countries through HISP/BEANISH.

WP 4: ICT and software support for HIS. Free and Open Source Software will be developed as a collaborative effort. Each country will participate in the development and/or testing, adaptation and implementation to support the integrated HIS for immunisation in their country. This work is already well established within various aspects of HIS in the partner countries as part of HISP/BEANISH.

Dissemination, writing and publications, and PhD and Masters research are integral to all phases and activities in the project.

The main points of the project design and general approach to the project:

- WP1 and WP2 are activities carried out at the consortium level, and aimed at co-ordination, networking and overall development of the consortium.
- WP3 and WP4 are applicable both at consortium and at country levels. A crucial aspect of the research methodology is that
 - 1) each country partner takes part in software process in order to achieve sustainability, and

- 2) that health professionals from each country take part in and direct the design and adaptation of the software
- A sub-project is carried out in each country, focusing on improving the HIS in that country. This involves the creation of a sub-network of informatics and public health competencies as well as a network including all relevant actors in the health sector (local and central health authorities, EPI-program) in that country, and is focussed around the six challenges mentioned in section XXX
- Organise the structures for cross country collaboration so as to achieve a common research arena that supports co-operation between the different country research groups.
- Integrate and expand the PhD programme at the University of Oslo and enable students to take active part in the project. Make the project a laboratory for the theses research of the students from the Integrate the International Masters Programme (NOMA /Norad).

The main research activities to be utilised are:

- Preparatory work. Literature review. Objective: Clarification of the central theoretical and practical positions and research gaps within each topic (work package)
- An introductory meeting for work package 1 and 2, first in each country, then for the consortium. Objective: development and determination of research gaps and questions and development of action plans.
- Initial situation analysis and assessment in each country. Objective: Write up well documented case study and assessment for comparative analysis
- Interventions and action: The following areas will be in focus:
 - Improve data collection and collation activities from patient level through to health district level
 - Improve data analysis, presentation and use as related to the immunisation programme
 - Identify best practices to support the local use of data
 - Support processes to achieve and integrated HIS
- Studies on the interventions and action research carried out in each country. Objective: One well documented study that should be expanded over time from each country available for comparative (published and updated on the web)
- Regular meetings at the country, region and “global” arenas to present results, adjust focus, and to promote discussions and transfer results. Objective: Quality assurance in relation to the relevance for the participating countries. Further empirical evidence. Exchange of experience and cross-fertilisation across countries.
- Establish an electronic forum (web-based) for global software development and dissemination. Objective: Enable each country to participate, get support and get access to the compilation of software applications.
- Conduct workshops, training and courses on tools used for software development and the software applications. In relation to the International Masters (in Asia and Africa, NOMA) courses will be established in the participating Universities.

- Objective: ensure sustainability in each country of the ICT components that are implemented.
- Publication of results will be prioritised: Through Conferences, newsletters, research journals and the web. Software products will be disseminated widely as Free and Open Source Software.

2.5 Project organisation

Organising the project

The project will be managed by a team of 6 people located in Norway who will have the following responsibilities: Project coordination, coordination of Asia and Africa respectively, Work package 3 (HIS) and 4 (software) and the project web site (reporting and dissemination and sharing of information). A web tool will be established and used for reporting and internal project communication.

In each country a project team will be established with one person responsible. The Norwegian management team together with the country coordinators will constitute the project board which will meet annually. Research in India include 5 states and will be organised as a regional sub-project with three full-time members for country coordination and one coordinator in each state.

A detailed project plan including the 4 work packages will be developed by the project team and disseminated by February 2007 for discussions and decision at the first project workshop March 2007. Each country project develops a country plan which will also be discussed and decided about at the workshop. The project plan will be revised and updated every year.

A contract regulating responsibilities will be signed with each partner. In case of conflicts, it will first be tried solved between the project management team and the partner in question, then it will be handled by the project board, before finally, we will seek assistance by the NFR. The project is as a principle Open Source and individual copy rights are not an issue.

Selection of partner countries and institutions

The objectives of GAVI to reach out to as big as possible marginalised population groups uncovered by immunisation services has had bearing on the selection of country participants in the project. India is the major partner and 5 states are actively involved. In Africa Ethiopia, Tanzania, Malawi and Mozambique include large marginalised populations as well as representing major Norad countries in Africa. Mozambique and Malawi are the two only countries where Norad is focusing on health.

In each country, the partner is a strong and well established university, all running Master Programs in Informatics and Public Health. Masters courses in HIS, both for informatics and public health students are in various stages of development and implementation in all the universities as part of the Norad funded NOMA program. The partnership with Zanzibar is different in that the University of Oslo has an agreement directly with the Ministry of Health on HIS development. The project will use this site as a relatively small and manageable area for full scale testing and implementation of results from the project.

Overview of project partners

Country and institutional partner	Role, experience and relation to project
Norway 1: Department of Informatics, University of Oslo	Project coordination. Have initiated and coordinated many international HIS projects since 1995, e.g. HISP, BEANISH, “Norad” Masters
Norway 2: National Centre for Electronic Patient Journals Research, Trondheim	Assist in project coordination. Research centre for IT and Health in Norway centre
Ethiopia: Information Science Department, Addis Ababa University	Part of HISP and BEANISH. PhD project with Oslo since 2003. Responsible: Work Package 4.
India1: Sri Chitra Tirunal Institute of Medical Sciences Technology	Leading public health institute in India, Collaborator with HISP India in Kerala, partner in NFR.
India 2: HISP India (NGO)	HISP India – implementing agency for HISP in designated Indian states. Agreements for project implementation and in the states of Kerala, Andhra Pradesh, Jharkhand and, Gujarat.
Tanzania: Muhimbili University College & Department of Computer Science, University of Dar es Salaam	Part of HISP and BEANISH since 2000. Running NOMA Masters courses. PhD program with Oslo
Zanzibar: Ministry of Health & Social Welfare	Zanzibar is a relatively small and manageable country for effective full scale implementation and testing of the results of the project
Vietnam 3: Maternal and Child Health Center, HCMC University Training Center for Health Care professionals HoChiMinh City University of Technology	Part of HISP since 2004. Project established as a collaboration between the Mother and Child Health services, Immunisation programme (EPI), and universities in Ho Chi Minh City. Developing Norad Masters with Oslo
Malawi: Medical College, University of Malawi	Part of BEANISH and HISP. Running Norad Masters courses with Mozambique, Tanzania and Oslo.
Mozambique: Medical faculty, University Eduardo Mondlane	Part of HISP and BEANISH. Base for Norad Master courses. PhD programme with Oslo since 2000
South Africa: HISP – 21 (NGO). Vincent Shaw was the manager of HISP South Africa 2003-2006. He is enrolled as PhD student in the project and will represent HISP in that position	HISP has been responsible for national HIS implementation including vaccination in South Africa since 2000. HISP-SA will ensure that their experience will be written up as research and best practices and shared within the network

3 Perspectives and compliances

3.1 Compliance with strategic documents. The GAVI objective of vaccinating all children is not controversial and is in compliance with governments’ strategies in all countries and in particular the Norwegian. The Department of Informatics, University of Oslo and the, support this application as part of their strategic plan.

3.2. Relevance to society. The project’s objectives are directly targeting important knowledge challenges and policies of the international community and in particular those of the low and mid-income countries.

3.3 Environmental aspects. N/A.

3.4. Ethical aspects. The project is working closely with the Ministries of Health in the countries of implementation and will follow closely their instructions on ethical issues. The project will work with data on vaccination which is “neutral” and not regarded as sensitive for the individual as it applies to the entire population.

3.5. The projects main target is to improve vaccination and health services – for women and children - in marginalised areas and communities, in the marginalised countries of the world. Gender equality is the key issue in this target. The project will ensure that at least 40% of researchers and PhD students engaged by the project are women.

4. Communication with users and exploitation of results

4.1 Communication with users

The users of the research results are the health services in general and the immunisation services in particular, in the countries where the project is implemented and ultimately also in other low and mid-level income countries. The project is following a participatory approach and cooperation and communication with the users are part of the research methodology. The project has agreements with the relevant health authorities in all the countries where the project is implemented.

The population affected by the result of the research is ultimately all those targeted for vaccination, children and their mothers in particular in marginalised communities and areas of the countries where the project is implemented. As the aim of the project is to help increase immunisation coverage the situation may only improve for these population groups.

4.2 Exploitation of results

In addition to scholarly and popular dissemination (see grant application) the results of the project will aim at wide dissemination of best practices supported by software, guidelines and models. Software and other products of the project are all free and open source. Among the channels to be used for dissemination are those of GAVI, Health Metric Network and WHO.