Health Information Architectures: A verb always in the making

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Some guiding principles

Principles of flexibility and user control are essential features of building a HIA

Standards are key to a HIA, and the principle of hierarchy of standards provides an effective way of their implementation

Principles of minimum and essential data sets are important in focusing the health information system on providing data on “what is needed most,” and not what people believe may be important in future.

Integration of information flows – involving all flows to come into a central point in a district framework – is key to an effective district based health system.

Rapid prototyping is effective as a tool to build communication and interaction between the users and developers, and to ensure that strong public health related domain

Public health domain knowledge must be inscribed in the software

IHIA: The motivation

"Better information. Better decisions. Better health." Health Metrics Network (HMN).

"Global" consensus on the importance of information, combined with a likewise consensus, that current HIS are fragmented and generally of poor quality. Need for integration.

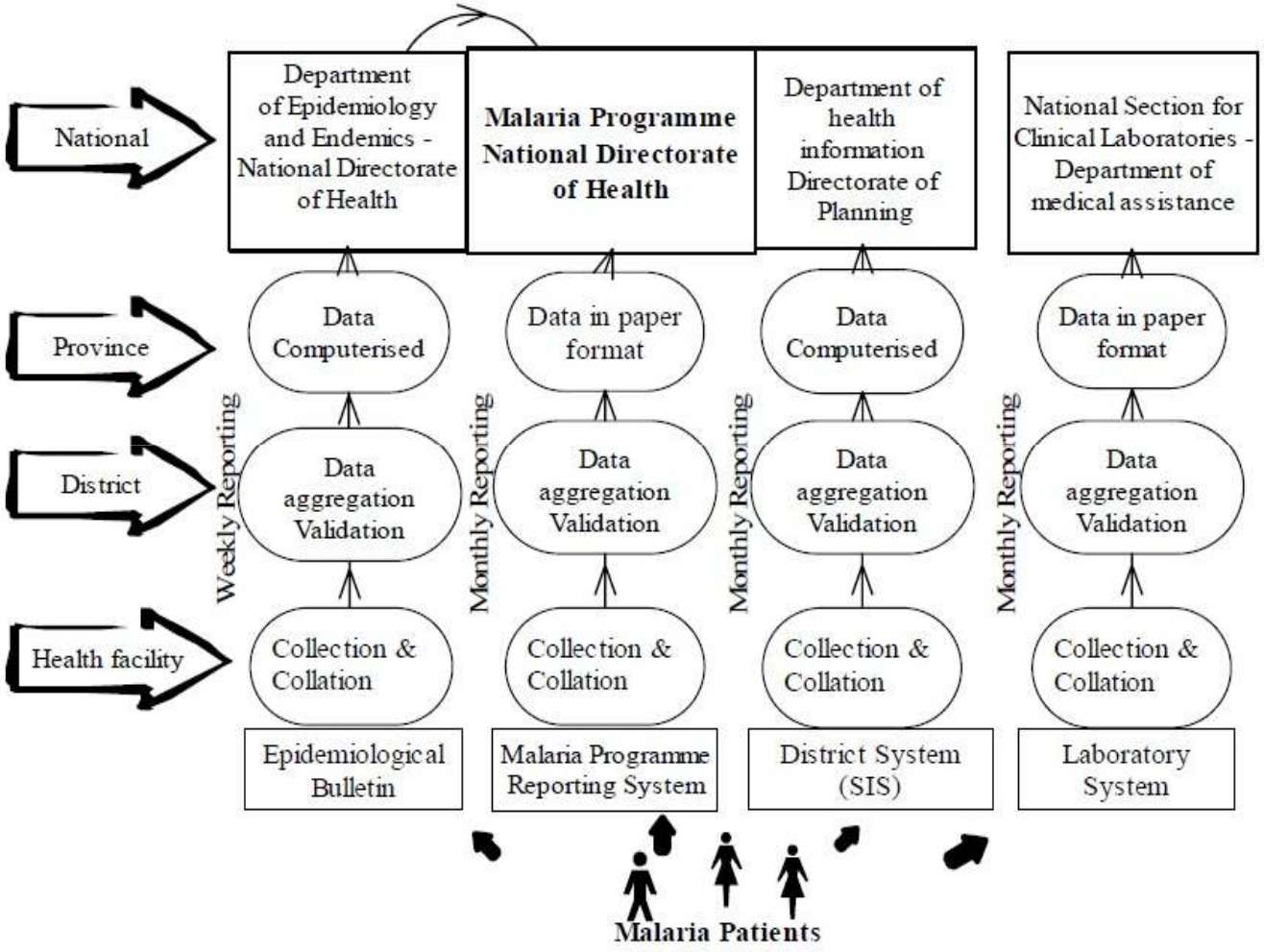
HIS is of multiple types and means different things to varying groups of people.

Different technologies form part of the infrastructure used to support various systems.

The crying need is to build bridges and standards for these different systems and supporting infrastructures to "speak to each other"

The motivation to design and develop "Integrated Health Information Architectures" abbreviated as IHIA.

An example of fragmentation: Mozambique



Fragmentation in HIS: Zanzibar

The situation in Zanzibar was characterized by fragmented and un-coordinated HIS. At a startup meeting of a project in 2006 to integrate and strengthen the national HIS, the Minister of Health said:

"When I need to get an overview of the situation across different diseases and services areas, nowhere is that information available. I have to ask for information from a large number of program offices - Malaria, HIV/AIDS, EPI, hospitals, and so forth. The resulting information is not easy to comprehend, compile and analyze, as each of the offices tend to structure their information differently, and is difficult to get exactly the information I need. …. "

What I need is to have all the important data from all the sectors in a harmonized format available at one point, in one office, so that I can get it here on my desk - on my computer. By the press of a button."

- Ministry of Health, Zanzibar, 2006

Conceptualizing an architecture

While a village would not need an architecture for planning, city development would definitely need one.

Development of mega-cities illustrates city's architectures and development plans are inadequate in solving with problems in a dynamically evolving city environment

Most people would, however, agree that without efforts to draw up an architecture for how the city should develop, the situation would be even worse.

Architectures are not an end-solution – as there is nothing like a perfect architecture – and should merely be seen as an approach to manage complexity.

In HIS, architecture is a process tool, at any point represents current understanding and knowledge, which by definition is inadequate and incomplete, and will enable the incorporation of new developments.

The point of departure, is to conceptualize architecture as a verb – a collective; always in the making - rather than a noun; representing an end solution. Provides a road map or compass for "good design"

A social systems perspective to IHIA

Architecture represents a system of systems

Social system perspective emphasizes the social context and its relation with the technical, alternative to assumptions of rationality

HIS in developing countries are situated and evolve in a complex web of social, political, institutional and cultural relations, arising out of the involvement of various actors (such as international donors, ministry officials, vendors, infrastructure providers) and technologies.

As a social system, HIAs are much bigger and qualitatively different from a computer or a technical system. Thus difficult to change, as it involves redefining power relations.

Thus messiness of things, full of unintended consequences

Basis for requirements of a HIA

Taking requirements as the existing work practices is conservative, with the danger of automating the existing inefficiencies

More effective is to focus on “information use”. What are the information support needs across the various horizontal and vertical dimensions of the HIA.

Guiding principles
Need for integrated information; from different areas available at “one point.”

Different levels and types of management in the health sector have varying needs.

While lower levels need richer and more granular data, higher levels need less data, in a more aggregated form.

Information for action; focus needs to be on, essential data and indicators linked to targets and real usage.

Presentation and form of the information, and how to access it; reports, graphs, maps, statistics – real time and online using different media.

Constructing HIAs: data warehouse approach

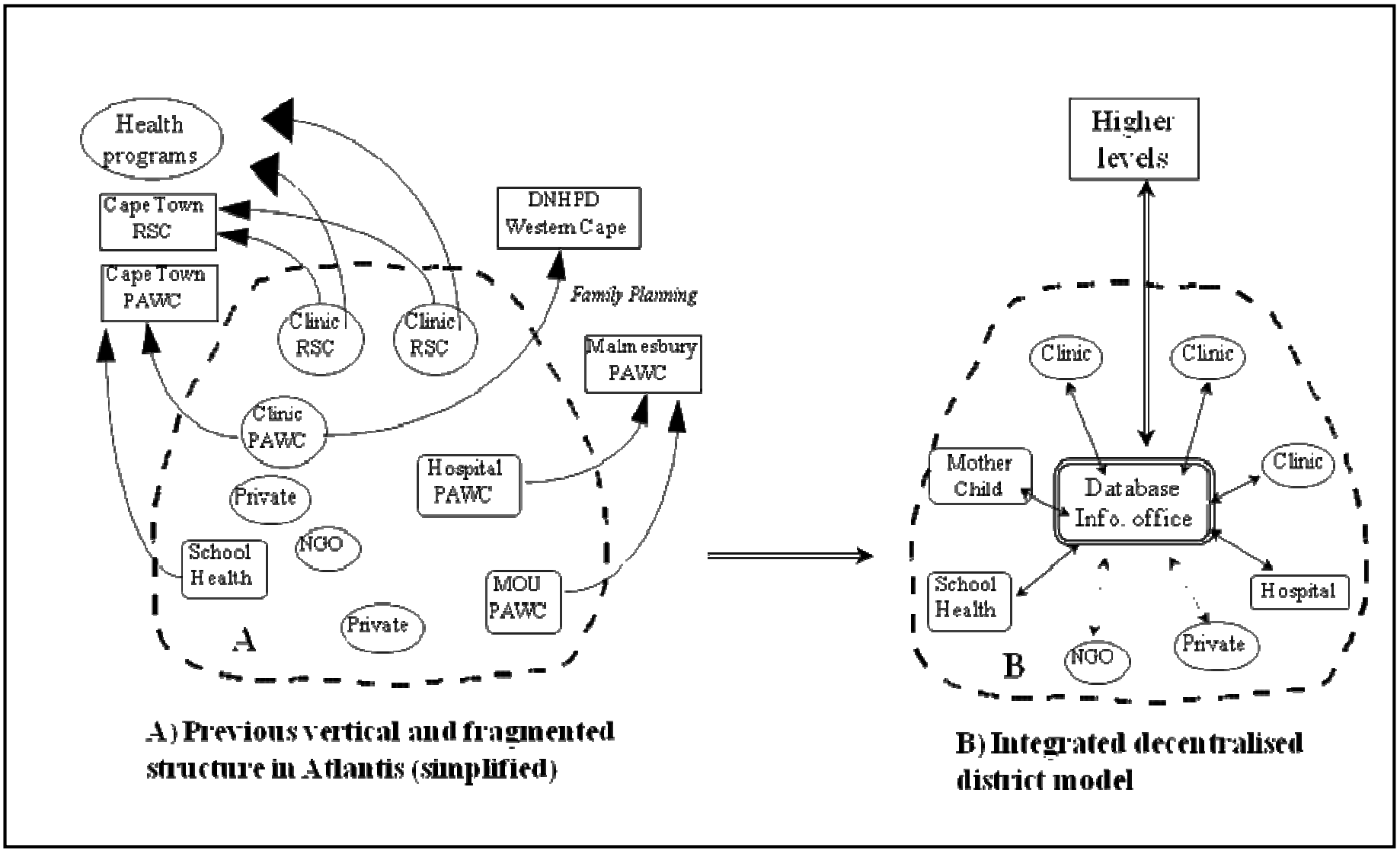
Data warehouse to support systems of decision making in organizations

Providing management with key data “at the touch of a bottom” from across relevant data sources

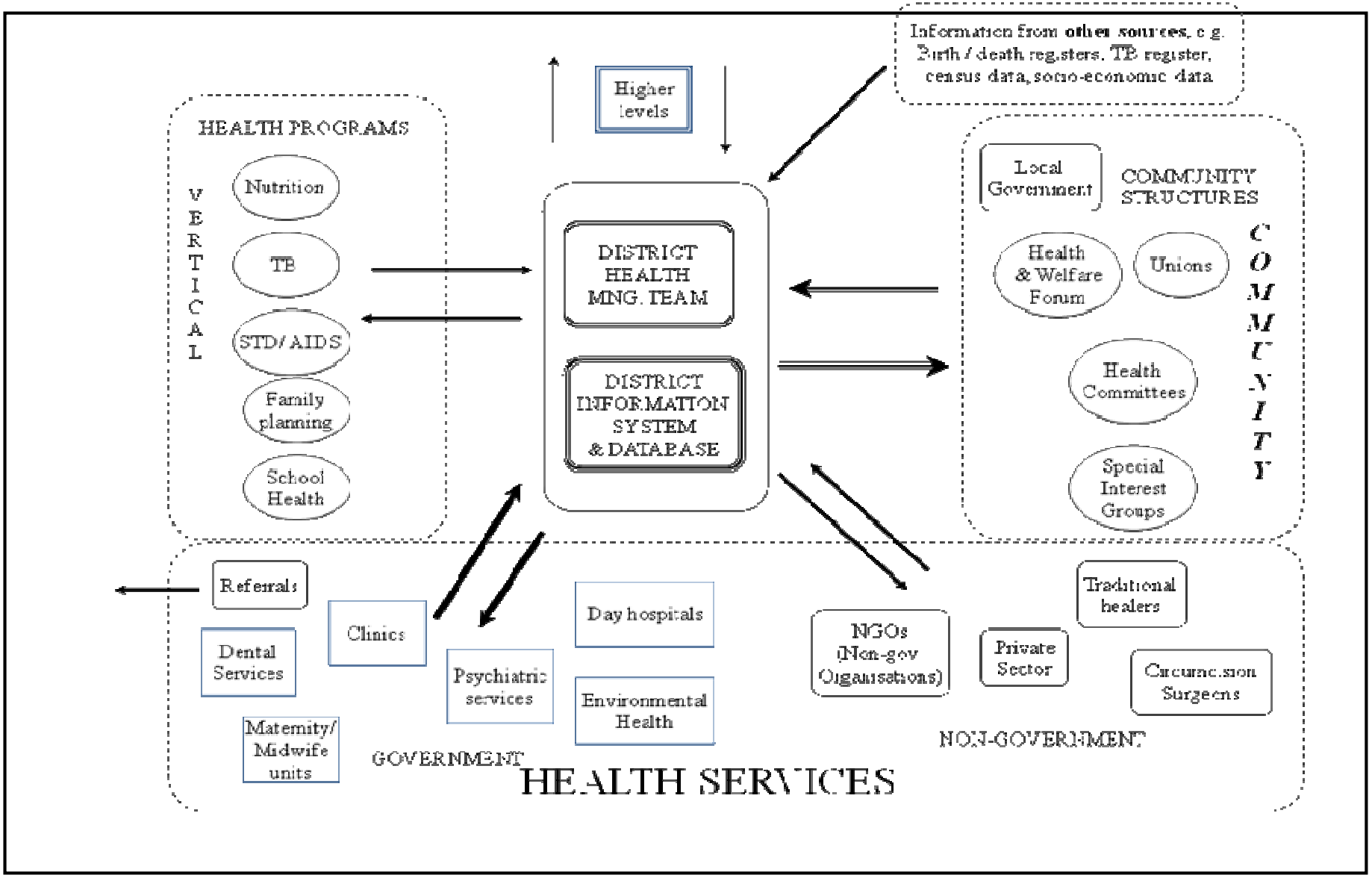
Eg in hospitals, provide key indicators on patient flows, by ward and diagnosis, finances, resource utilization (staff, drugs, equipment) etc.

A data warehouse, on the data *input* side, is a database which contains and manages data of different types from varying sources; and on the *output* side, helps to process and present the data and provide a multiplicity of users with data, tailored for their specific needs. Simply put, it represents a “warehouse of data” (database).

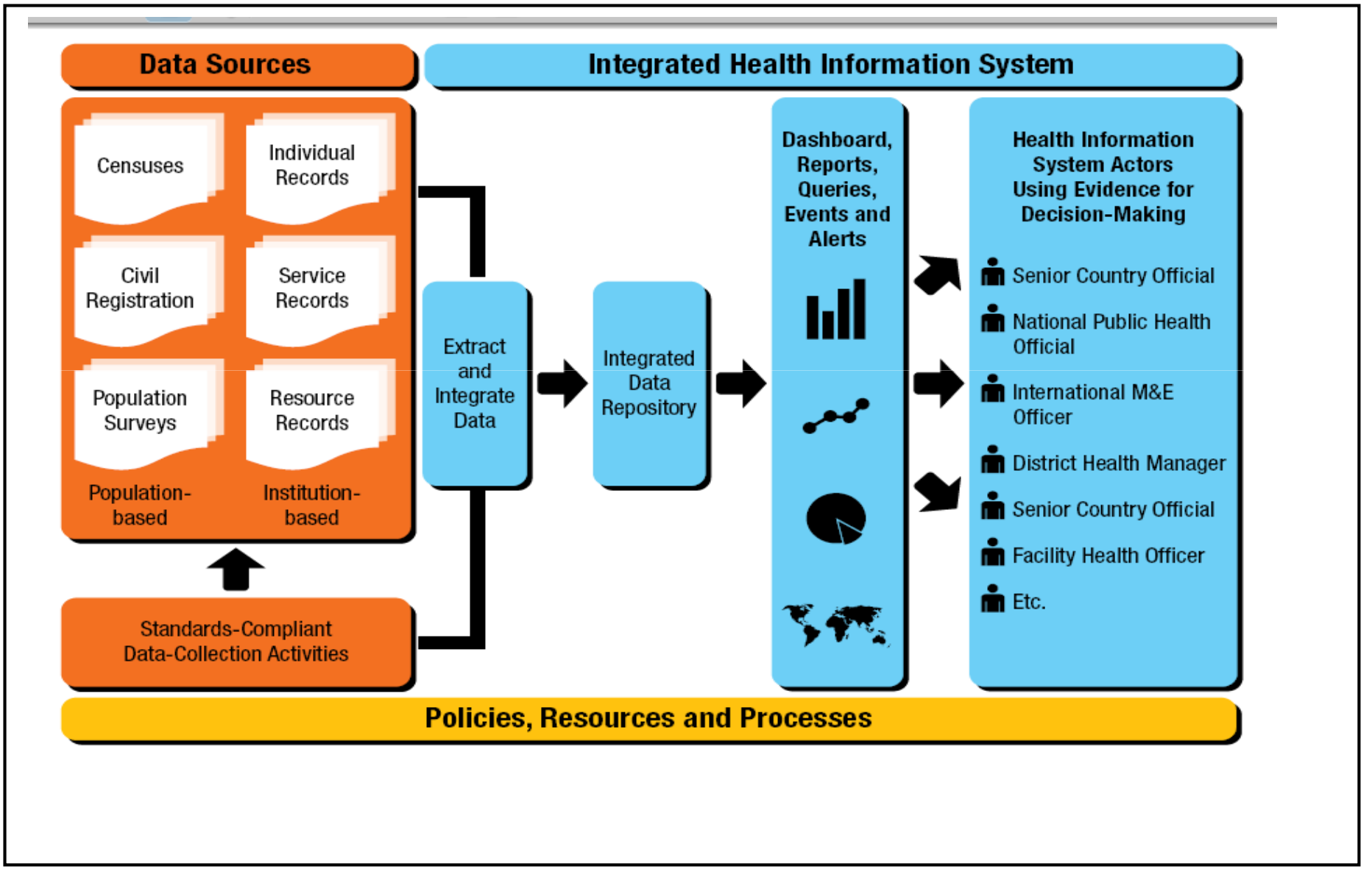
South Africa: towards a district warehouse



South Africa: next phase of evolution



The HMN vision of data warehouse



Principal data source categories for the National Data Warehouse	
Institution-based data sources	
Individual records	All name based client and patient records, from register books for out patients, or ANC clients, to the registration and tracking of all pregnant women and Medical Record Systems in hospitals. The data warehouse import, aggregates data from these primary data sources.
Resource records	Taken to mean that all other sources of health services data and records, ensures quality, availability and logistics of all inputs, in areas of; human resources, drugs, health facilities and their services, laboratories, financial systems- budget /expenditures.
Service records	Includes data and records from across sectors; like, environmental health, insurance, police, and occupational health.
Population-based data sources	
Census data	Population census is the primary source for the size of population, geographical distribution, target population for interventions, plus data on social and economic conditions.
Civil registration	Compulsory registration on birth, death and marriages provide both legal documents and important data sources in many countries. In many developing countries, such registration systems are relatively poor.
Population surveys	In developing countries, where civil registration is poor, health and demographic surveys are the most important source of population health status. For example, for HIV status; child and maternal mortality.

Our point of departure

The requirement is not for one national database, but multiple databases corresponding to different administrative levels, each containing its key data; required for management.

For example, in a hospital, the data warehouse will include aggregate data and indicator data, on patient flow, outcome by wards, services, diseases and patient groups; financial data, laboratories, etc to provide indicators like bed occupancy and average length of stay.

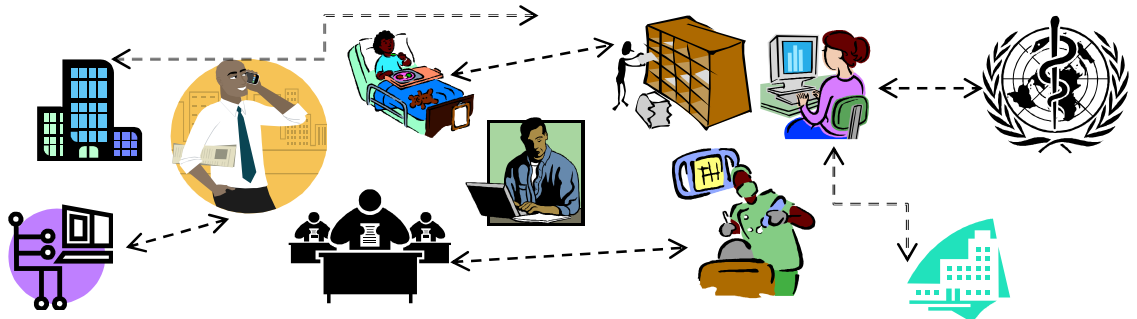
Vital to release the “data warehouse” concept, and its exclusive, all-encompassing, ideal features to turn it into a practical tool; for the stepwise development, targeting first the low-hanging fruit, and then gradually “climbing higher up the tree.”

Architecture in the making. Example, Himachal Pradesh

Enterprise architecture: 3 Layers

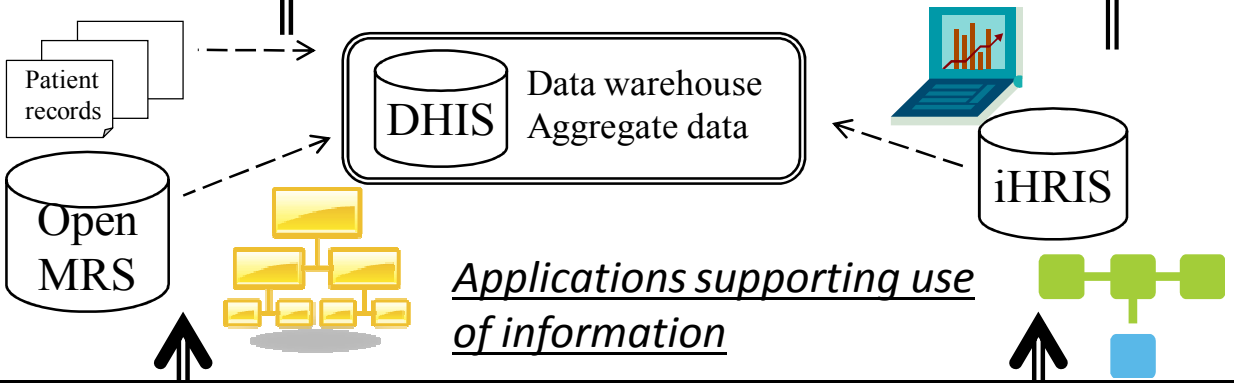
Level 1:
Information Needs, Users, Usage Across Organisations

"Social System level"



Institutional use of information

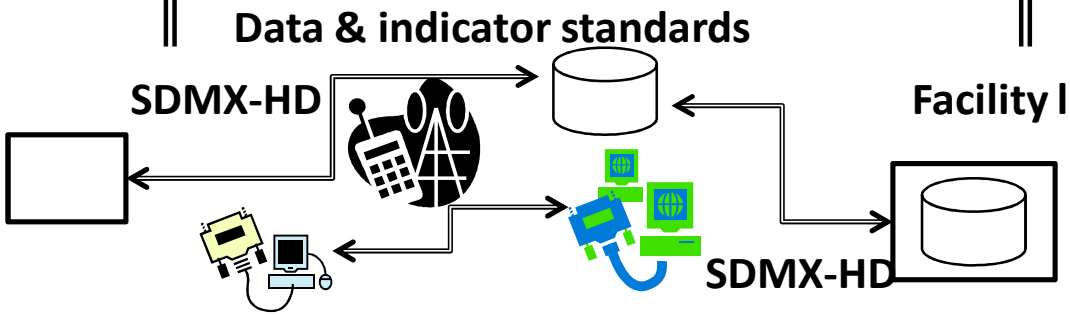
Level 2:
Software applications & Information Systems
"Application level"



Applications supporting use of information

Level 3: "Data exchange level"
"Technical level"

Interoperability & standards, technical infrastructure



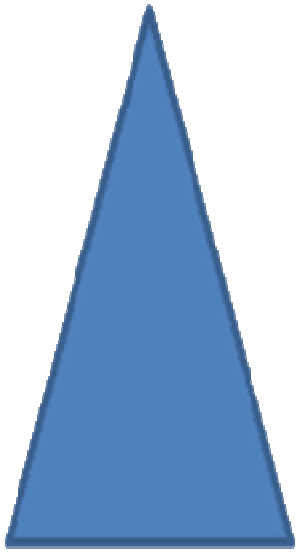
Data Standards and infrastructure supporting the applications

Three levels of HIA (enterprise architecture)

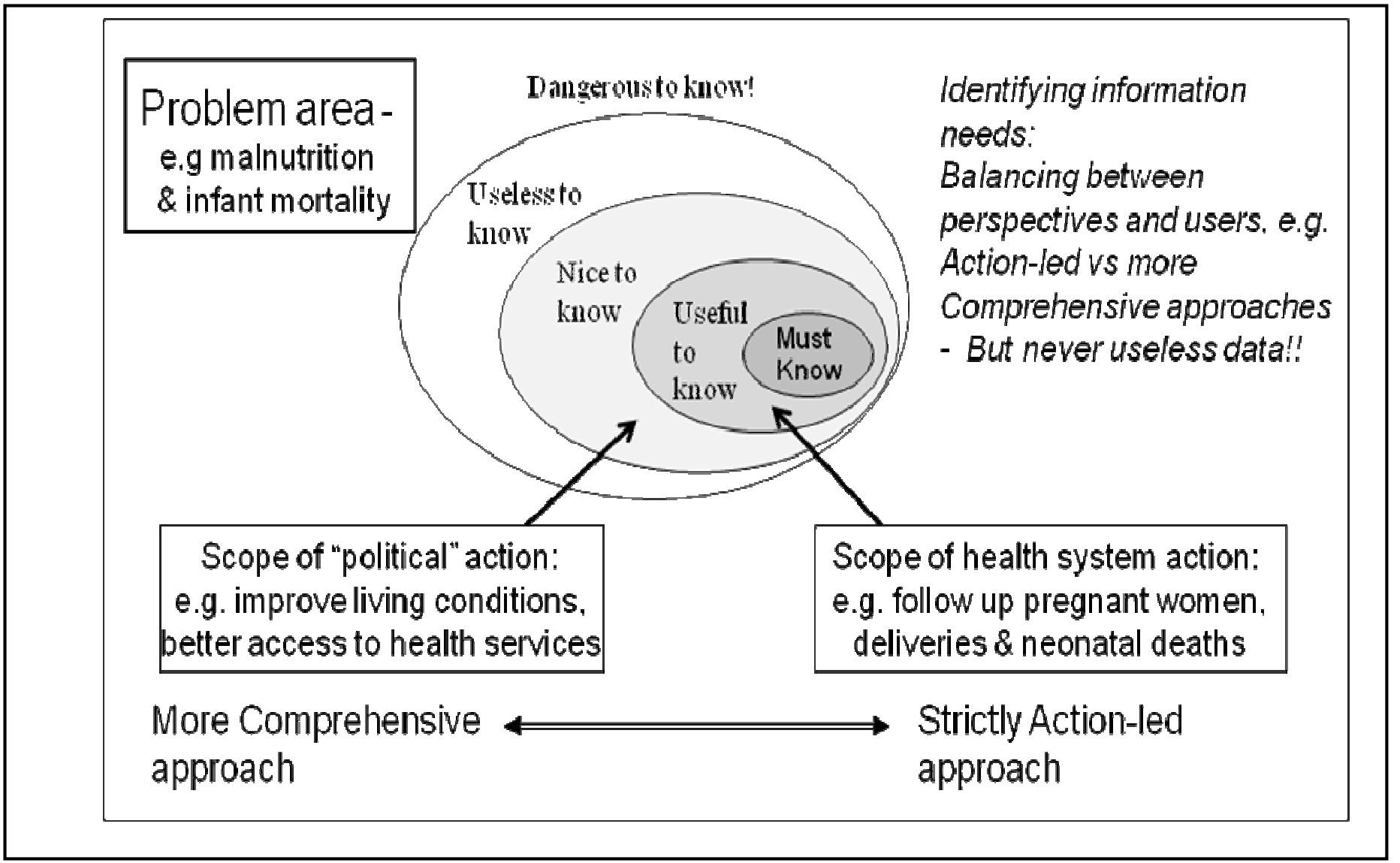
Three Levels of the Health Information Architecture	
Level 1: Information needs, users and usage: "Business Level"	The users' information needs and actual usage of information; the business processes and functionalities, supported by the HIS. Documented through users specifications and requirements, within the context of relevant business processes and organization. The defining layer of the architecture!
Level 1 uses services from the level below (level 2)	
Level 2: Software applications and information systems: "Application level"	Applications and systems responding to the users' needs, providing the required information and services to the users. Documented through SW application documentation, manuals, - and actual implementations!
Level 2 uses services from the level below (level 3)	
Level 3: Data exchange, interoperability and standards: "Technical level"	The technical level of data exchange and interoperability; the glue of it all. Data and technical standards for interoperability of data between systems and applications, enabling data flow. Types of standards are described differently; from formal standards for data exchange to data dictionaries of data standards and semantics.

Data needs across levels

Level of health system	Quantity of data Data granularity	Information needs
Global	Less data	Summary indicators General, e.g. MDG
National /State		Summary indicators National needs
District		Indicators district management
Facility		Facility management
Patient	More data	Patient records, tracking & care



Balancing varying information needs



Information for a purpose: for action

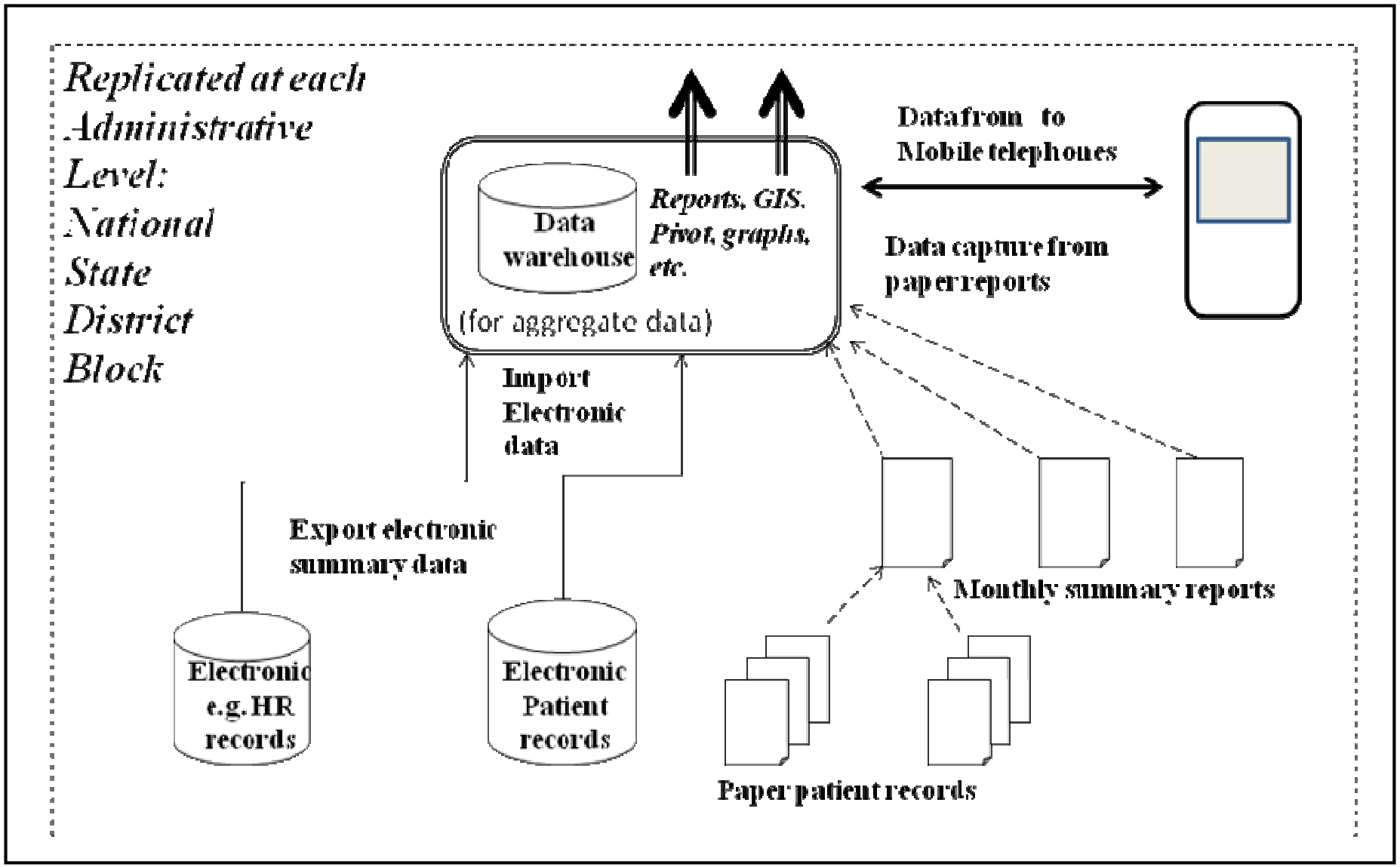
South Africa: Individual provinces, districts and national programmes were systematically using information for action. Eg the health sector was shifting towards activity-based budgeting where information from the HMIS would be a deciding factor on resource allocation.

In Thailand, maturity around the use of information, could be gauged from the fact that information was used to support the everyday working of the health department, as well as, national initiatives like "Healthy Thailand," and the national insurance scheme.

Both countries, despite significant and increasing use of information for action, still collected more data than they used.

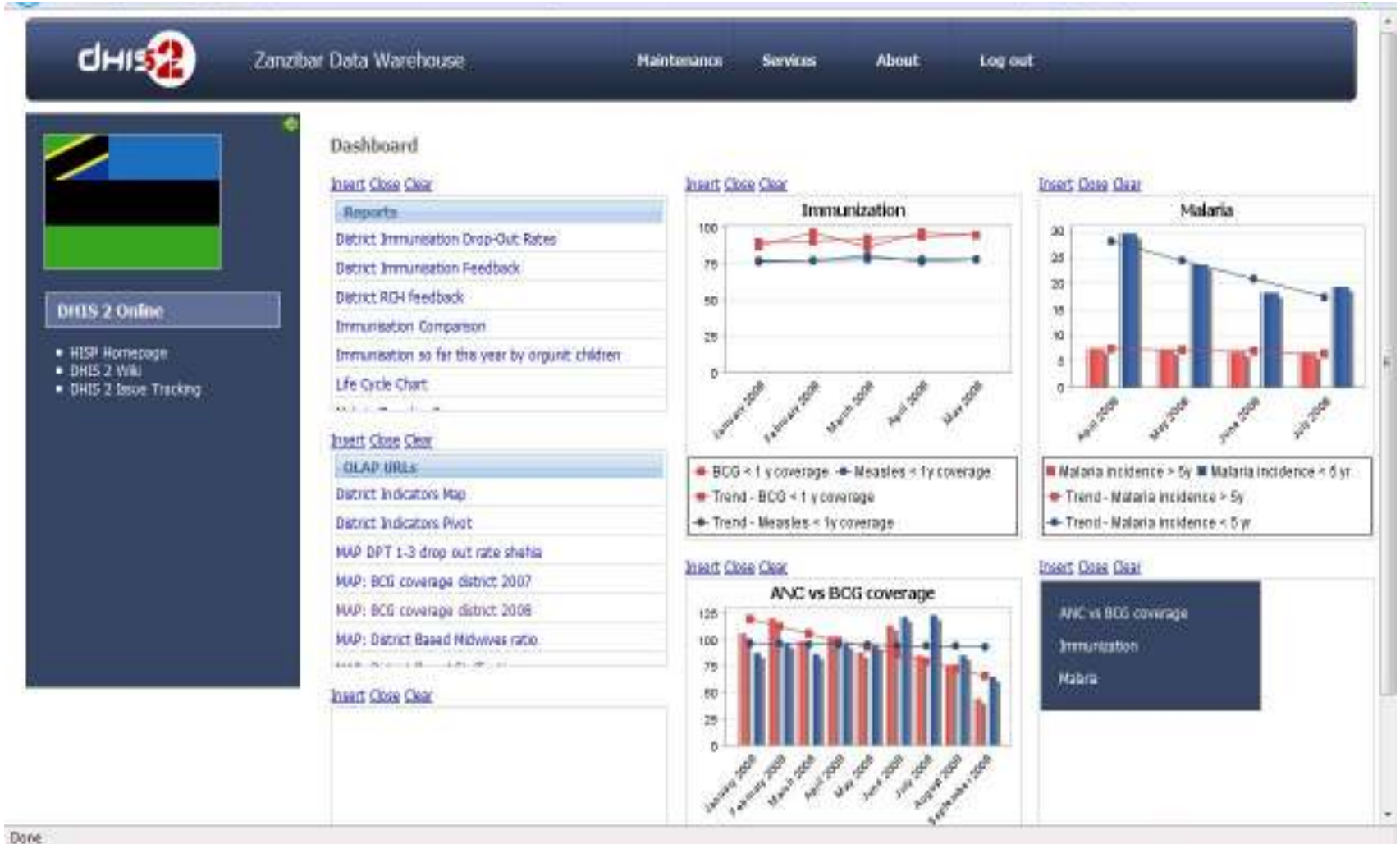
Exception. Most countries in the vicious cycle; of **poor quality data not being used**; and because it isn't used, remains poor in quality.

Conceptualizing the application level of IHIA

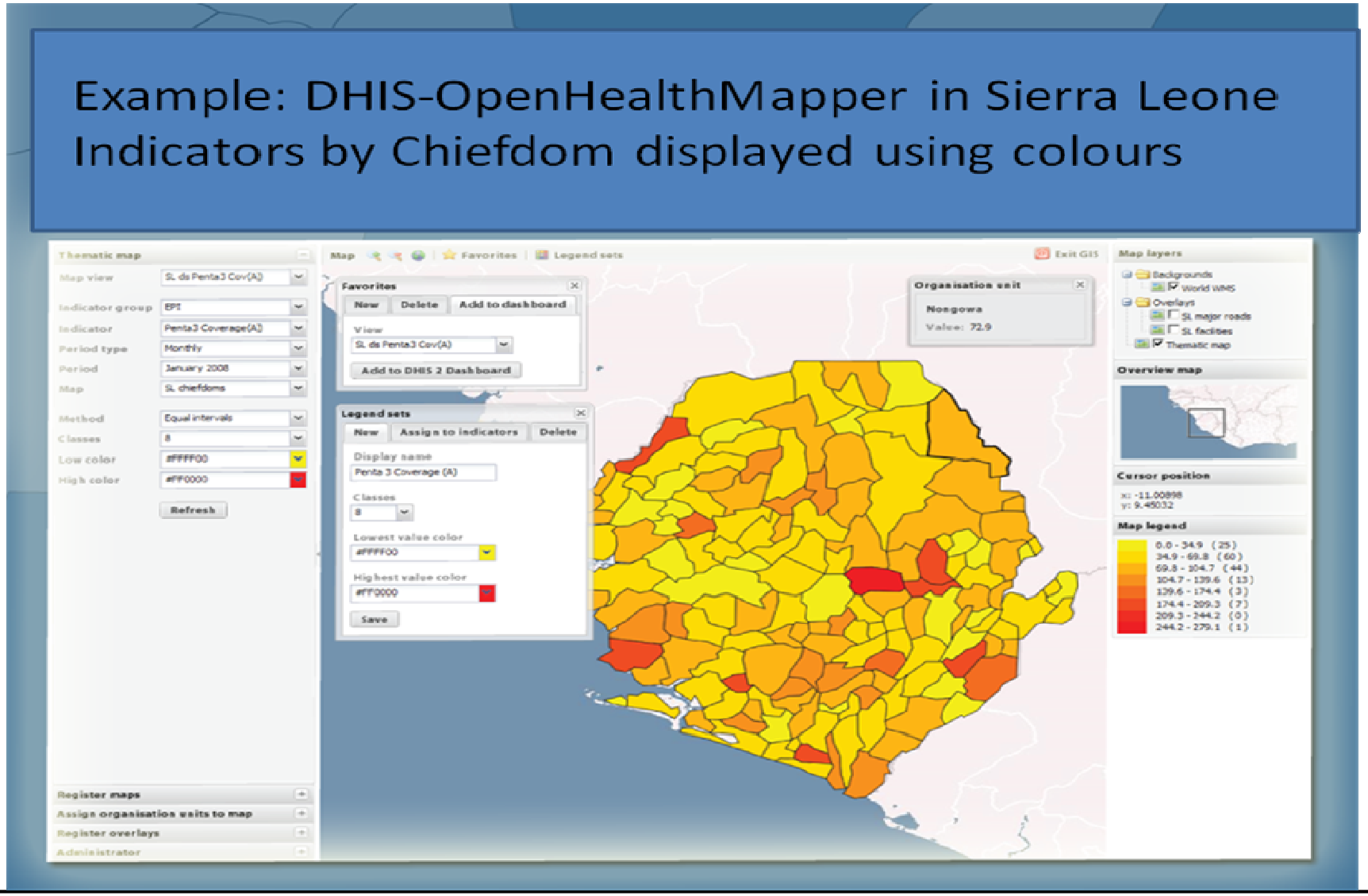


Presentation and dissemination of information – the purpose of a IHIA

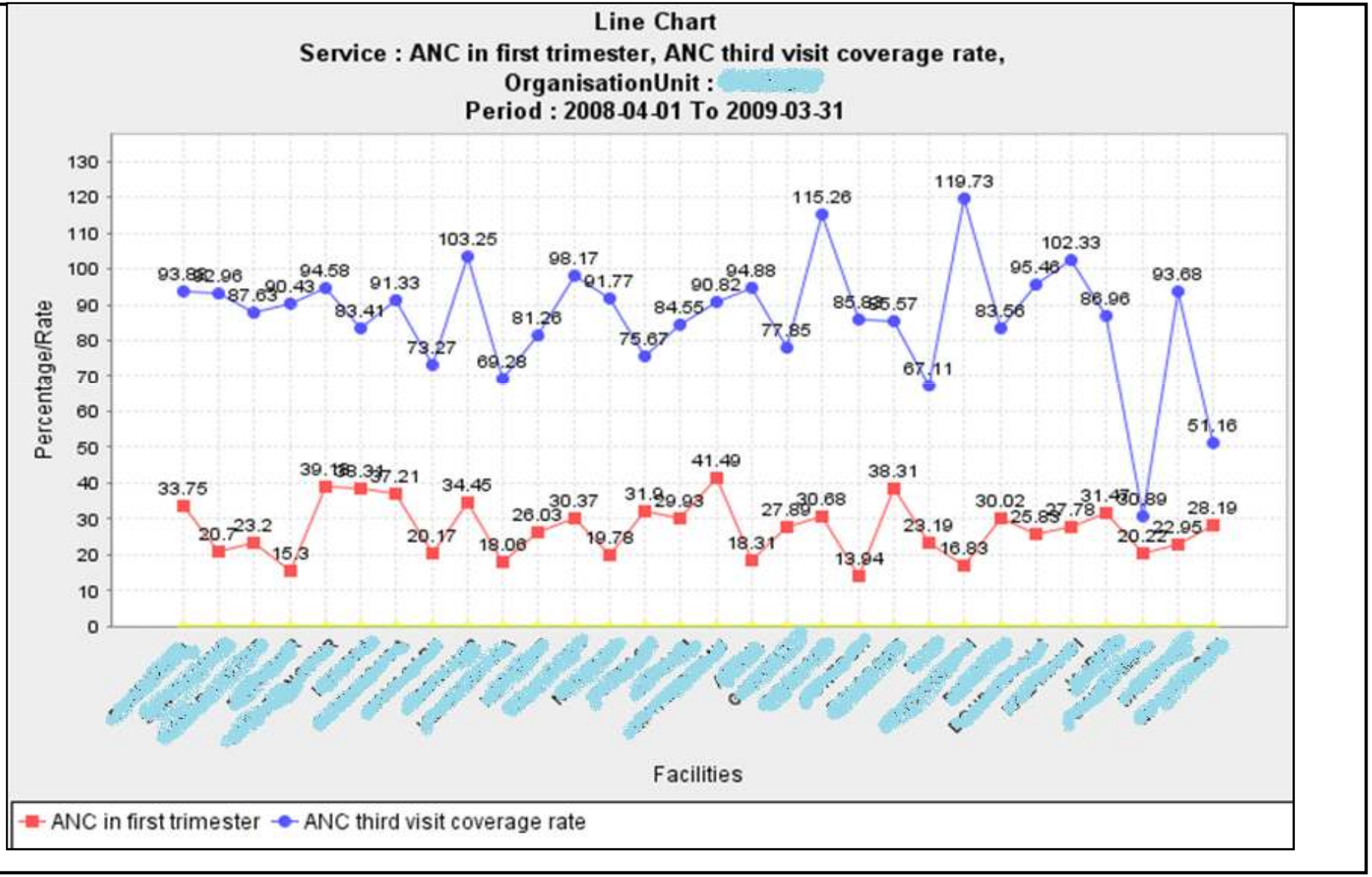
Bird's eye view through the DHIS2



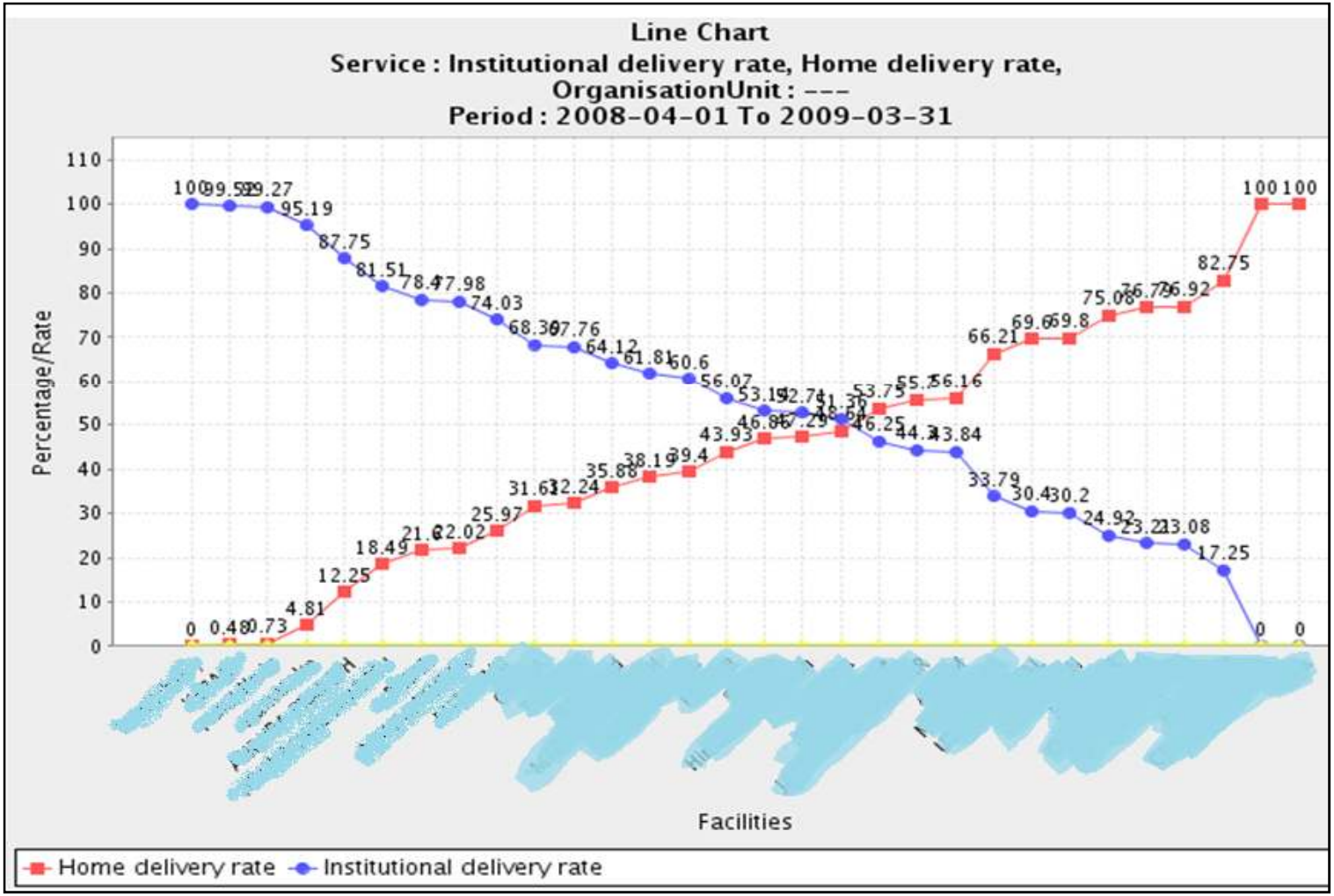
Displaying spatial information



ANC 1st Trimester and 3rd Visit Coverage.



Comparing Home & Institutional Deliveries



Strategies for scaling of IHIAs

Scaling of design principles and not boxes

Across two dimensions

1. **Structure, technical system, quantitative dimension: components of the scalable IHIA**

1. **Process, social system, qualitative dimension: Scaling and cultivation approaches**

Scaling principles: Quantitative dimensions

Structure, technical system, quantitative dimension: components of the scalable IHIA
Agreed data standards, integrated data and indicators, are the primary building block of the IHIA. Data standards need to develop, according to the users' needs and be flexible to adapt to a changing context and expanded and changed with addition of new data and datasets.

Develop based on a data warehouse framework, or data repository for aggregate data, which provides the means to manage the data and integrate the various datasets and sub-systems. The data warehouse needs to be expandable and flexible, including:

- Integrate and manage data sets as they are emerging, changing and developing.
- Present and make data available according to domain knowledge and "business intelligence", as user needs are developing and emerging.

Establishing interoperability and data exchange using standards, and through the provision of gateways between the data warehouse and the sources of data, whether they are based on paper, computer or other electronic means.

System development is based on use of mature FOSS components, supporting both web based and offline deployments. FOSS contributes to the scalability; no license transaction costs. “Open standards” are devoid of intellectual property constraints, and which enjoy legitimacy through open, fair and participatory development and maintenance arrangements, by not-for profit agencies.

Scaling principles: Qualitative dimensions

Process, social system, qualitative dimension: Scaling and cultivation approaches

User participation, learning and local empowerment. To get users' at all levels committed, and foster a sense of ownership to information and system.

"Radical change through small steps"- evolutionary strategy, start small and grow big (ger) as users' learn and see the potentials.

Going first, for the lower hanging fruits which are easy to reach, before moving up the tree.

Scale the architecture gradually along the vertical and horizontal axes, depending on users', and institutional readiness and learning, according to available infrastructure.
Create "attractors" by establishing initial success, which serves as the best way to enroll more actors and user organizations, and thereby rallying scarce resources to increase the success.

Focus on solving specific large problems shared by many, rather than addressing "all problems," or specific problems which don't affect many.
Flexibility. Data standards, data warehouse and means of data exchange need to be flexible; to enable change according to redefinition of needs, infrastructure and overall context.
The architecture can never be developed (or constructed) right from scratch, the existing installed base needs to be nurtured and cultivated, so that it evolves and scales over time taking advantage of existing capabilities.

Scaling strategies

Scaling as horizontal spreading of replicable vertical processes

Scaling the architecture through geography and health structures

Scaling as increasing the scope and comprehensiveness of the architecture and its technical solutions

Scaling as increasing the depth and grounding of the system

Scaling across uneven contexts