USAID-MEASURE Evaluation HMIS Scale-up Project

eHMIS

Technical Report on Electronic Health Management Information System (eHMIS)

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Policy Planning and Finance Directorate

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Acronyms

AHU – Administrative Health Unit

AU – Administrative Unit

CHIS – Community Health Information System

DSS – Decision Support System

eHMIS – Electronic Health Management Information System

FMOH – Federal Ministry of Health

HMIS – Health Management Information System

HSDP – Health Sector Development Program

HSRD – Health System Reference Database

IDSR – Integrated Disease Surveillance and Response

JSI – John Snow Inc.

M & E – Monitoring and Evaluation

MEDSS – Mobile Executive Decision Support System

MET – Manual Data Entry Tool

PHCU – Primary Health Care Unit

RHB – Regional Health Bureau

SNNPR – Southern Nations and Nationalities People's Region

SpWO – Special Woreda Health Office

ToHO – Town Admin Health Office

WoHO – Woreda Health Office

Preface

eHMIS implemented in SNNPR by USAID funded MEASURE Evaluation HMIS Scale-up Project since 2010. This electronic application i.e. eHMIS is a robust system, time-tested for over 2 years now and serving its client i.e., the SNNP RHB with satisfaction. SNNP RHB is now able to generate various reports within seconds.

eHMIS is a home-grown solution developed by Ethiopian IT experts taking advantage of international expertise made available by John Snow Inc. (JSI). The development of the application took account of the Ethiopian health system's context and requirements, yet having the standard design and operational features seen in any internationally acclaimed IT application. eHMIS has been developed to suit particularly the Ethiopian Health Management Information System (HMIS) with ability to meet any future changes or information needs as they evolve.

eHMIS has the ability to be installed and implemented in any Region of Ethiopia and has the capacity to interoperate with any other system used by FMOH.

The important features of the eHMIS in SNNPR are as following:

a. Health System Reference Database:

In addition to the complete health facility list, the Health System Reference Database (HSRD) provides population denominators for various catchment areas, health facility information and human resource information. Data for the whole SNNPR has been entered into the system and is readily available for updating and use. One important utility of HSRD is that it provides the necessary data on various denominators for the calculation of HMIS indicators.

b. Data entry module

The Data Entry into eHMIS can be done in two ways: (1) the manual data entry and (2) scanning which uses intelligent character recognition to populate the HMIS database. The scanning of facility reporting forms is especially set to reduce the time the RHB spends manually entering data by a significant margin. This solution is expected to shift this current clerical task

to more advance roles such as analyzing data for decision making and working on improving data quality.

The offline manual data entry at woreda health offices is currently being rolled out to all the woreda health offices in SNNPR. This feature is empowering the woreda health offices to enter their own data as soon as HMIS reports are received from the health facilities so that the monthly HMIS data is promptly available & accessible to district and zonal managers for review. The entered monthly report data is uploaded into Regional server through internet.

c. Data synchronization

This features allows synchronization of HMIS data either entered at woreda level or at regional health bureau level

d. Date Aggregation Module

The Aggregation Module is an application that dynamically aggregates data entered via the Data Entry Module to provide woreda, zonal and regional aggregation for the month, quarter and year. Thus both aggregated data and data disaggregated up to Health Post level are readily available to the managers and decision makers.

The aggregation software is adding significant time savings and improvement to quality by reducing the time it takes to aggregate reports to a matter of seconds and virtually eliminating calculation errors that might occur if the task was to be done manually.

e. HMIS Report Status Tracker

This feature allows tracking the receipt and processing of HMIS monthly reports. It also lists the names of missing health facilities to enable the HMIS focal person follow-up with those facilities to submit their reports.

f. Performance Reporting

This feature provides a quick snapshot of woreda, zonal and regional level performance with regard to HMIS indicators and comparisons with targets set by the region.

g. Decision Support System (DSS)

The DSS is the dashboard that provides decision makers' access to data collected that can be easily analyzed for effective and timely decision making. The DSS employs simple and yet powerful charting tools such as line, bar and maps to communicate information in a way that makes the thousands and millions of records in the database represented in simple user-friendly charts. In addition to the desktop DSS application, top level management can benefit highly from the Mobile Executive Decision Support System (MEDSS).

The DSS uses the HMIS Indicator definition module which has been in-built into the system as a quick reference to how each indicator is calculated.

A recent assessment done by SNNP RHB confirms that there is high level of satisfaction with the eHMIS at woreda level. The Woreda Health Offices feel that they are the owner of their HMIS data and are able to use it in various ways as deemed necessary.

Committed to working with the FMOH for strengthening the Ethiopian Health System in general and the Health Information System in particular, the MEASURE Evaluation HMIS Scale-up Project submits this report to the Federal Ministry of Health, Ethiopia on the request of the ministry to have a better understanding of the electronic HMIS system implemented in the country.

1 Overview

The Health Management Information System and Monitoring and Evaluation (HMIS/M&E) strategy is one of the pivotal components of the Health Sector Development Program (HSDP) of the Federal Ministry of Health (FMOH). The FMOH adopted a "One Plan, One & Budget One Report" policy with the aim of improving management and optimum use of resources for making timely decisions and considers HMIS/M&E as the core information component of effective health care delivery.

To this end, HMIS reform has been given paramount importance in the HSDP agenda. The reformed HMIS was designed, piloted and tested in 2006–2007 with technical assistance by John Snow, Inc. (JSI).

At the request of the FMOH, USAID/Ethiopia asked JSI, through MEASURE Evaluation, to assist in the scale-up of the reformed HMIS/M&E in Southern Nations and Nationalities People's Region (SNNPR) in particular and work with FMOH on strategies for a national Health Information System (HIS) in general. The primary activities of the project include assisting the Regional Health Bureau (RHB) of SNNPR with the implementation of the new HMIS/M&E, establish a computerized HMIS/M&E data processing and reporting system at regional, zonal and woreda levels in SNNPR, promote HMIS data quality and information use, and provide technical support to the Policy, Planning & Finance General Directorate of FMOH in coordinating the multi-partner scaling up of the HMIS/M&E.

Accordingly, since September 2009 the USAID-funded HMIS Scale-up Project has provided training to regional, zonal and woreda health managers and health care providers of 22 hospitals, 658 health centers and 3855 health posts in all the 14 zones, 1 City Administration and 4 special woredas of SNNPR. By December 2012 all these health facilities have started reporting using the national reformed HMIS. To facilitate data processing and utilization at various levels of health administration, the Project has developed and implemented in SNNPR an Electronic Health Management Information System (eHMIS) that is assisting health bureau planning managers, HMIS focal persons and health managers at all levels to use HMIS information for planning and management of the health services. On the request from FMOH, the Project is collaborating

with Oromia Regional Health Bureau to scale-up the community component of the HMIS (i.e. Community Health Information System – CHIS) in Oromia. Similar collaboration with Tigray Regional Health Bureau is in the pipeline.

2 Electronic Health Management System (eHMIS)

There are about 3855 health posts, 658 health centers and 22 hospitals in SNNPR. Routine data is collected from these health facilities using the monthly IPD disease reports, OPD disease reports, hospital service reports and PHCU (i.e. Health Center and Health Post) service reports.

Considering the number of data generated every month by each type of health facility and the number of health facilities in SNNPR, over 2 million data is generated every month in SNNPR alone (Table 1). Without support of an electronic data management system, it is nearly impossible to generate timely reports while processing data manually using simple Excel/Spreadsheets. Besides, advanced data aggregation, e.g. aggregation of data at health posts, health centers, hospitals, woredas, zones, and region levels is a time taking process and prone to errors unless carried out with the support of a robust data management system. Similarly for any type of data analysis viz. time trends or spatial and temporal comparisons an electronic data management system is a must.

Table 1: Data fields collected monthly/quarterly

Health Facility	No of health facility in SNNPR	IPD Disease	OPD Disease	Service Monthly	Service Quarterly	Total
Health Post	3855	-	122	70	-	740,160
Health Center	658	1236	533	147	35	1,283,758
Hospital	22	1236	533	147	35	42,922
Total	4535					2,066,840

Hence, the need for automated data processing is inevitable and there emanates the Electronic Health Management Information System (eHMIS).

The eHMIS developed by the USAID HMIS Scale-up project and currently implemented in SNNPR is a system that helps to accurately and timely enter, aggregate, store, analyze and evaluate health related data from health facility to federal level. eHMIS is composed of a set of interrelated components and procedures organized with the objective of generating health information and intelligence to monitor the health status and health services of the PHCU,

woreda, zone, region and the country for improving public health care management decisions at all levels.

System Architecture

eHMIS is designed as a desktop application to support decentralized and yet synchronized data management. The eHMIS database server, which is located at SNNP RHB, serves as a central repository where as woredas and zones keep their synchronized local copy at their premises. Data flow follows the national standards and is described in section 3.3 along with the data entry procedures.

3 eHMIS Components

eHMIS is a collection of interrelated tools that are integrated for a common purpose. The major tools include the Health System Reference Database (HSRD), Report Tracker, Data Entry, Aggregation, Performance Reports and Decision Support System (DSS).

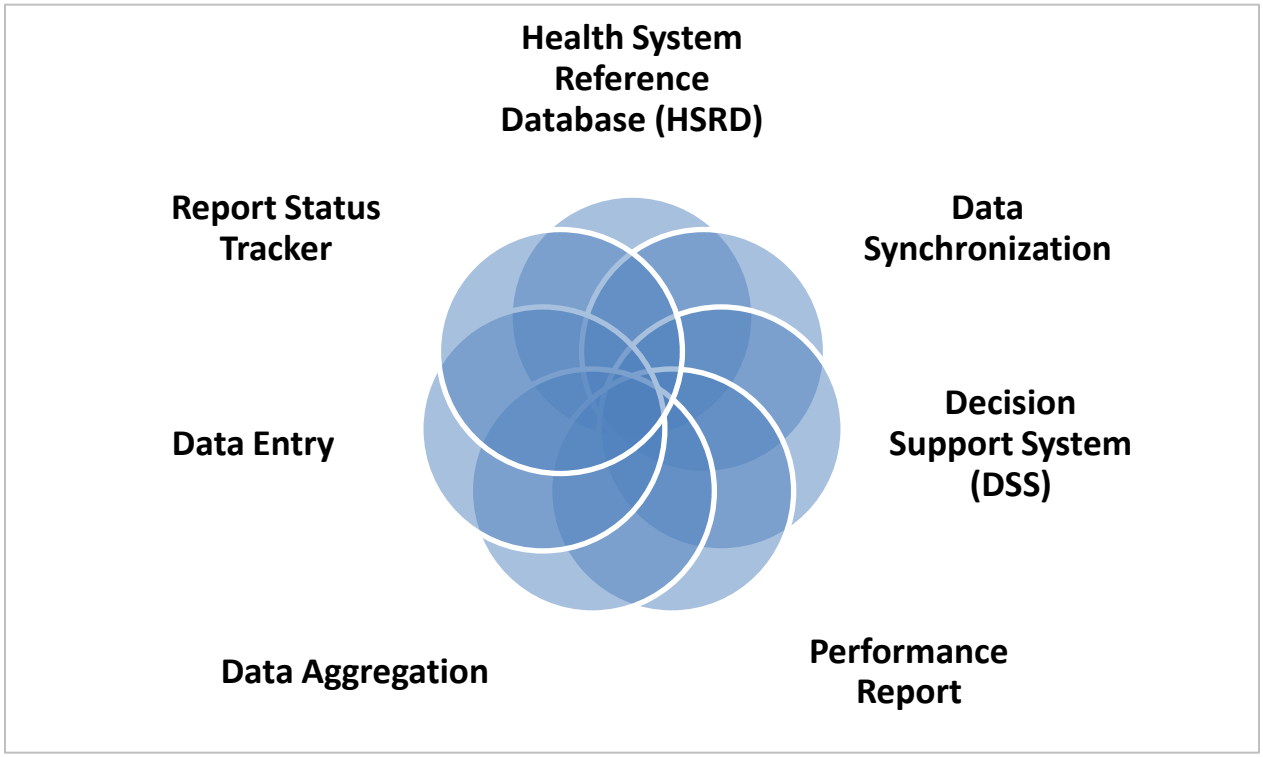


Figure 1: eHMIS components

3.1 Health System Reference Database (HSRD)

The Health Systems Reference Database (HSRD) is the foundation, first and foremost prerequisite for a Health Information System (HIS). The main purpose is to establish a reference database where by information about administrative units, administrative health units and service delivery units are centrally managed. The need for HSRD spans beyond its use for the eHMIS and is equally needed and used for other HIS components (such as Finance, Human Resource, etc) and MIS systems as well.

The implementation and adaptation of HSRD means there is a system wide standard from which both routine as well as surveys can refer to regions, health offices and health facilities using the same universal ID. This reduces, virtually eliminates, duplication of efforts, ability to analyze data, easy linkage of data to other systems, web access of data and incorporating population and GIS information from sources such as Central Statistics Agency (CSA).

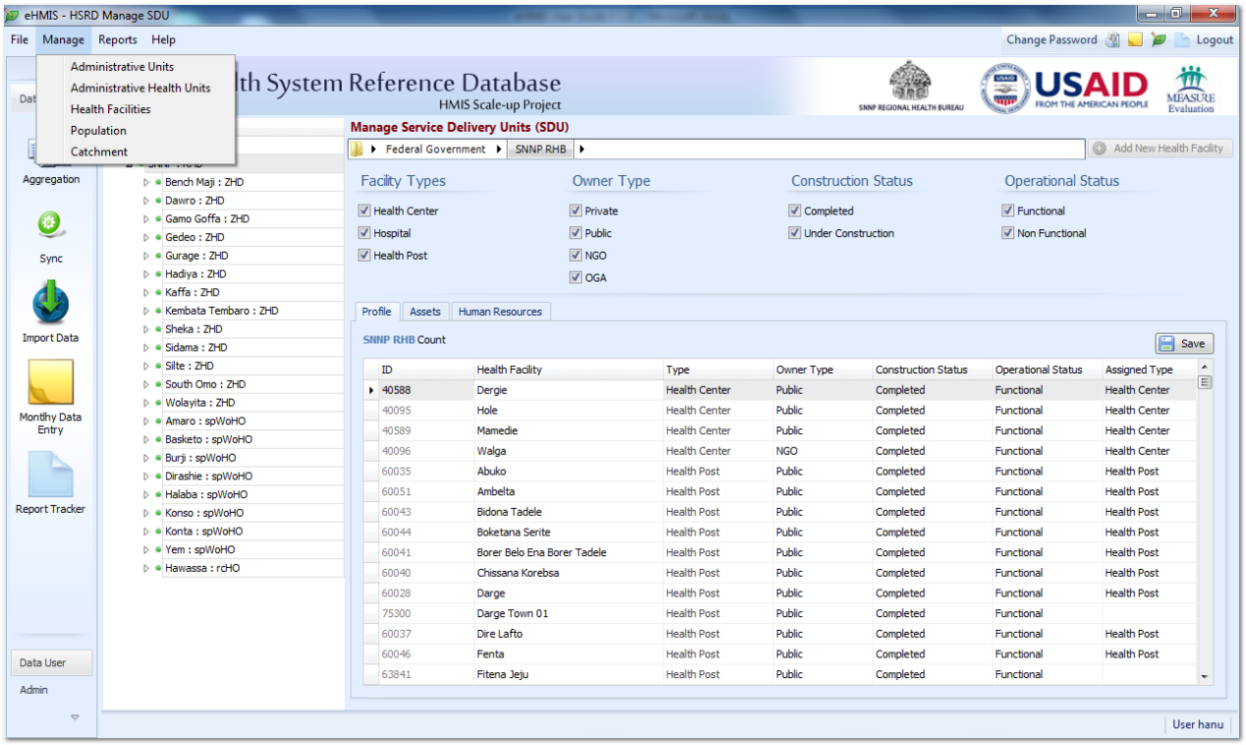


Figure 2: HSRD - Master Facility List

Besides, the system is designed with the aim of meeting local needs by incorporating all standard requirements that are set out by the World Health Organization and considering best practices from other related systems.

Moreover, HSRD is integrated to all other components of eHMIS providing 'on the fly' list of health posts, health centers, hospitals, AHUs and AUs.

3.1.1 HSRD Components

- **Administrative Areas (Units) - AUs:** this component is used to define regions, zones (special woredas), woredas, city admins as well as towns and kebeles
- **Administrative Health Offices (Units) - AHUs:** this component defines regional health bureaus, zonal health departments (ZHD), woreda health offices (WoHO) that are located in designated administrative areas (units)
- **Service Delivery Units or Health Facilities - HF:** this component defines and stores hospitals, health centers and health posts information

In addition to this, HSRD has catchment and population information regarding health posts, health centers and hospitals, and administrative units.

3.1.2 Common Attributes

For each of the HSRD components, it provides key attribute data

Table 2: HSRD Common Attributes

Attribute	Administrative Unit (are)	Health administration	Facilities (SDU)
Proper name of the unit	Yes	Yes	Yes
Unique ID	Yes	Yes	Yes
Shape File	Yes	N/A	N/A
GIS information	Yes	Yes	Yes
Population/ Catchment	Yes	Yes	Yes

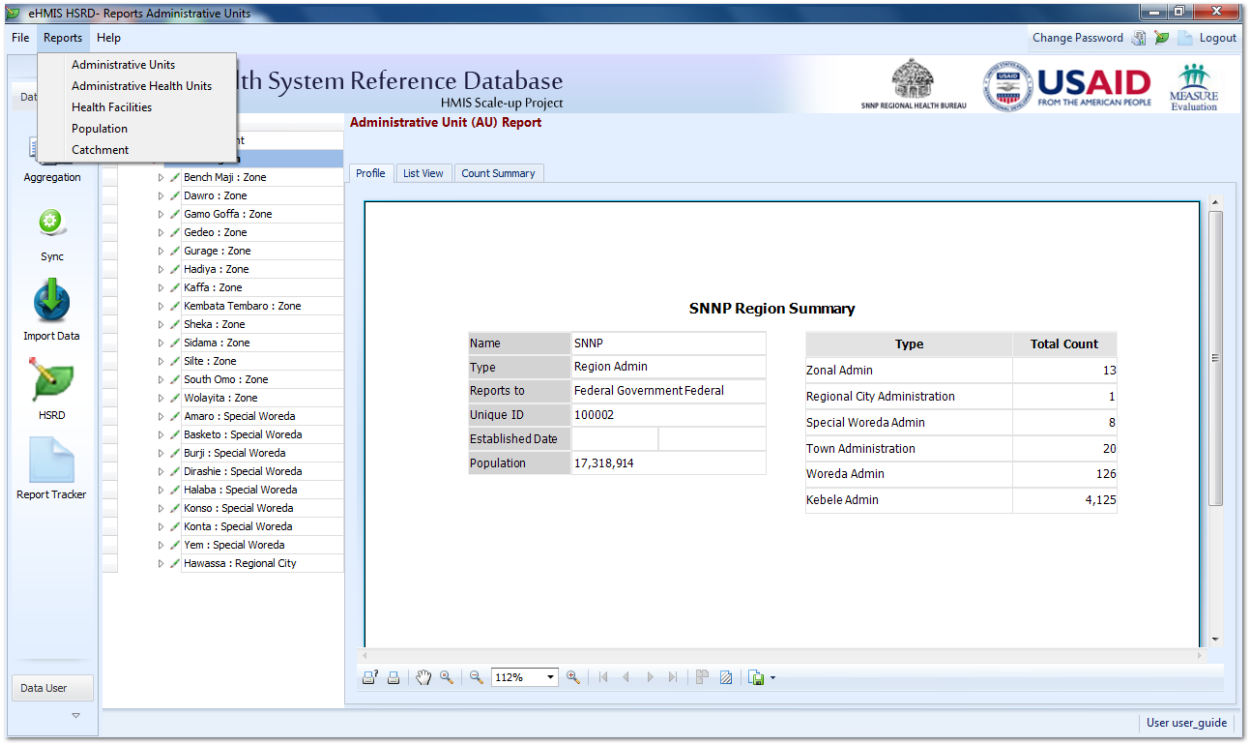


Figure 3: HSRD AU Report

Key Features

HSRD, among other things, assigns Master Facility ID for hospitals, health centers and health posts, and administrative units (including regions, zones/special woredas, woredas and kebeles) and administrative health units (RHBs, ZHD/SpWo, WoHO, ToHO). It also provides easy to use mechanisms to generate reports about AUs, AHUs, Health Posts, Health Centers and Hospitals, and Population and Catchment.

Moreover,

- It provides a mechanism to create new AUs, AHUs, Health posts, health centers, and hospitals
- It offers easy to use mechanisms in managing existing AU's, AHU's and Health posts, health centers and hospitals information
- It provides detail facility status information including their operational and construction statuses,

- It serves as a directory of administrative areas providing latest information about regions, zones, woredas and kebeles with population and shape files for GIS mapping
- It provides the current demographic estimates used by eHMIS for calculating HMIS indicators
- It functions as a directory of health offices across the region (zonal health departments, woreda health offices) along with their GPS record
- It can be considered as an extension to store/manage data on services provided by health facility (i.e. health post, health center and/or hospital), human resource capacity, etc…
- It provides graphical report depicting health posts, health centers and hospitals ownership type, operational and construction statuses
- It offers a powerful mechanism to search as well as generate list of AUs, AHUs, and health posts, health centers and hospitals by name
- It has the ability to export (to PDF and Microsoft Excel) and print health posts, health centers and hospitals list
- It offers the ability to manage population, catchment and contact information details of AUs, AHUs and Health posts, health centers and hospitals
- It serves as a mechanism to track AU's, AHU's and Health posts, health centers and hospitals GIS information
- It serves as a reference for AHU's and health posts, health centers and hospital's infrastructure (such as telephone, safe water, electricity, mobile network etc…)
- It provides on-screen prompts and tool tips that allow users to adapt the system easily with comprehensive availability

The Project Management Unit of FMOH is currently actively seeking to develop a Master Health Facility List/Database. In that context, a draft system requirement framework was agreed upon among different partners and FMOH. An assessment of the HSRD developed by MEASURE Evaluation HMIS Scale-up project in relation to those requirements was done and is presented in the table (Table 3) below:

Table 3: HSRD in relation to FMOH Master Facility List Requirement

No	Health Facility Master List Requirement description by FMOH	Importance	Weight	MEASURE Evaluation Health System Reference Database (HSRD)
1.	Scope of system (items of this may come back in the detailed sections)			
1.1	Relational database	1	5	✓
1.2	Authorized decentralized data entry at zonal level	1	5	+/-
1.3	Import / Export and data integrity checks	1	3	✓
1.4	Reporting of changes made to primary key data to next level up (remove; addition; edit); = history log	1	4	
1.5	Control of primary key data in other HIS modules by acting as the look up table on primary key data for these modules	1	5	✓
1.6	Web based system	1	5	+/-
2.	Health facility types to be included			
2.1	Public facilities acknowledging the standard gvt types	1	3	✓
2.2	Private facilities	2	3	✓
2.2.1	Acknowledging specialized care (eye, dental, cardiac etc)	3	2	
2.3	Faith based facilities	2	3	
2.4	NGO based facilities	2	3	✓
2.5	Public health related facilities like laboratories and pharmacies	2	2	
2.6	Private health related facilities like laboratories and pharmacies	3	2	
2.7	Embedded licensing process	2	1	
3.	Data elements to be included			
3.1	Signature domain:			
3.1.1	Unique identifier with the ability to generate this automatically from an embedded reference list (CSA administrative unit codes to be concatenated) or automatically system generated number	1	5	✓
3.1.2	Facility name	1	2	✓

No	Health Facility Master List Requirement description by FMOH	Importance	Weight	MEASURE Evaluation Health System Reference Database (HSRD)
3.1.3	Facility type (see section 2)	1	2	✓
3.1.4	Ownership/managing authority (see section 2)	1	2	✓
3.1.5	Location/address (with at least the kebele name)	1	2	✓
3.1.6	Administrative units (woreda, zone)	1	2	✓
3.1.7	Geographic coordinates	1	2	+/-
3.1.8	Operational status (planned, bid, construction progress, functional)	1	2	✓
3.1.9	Referral from health facility	1	4	
3.1.10	Referral to health facility	1	4	
3.1.11	Population catchment area automatically generated through kebele and referral identification	1	4	✓
3.1.12	Date of last update	1	2	✓
3.2	Service Domain			✓
3.2.1	Status water supply	1	2	✓
3.2.2	Status power supply	1	2	✓
3.2.3	Status means of communication	1	2	✓
3.2.4	Availability of computer	1	2	
3.2.5	Availability of ambulance	1	2	
3.2.6	Maintenance related data	1	2	
4.	Data management and maintenance procedures			
4.1	Decentralized authority levels for data entry and updates	1	5	+/-
4.2	Transfer and update of data in both directions (import / export functionality in relation to changed data only to limit the size of the file)	1	3	+/-
4.3	Data integrity check and reporting on changes made = history log	1	5	+/-
5.	Data dissemination			
5.1	Decentralized authority levels to access data	1	5	✓
5.2	Report writing capabilities in relation to HFM	1	5	
5.3	Report writing capabilities across modules	1	5	✓

No	Health Facility Master List Requirement description by FMOH	Importance	Weight	MEASURE Evaluation Health System Reference Database (HSRD)
5.4	Public (filtered) access	2	2	+/-
5.5	Export capability of data sets in other file formats	1	3	✓
6.	Linkage to other electronic systems			
6.1	Relation to other modules representing the control module for the primary key (look up database for other modules)	1	5	✓
6.2	Mapping software	2	3	
6.3	Uploading selected data and formats to the web	2	3	
7.	Database features			
7.1	Relational database	1	5	✓
7.2	Multilingual considerations	2	2	
7.3	Web based application	1	5	+/-
8.	Ability to alter the existing system with reference to ownership and access to the source code by the FMoH	1	Must have	+/-

3.2 Report Status Tracker

Health posts, health centers and hospitals report data through Service (Monthly and Annual) and Disease (OPD and IPD) forms on monthly, quarterly and annually depending on the type of data to be reported. The reporting forms collected from these health facilities are sent to Woreda Health Offices for data entry and to the Regional Health Bureau if offline data entry is not available at woreda level. The Report Status Tracker application is designed in a way to track reporting forms receipt and processing statuses. This tool supports tracing the status of these forms so that the HMIS Focal Person or the health managers can review the timeliness and completeness of HMIS reporting from the Health Facilities every month. The Report Status Tracker allows them to see the number and percentage of health posts, health centers and hospitals in each woreda, zone or regions that have submitted their report in a given month and

review the list of health facilities that have not yet submitted their reports or whose reports have not yet been processed i.e. data not entered into eHMIS.

For this reason, the Report Status Tracker application is implemented at woreda, zone and regional health bureau providing powerful tool for two-directional control in reporting data. The health offices can track the delay/loss of reports and claim immediate delivery of reports from health posts, health centers and/or hospitals. And, also track whether those reports that are already received are processed or not.

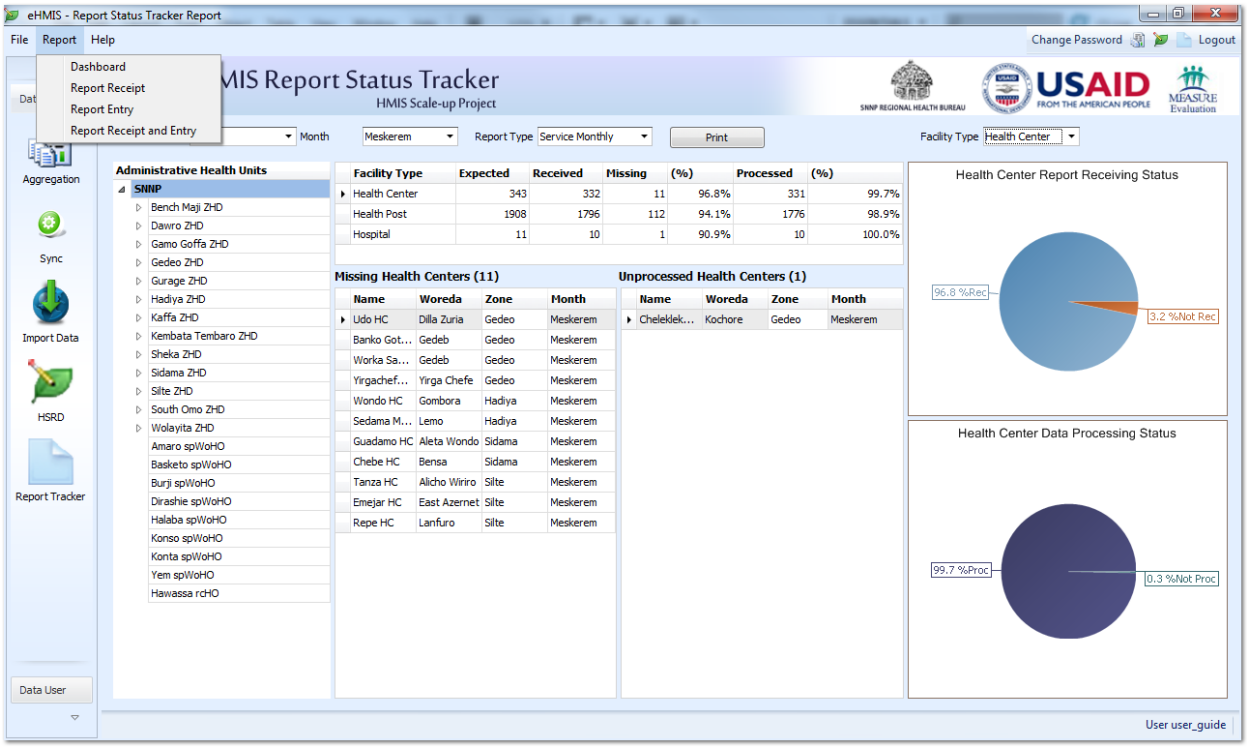


Figure 4: Report Status Tracker

3.2.1 Components of Report Status Tracker

The Report Status Tracker application has the following components:

- Report Receipt

This component assists the Administrative Health Unit (AHU) viz. WorHO, ZHD or RHB staffs to mark reporting forms as received. Moreover, the component is essential for tracing

reports that arrived on time or are late/lost. The system easily displays the number of expected reports from the specified AHU in the selected year/month as well as the number of reports that are actually received together with the number of missed reports.

Besides, it generates a receipt report that can be printed in two copies and signed by the report receiver and deliverer with one copy provided to each.

- **Report Entry**

This feature of the Report Status Tracker application is used to track the data processing status of reports at woreda, zonal and/or regional levels as applicable. It also generates a summary data entry status report depicting the Facility ID, Facility Name, Facility Type, IPD Service Status, Construction and Functional statuses, and Form Types (Service Monthly, OPD or IPD) with the status of the reporting forms.

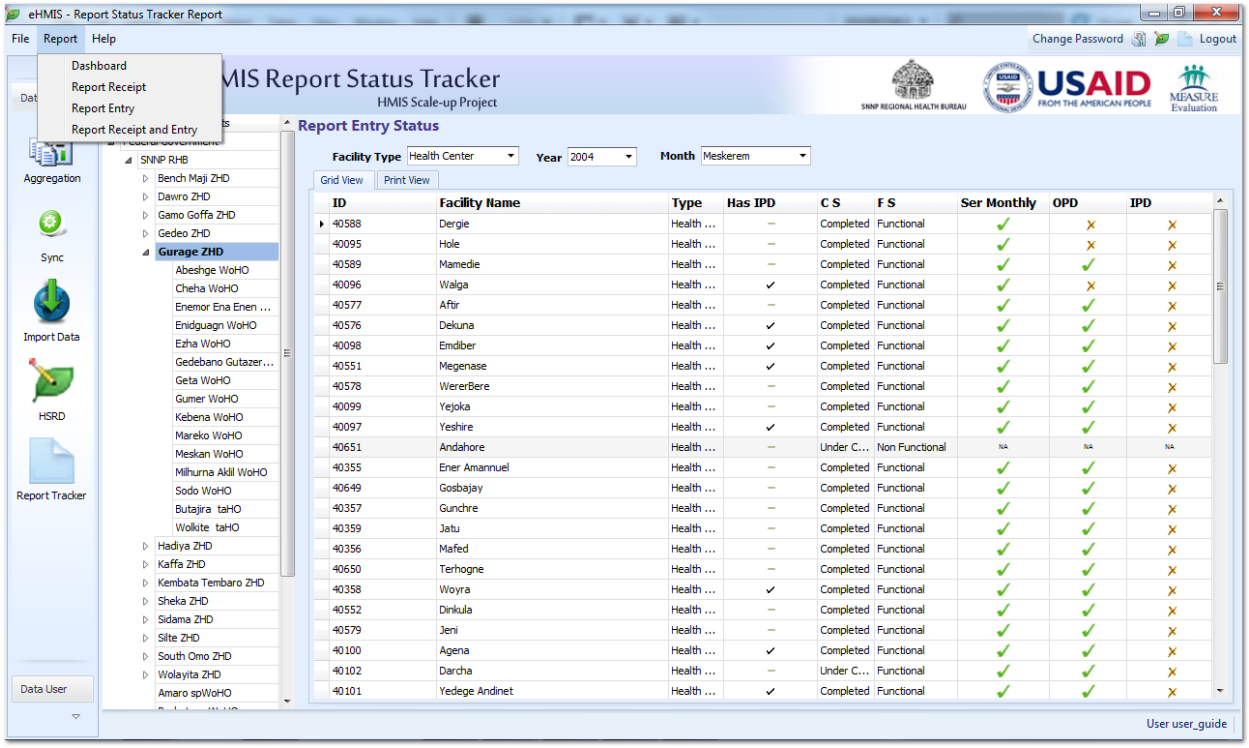


Figure 5: Data Entry Status Report on Report Status Tracker

- **Report Receipt and Entry**

This component of the Report Tracker application provides an option to compare the report receipt and data entry statuses of the reporting forms for selected AHUs. Besides, it serves users to identify reports as Received (R), Not Received (NR), data Entered (E) and/or data Not Entered (NE).

Moreover, the Dashboard on the Report Tracker application provides a summarized information regarding the number of reports expected from health facilities, reports that are received (arrived at the Woreda Health Office in case of woredas doing offline data entry or the Regional Health Bureau), missed, and lists health facilities whose reporting forms do not arrive at RHB on time. The charts on the dashboard also provide health facility's report receiving as well as data processing statuses.

3.2.2 Woreda to Region Synchronization (Sync)

As reporting forms are collected from health facilities to woreda, zonal and regional levels, tracking reports from woreda, zonal and regional levels is essential. The report tracking, like the other tools (such as HSRD), is synchronized in a timely fashion so that users at woreda, zonal and regional levels have the exact data based on which to make a sound decision.

This provides a powerful option by which AHUs at zone level can easily communicate with woreda AHUs about late delivery and loss of reporting forms. In turn, this approach minimizes, if not avoid, enormous burden and work load at regional health bureau by which personnel at the regional health bureau can only check the forms for confirmation purposes.

3.2.3 Key Features

- Tracking received and missed reports together with their data processing status
- Filtering report status based on Administrative Health Units (AHUs)
- Selecting a specific date for data entry
- Generating Receipt Reports in grid and print views
- Mechanism to print and export report statuses to known formats such as PDF and Microsoft Excel

3.3 Data Flow and Data Entry

3.3.1 Data Flow

Data is collected from health posts, health centers and hospitals and reported to woreda health offices. One option to data entry is that Woreda Health Offices (WorHO) and, if needed, Zonal Health Departments (ZHD) doing data entry using the Manual (Offline) Data Entry Tool and upload the data to eHMIS database server.

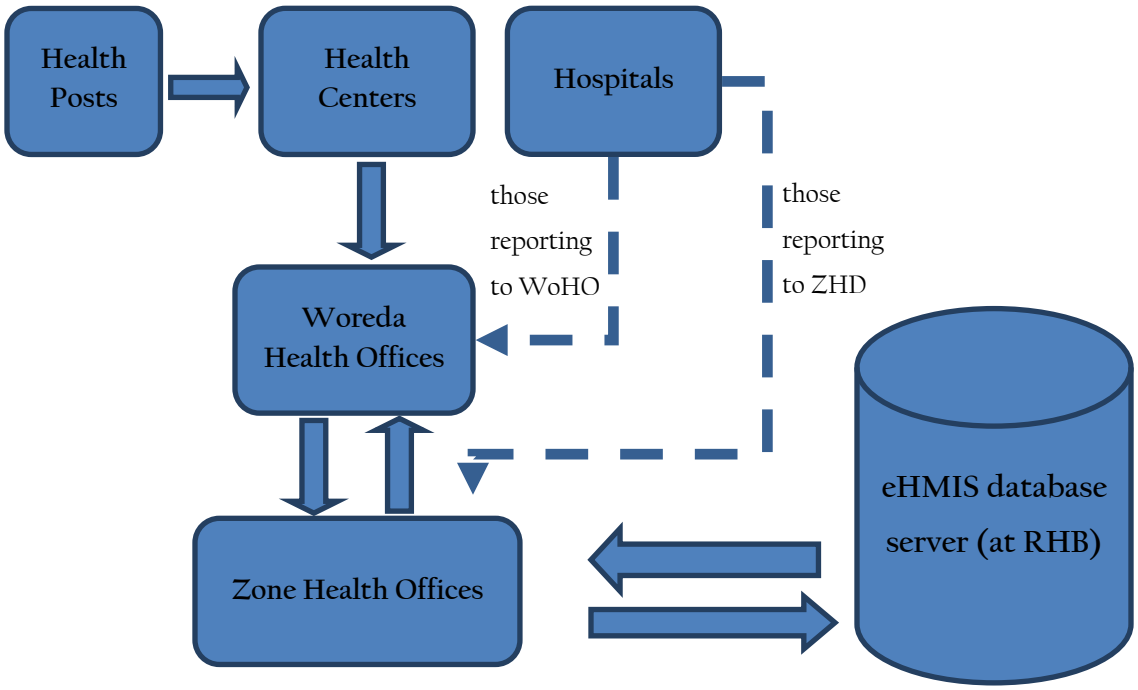


Figure 6: eHMIS data flow

The second data flow and processing option is suitable for batch processing using Image Capture and Character Recognition (ICR) technology. In this case, reporting forms is done at RHB once they are properly filled out and verified (for missed data, facility ID, etc…) at woreda and zonal levels. This option is very effective to enter data in batch and generate reports with the minimum time possible keeping greater data accuracy and reliability.

Fields and other elements of the data collection forms are managed by the Data Element Dictionary component of the eHMIS. Using the attributes identified and specified by the Data Element Dictionary tool, the Reporting Form Designer provides the best, cost effective, and flexible mechanism to compose new forms and edit/update existing forms. In addition to this, the Reporting Form Designer is designed in a way that enables the eHMIS System Administrator and/or Data Manager to easily manipulate data collection forms.

Data that is collected through reporting forms (from health posts, health centers and hospitals) can be entered into eHMIS database using either the Manual Data Entry Tool or Image Capture and Character Recognition Tool (also known as Scanning/Form Processing System).

Initially data used to be reported quarterly but now it has been changed to monthly and the tools simplified the transition without affecting the system or already existing data.

3.3.2 Data entry

3.3.2.1 Manual Data Entry Tool (MET)

The desktop Manual Data Entry (MET) application assists data clerks at woreda, zonal and regional bureaus to enter and readily avail monthly, quarterly and/or annual data. The MET is especially designed to mimic the exact reporting formats therefore the number or pages as well as the order of fields in the forms are exact replica of the paper forms. Moreover, the look and feel of the forms (formatting: fonts, shades and even colors) are designed to be identical to the paper forms with aim of increasing accuracy in data entry.

Further, the MET is more than just a data entry system; it has some 'intelligence' built into it to prevent bad data entry. The application is designed with advanced data validation options that display warning messages for those that require the data clerk's attention but could still be entered in the database up on approval; example: unusual high number being entered. The system also rejects errors outright and prohibits erroneous data from being entered (e.g. if more digits than allowed are attempted to be entered, the user tries to enter a character, etc…).

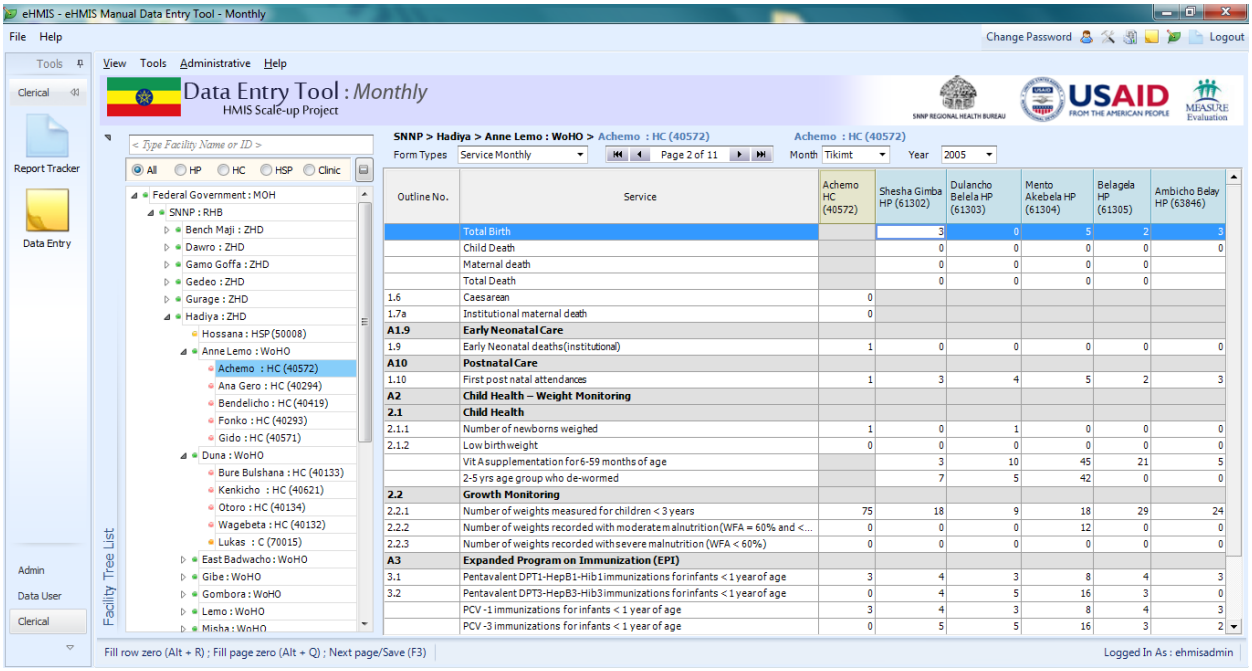


Figure 7: Health center Manual Data Entry Tool for service monthly report

More importantly, the system allows users to save forms as draft for future verification and completion. It also has Hotkeys that allow users to auto fill 0s, which are often common especially in Disease reporting forms, saving significant time.

The MET is also well integrated to HSRD and the Report Status Tracker applications ensuring that only those health facilities that are operational (on HSRD) and whose reporting form is marked as "Received" can only appear in the MET while inactive facilities appear grayed out.

3.3.2.1.1 Key Features

- MET is near 100% replica of the paper form
- Ability to save documents as draft
- Hotkeys to auto fill 0s and ease of page navigation
- Advanced data validation
- Generating reports to show status of entered reporting forms for specified health posts, health centers and hospitals

- Audit trail (who and when) on data entry

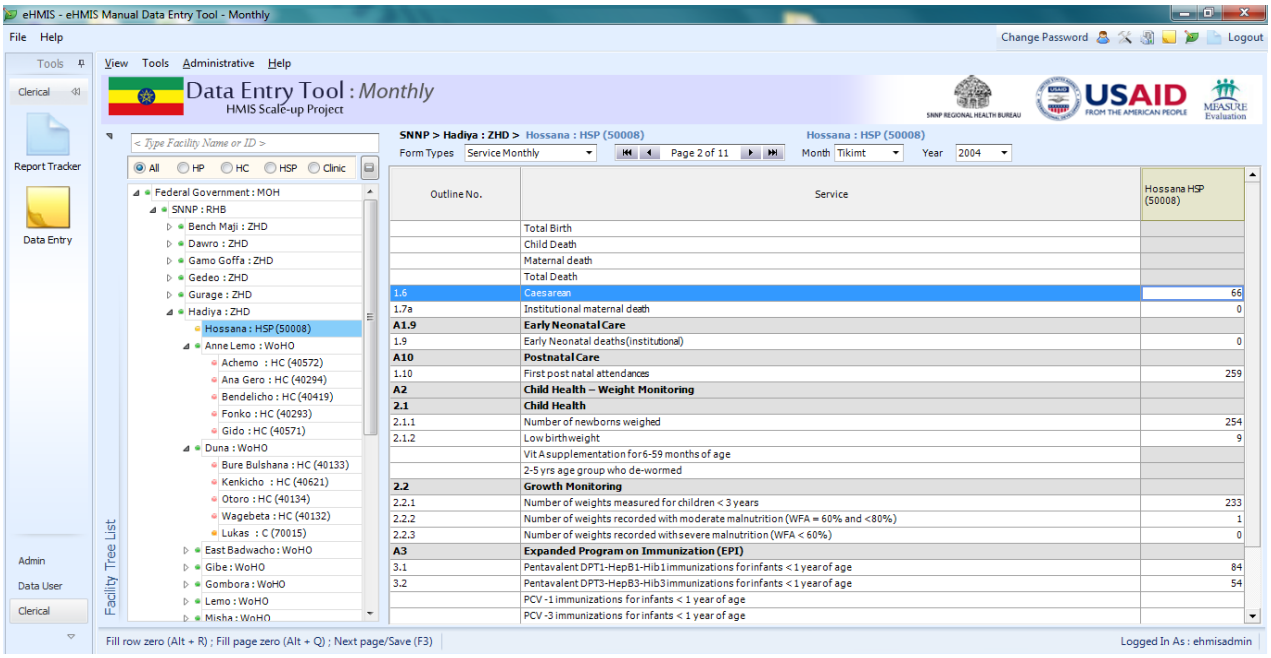


Figure 8: Manual Data Entry Tool for a selected hospital

A recent assessment of the MET was done by SNNP RHB. The important features of this system highlighted through the assessment include:

1. Woredas are able to get monthly reports from one day to one week time (very timely)
1. Zones and region also get timely reports as the electronic files can be easily uploaded into RHB server through using internet connections at woreda or zonal offices.
2. The system has functioned properly with little support.
3. System is user-friendly and one with basic computer skill can learn to use the system.
4. It is easier to check the data they enter for quality as they see it on the report right away.
5. The system saves them big aggregation and report generating time.
6. The Woreda Health Offices provided HMIS reports by printing or exporting it to other departments like Disease Control, Health Service and even to the local municipality
7. On an average, the woreda Health Office accessed and use the system at least once or twice a week for reasons other than for data entry.
8. There was a very high data ownership feeling.

3.3.2.2Image Capture and Character Recognition Tool

The Image Capture and Character Recognition tool is a very comprehensive tool that incorporates digital image capturing as well as form and character recognition. This is an automated batch processing mechanism with advanced accuracy level of character recognition with the aim of cutting data entry time by a remarkable level. Thus, timely reports can be generated and be used by decision makers at all levels.

3.4 Aggregation

Aggregation (summarization) is one of the essential tasks to be carried out after data is properly entered. This tool offers an option by which users can specify form types (i.e. Service Monthly, Service Annually, Disease OPD and Disease IPD forms), and the month (s) and year based on which they want to aggregate data.

- **Aggregation at Different Levels**

One of the strengths of the Aggregation Tool is its capability to aggregate data of health post, health center, hospital levels in addition to woreda, zonal and regional levels with the option to view a summarized profile report of an Administrative Health Unit (AHU).

- **Raw Data**

The Aggregation Tool is dedicated to generating aggregate (summary) results. However, it also incorporates a feature that allows users to view the raw data collected from the health posts, health centers and hospitals.

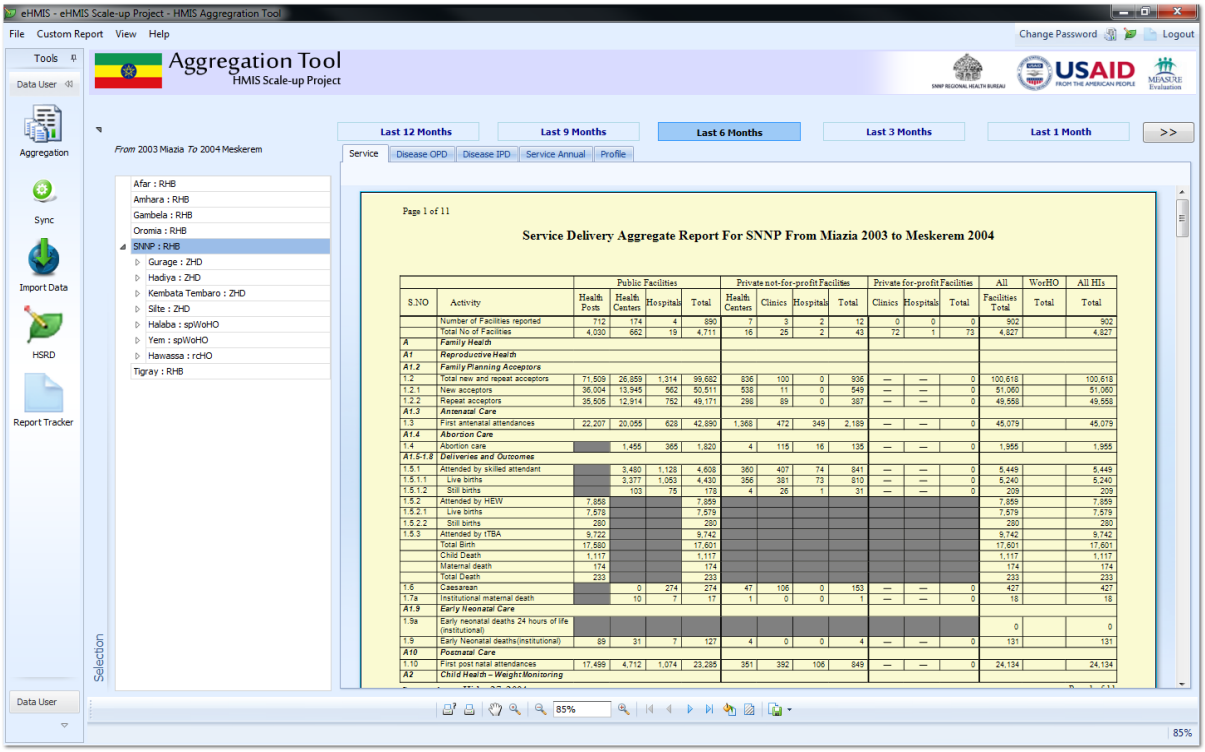


Figure 9: Aggregation Tool

- **Generating Reports**

The main purpose of the Aggregation Tool is to produce summary of the data (aggregate results). For this purpose, the tool provides a mechanism by which users can generate reports featuring summarized (aggregated) data specifying the health facility or AHU based on the report type (i.e. service, OPD or IPD), and reporting month and year.

- **Range of Months**

Besides, the tool also offers an option to generate aggregated report based on range of months specified (such as 1 Month, 3 Months, 6 Months, 9 Months and 12 Months or any range).

3.4.1 Custom Report

One of the many reasons that make the Aggregation Tool powerful is its ability to support custom reports. Users can produce customized reports based on features that they want to be included in the reports and save them as a template for future use. It's also possible to further edit the customized reports to incorporate new features or remove existing ones.

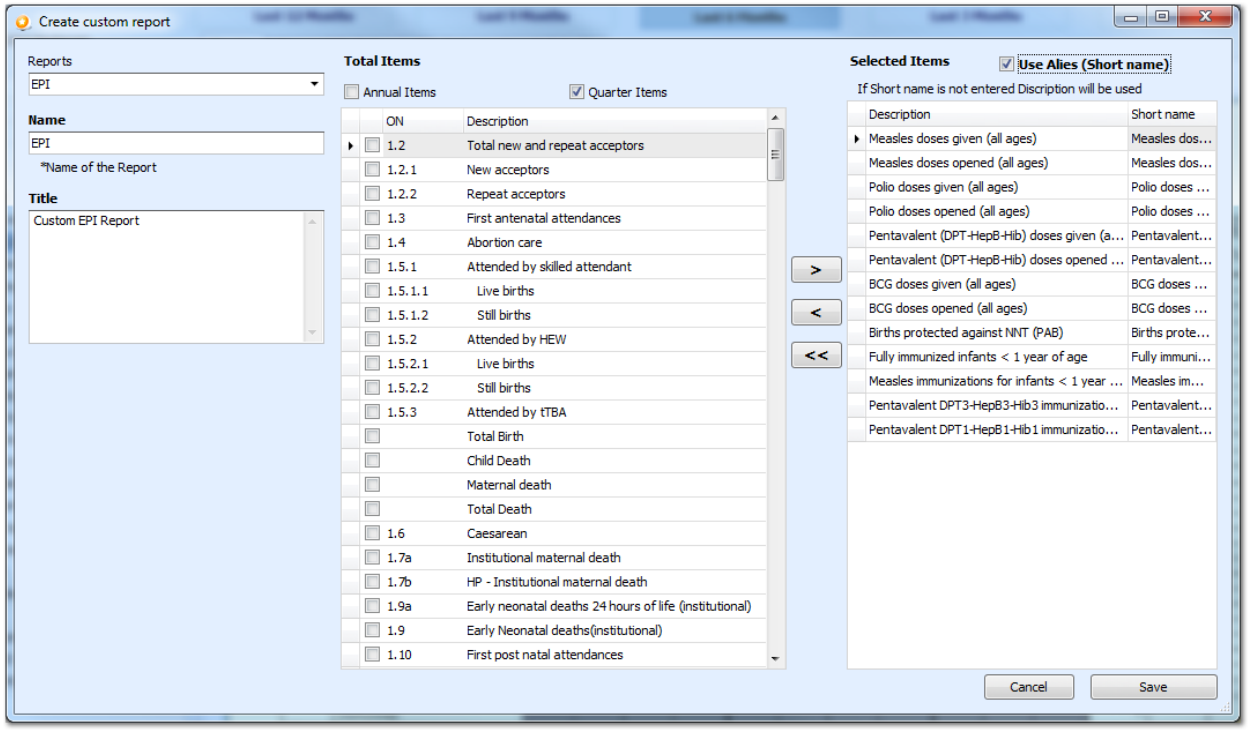


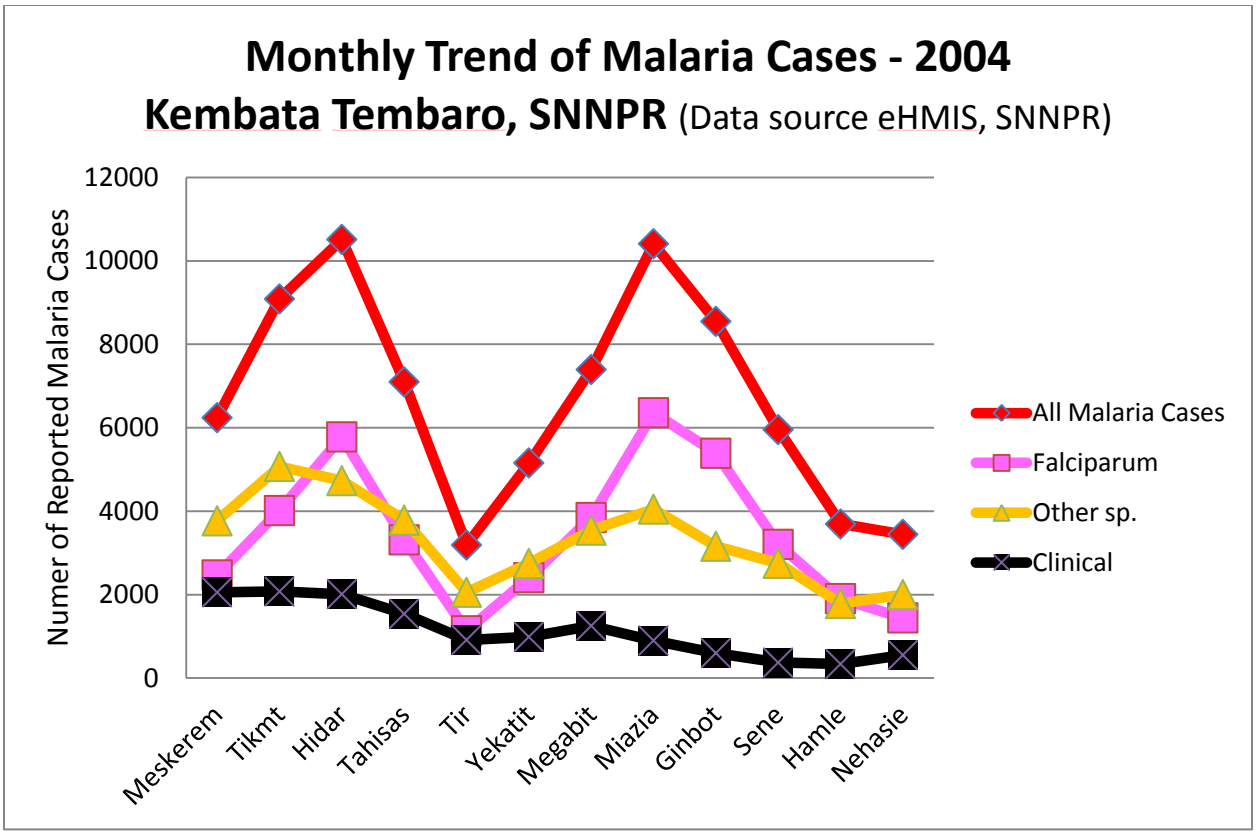
Figure 10: Custom Report Designer

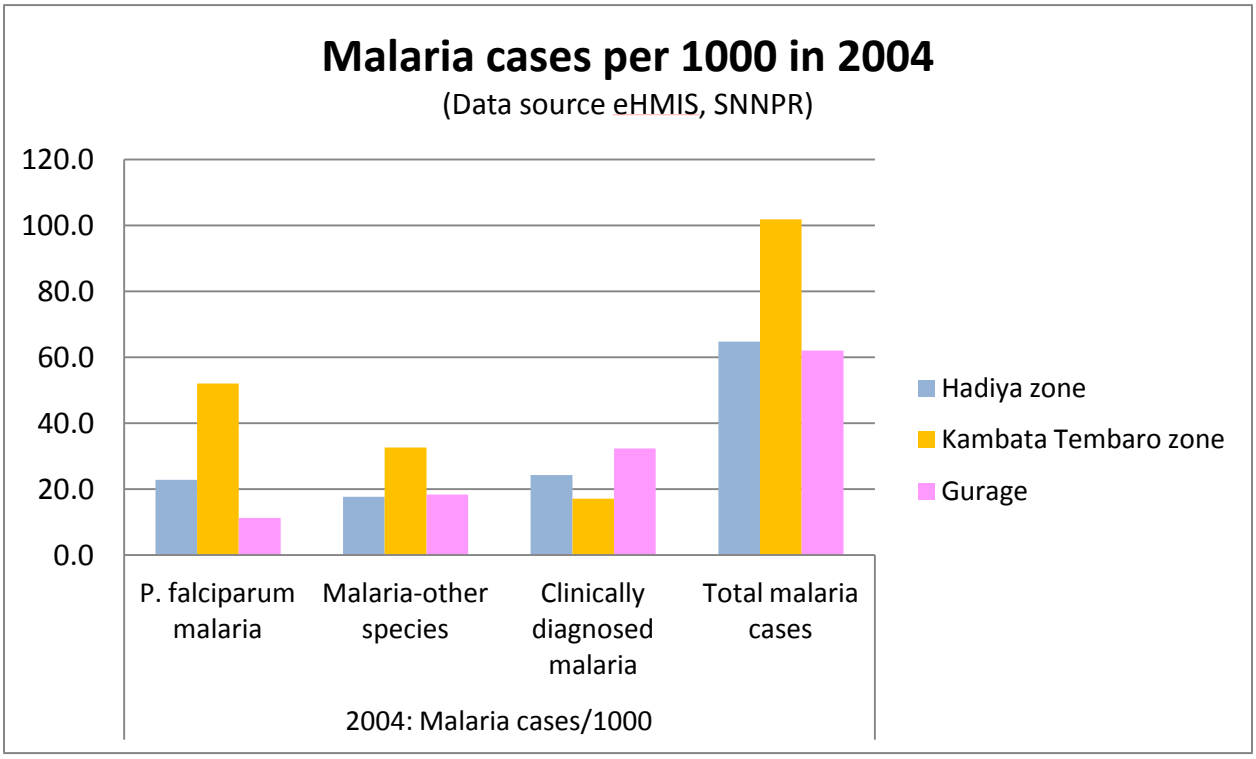
3.4.2 Comparison (Analysis)

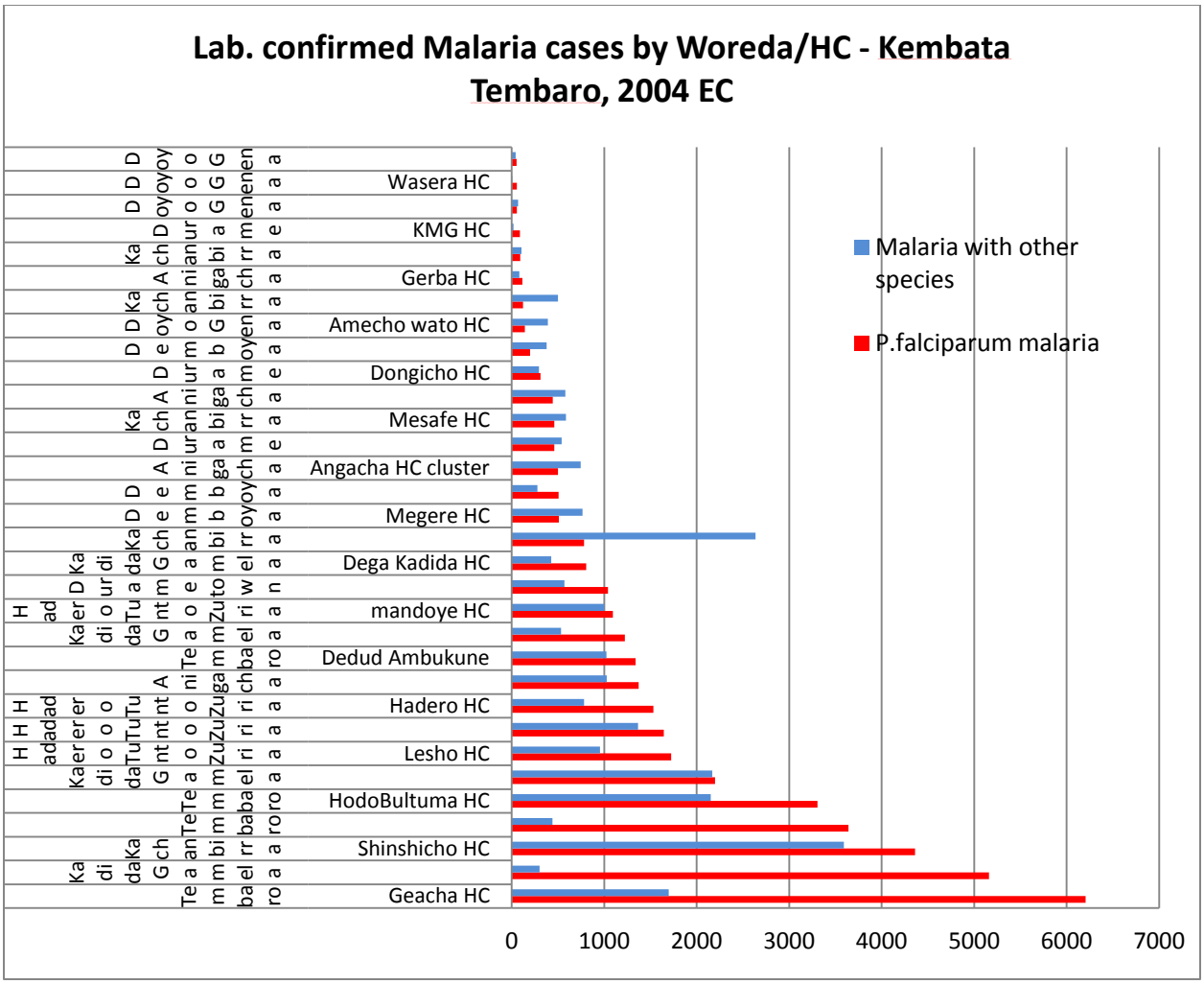
With the support of the Aggregation Tool, users can perform comparison (analysis) between different AHUs based on month and/or year ranges specified. The comparison can also be done to observe the activities of a specific AHU within a range of months and/or years which could facilitate timely and sound decisions to be taken.

3.4.3 Data Export and Analysis

The Aggregation module allows for exporting data in various formats like Excel or PDF. This facilitates using various data sets for analyzing different aspects of a program. For example, recently Malaria data taken from eHMIS was analyzed and shared with the SNNP RHB. Some examples of the analysis done using data from eHMIS are shown below. Availability of data from eHMIS allowed pinpointing the PHCU units that were with the highest burden of malaria cases.


Monthly Trend of Malaria Cases - 2004
Kembata Tembaro, SNNPR (Data source eHMIS, SNNPR)
Numer of Reported Malaria Cases
12000
10000
8000
6000
4000
2000
0
Meskerem
Tikmt
Hidar
Tahisas
Tir
Yekatit
Megabit
Miazia
Ginbot
Sene
Hamle
Nehasie
All Malaria Cases
Falciparum
Other sp.
Clinical


Malaria cases per 1000 in 2004
(Data source eHMIS, SNNPR)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
P. falciparum malaria
Malaria-other species
Clinically diagnosed malaria
Total malaria cases
2004: Malaria cases/1000
Hadiya zone
Kambata Tembaro zone
Gurage



These examples illustrate the extent to which the eHMIS allows data to be analyzed and used for decision making.

Key Feature of Aggregation Module

- Viewing the Raw Data of health posts, health centers and hospitals
- Aggregating data for range of months
- Generating aggregation reports for specific health posts, health centers, Primary Health care Units (PHCU), hospitals, woredas, zones and region
- Creating, saving and editing Custom Reports
- Comparison (Analysis) of data on selected AHUs over a range of months/years
- Printing and exporting reports to PDF and Microsoft Excel formats

3.5 Performance Report Tool

The Performance Report tool is a handy option to generate performance reports for woredas and zones based on various performance indicator variables. The reports will have features that are essential for evaluating the performance of woredas and zones. To this end, the reports indicate the coverage rate of each variable in the woreda/zone. Moreover, some of the reports are based on population estimates (e.g.:- ANC Coverage is based on the population estimate "estimated

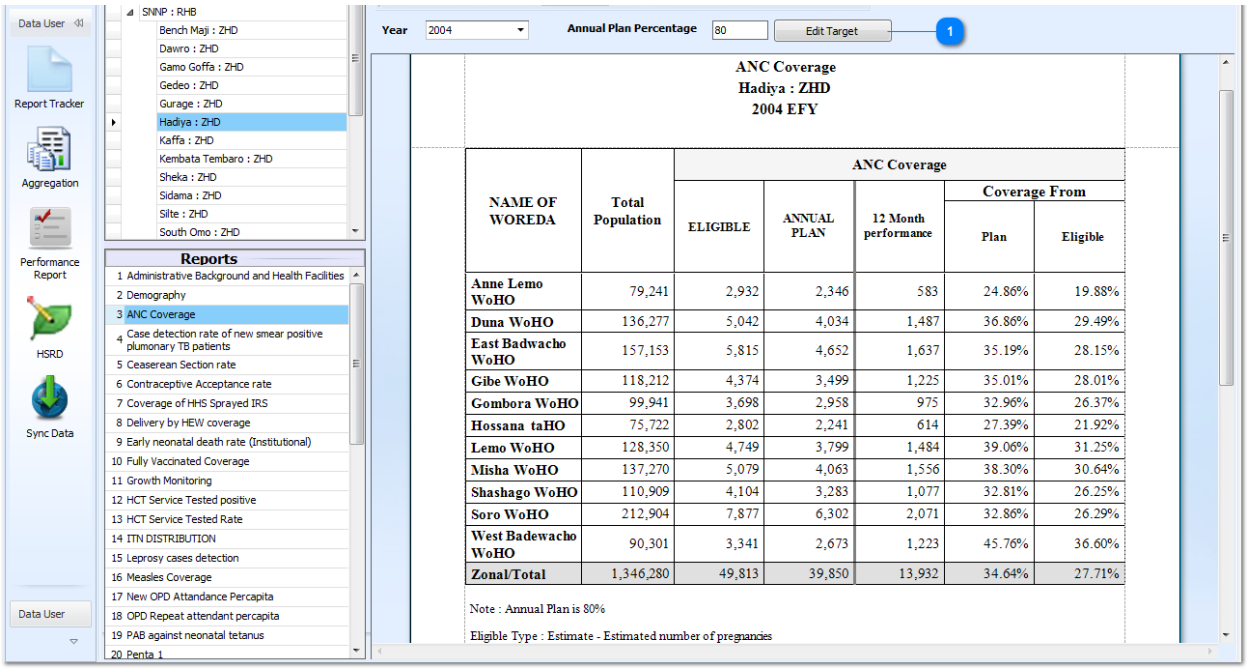


Figure 11: Performance Report Tool

number of pregnancies") whereas others are based on Service Delivery report data (e.g.: TB treatment Cure Rate is based on the service delivery item 2b.2.1 Smear positive TB cases enrolled in cohort). Details of the variables can be found from the foot notes in each report generated.

Moreover, the tool allows users to define annual targets (percentage value) for each HMIS indicator.

3.6 Decision Support System (DSS)

The Decision Support System (DSS) is the ultimate output of every eHMIS tool. The eHMIS DSS, therefore, is the dashboard that provides decision makers access to data collected that can

be easily analyzed for effective and timely decision making. The DSS employs simple and yet powerful charting tools such as line, bar and maps to communicate information in a way that makes the thousands and millions of records in the database represented in simple user-friendly charts.

- **Drill Down: Targeting Decision Making**

For the information presented to be useful and have credibility, users must have the ability to drill down to specific data so they can identify areas that need attention or that are effective. The DSS, therefore, provides a feature for the user to "zoom in" to maps and charts and allows drilling down to the lowest level of data that is available.

- **Trends: Line Charts**

Users can easily run reports which depict trends of indicators at the regional, zonal or woreda levels but also for a specific health facility even as low as health posts. Further, users may click on each point/unit of the trend and see a more detail trend. For example, if the unit of each point in the line chart is a Year, the user can zoom it to a given month and monitor the trends of the specific performance at monthly level.

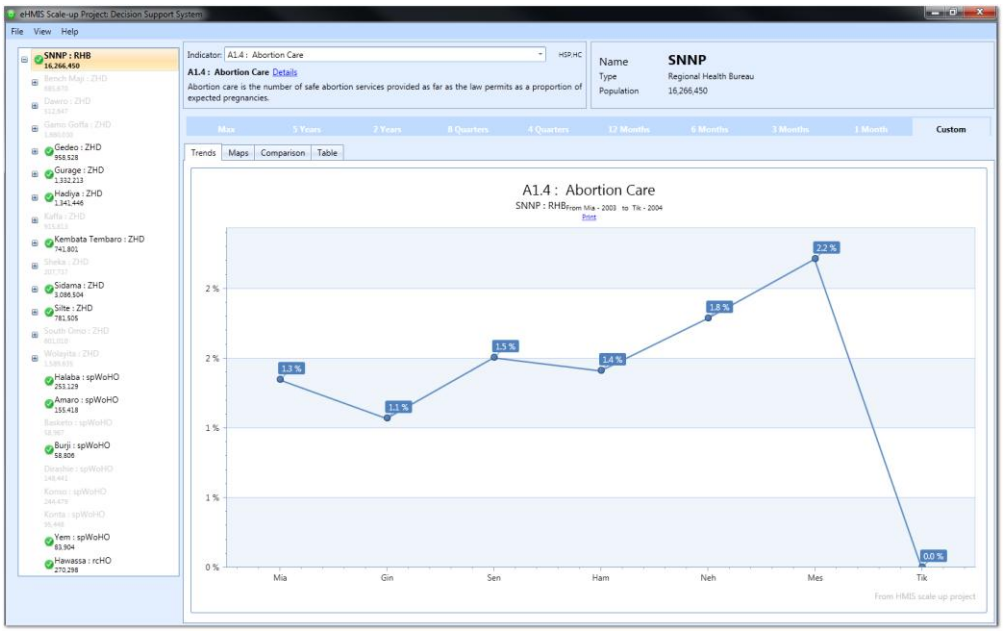


Figure 12: DSS Trend Chart

- **Comparing: Bar Charts**

The DSS also allows for easy comparison of woredas, zones/special woredas and even regions. It provides advanced features that allow look into the performance and various statistical values (minimum, average and/or maximum) of the selected AHUs and/or health posts, health centers and hospitals.

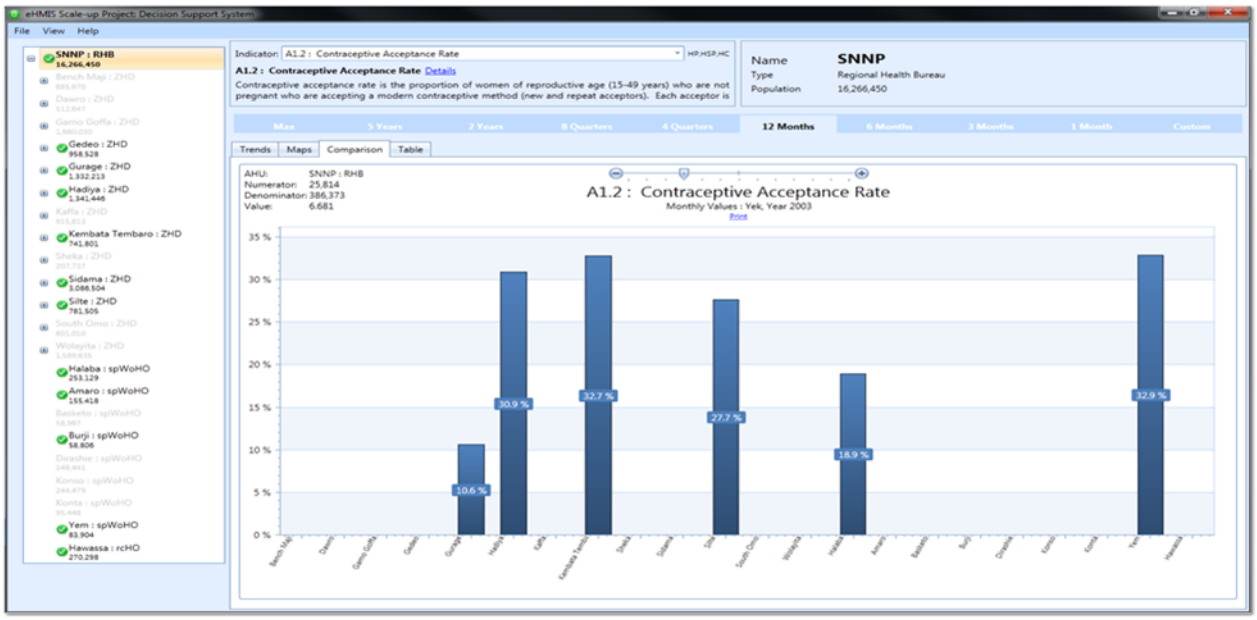


Figure 13: DSS Comparison Chart

- Map

Maps are a powerful way to communicate information to busy leaders. Using shape file obtained from the HSR, the DSS provides dynamic hit maps that the user can use to analyze trends and performance at various levels of HMIS. Maps can be presented at the regional level with drill down ability down to woreda or even to the kebele levels where shape files are available. Further, DSS allows users to customize various scales to calculate the drawing of the hit maps.

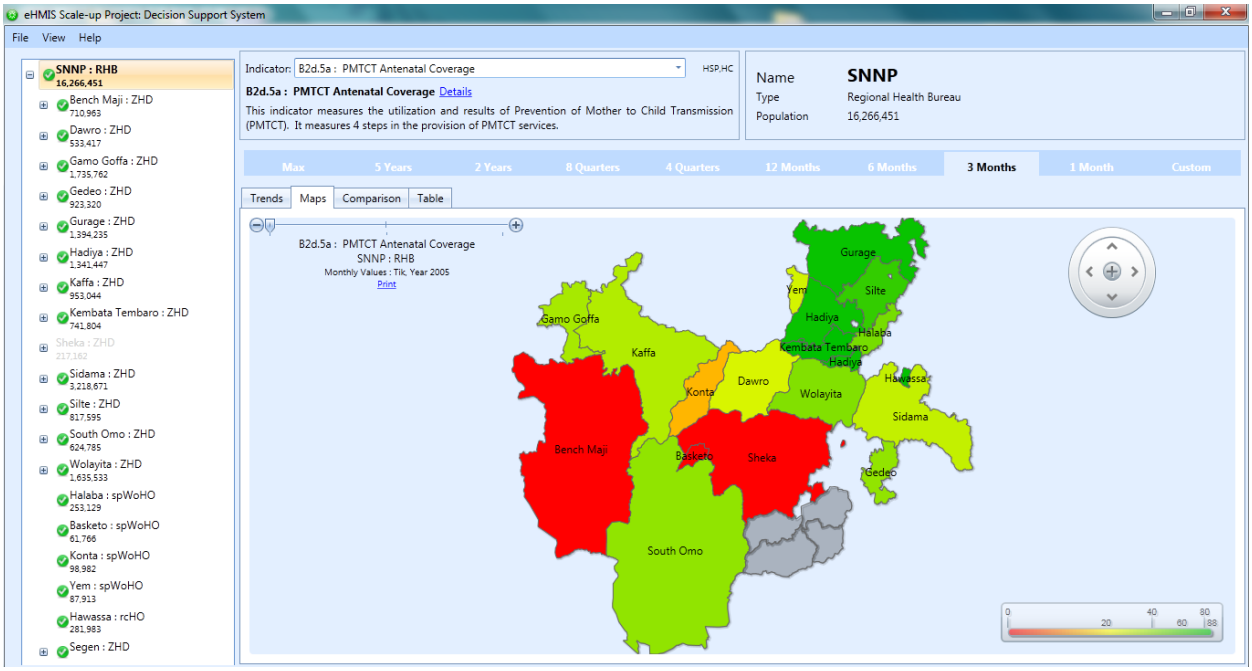


Figure 14: DSS Map

- Tables

In addition to the line, bar charts and maps, DSS also presents data in a tabular form which allows users to actually see raw numbers behind the graphical charts. Similar to all the other features, here again, the user can drill down to the lowest level where data is available.

3.6.1 Indicator Definition

For those who are interested in inquiring about the details of how the indicator is calculated, DSS using the Indicator Definition tool, provides a screen where the users can learn exactly

which fields in the data source as well as demographic estimation (as applicable) were used in calculating the specified indicator.

In addition whenever new indicators need to be added, users with the right privilege can add and define the new indicator so that the DSS will automatically show the report for the newly added indicator.

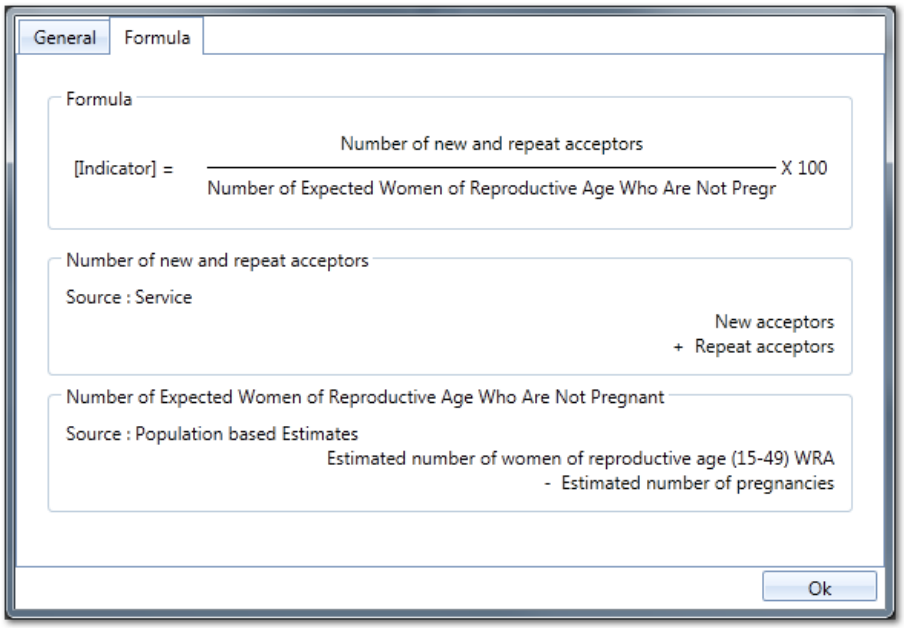


Figure 15: DSS Indicator detail description

Considering the need for availability of data everywhere, every time, a mobile version of DSS - Mobile Executive Decision Support System (MEDSS) has been developed, tested and being used by Regional Health Bureau and Zonal Health Department heads. To this end, a smart phone with MEDSS installed is provided. For further information, see Table 6 under eHMIS Implementation Status.

3.6.2 Key Features

- Easy way to analyze data using charts and maps
- Power to make targeted information at fingertips with the ability to point to drill down to the lowest level of data – health post
- Advanced line: ability to auto expand and collapse
- Advanced bar charts: ability to sort charts by performance, show average, use of "lines"

- Hit maps with specific, different scales
- Ability to zoom on maps, charts, tables
- Easy to customize/select date ranges
- Print and export data to known formats such as Microsoft Excel and PDF
- Ability to see definitions behind indicators: see sources of indicator calculation and how they are calculated

4 Data Synchronization Tool

This component of the eHMIS is responsible for managing data synchronization at different levels. Data entered at woreda health offices and zonal health departments (using the MET) need to be uploaded to the eHMIS database server (at RHB) and be accessible to all users. By the same token, data that is entered at RHB should be accessible from zones, woredas, health centers and hospitals as necessary. For this to happen, eHMIS users have two options (i.e. online and offline) to synchronize their local database with the eHMIS database server.

The first option requires Internet connection and the second one can function at places where Internet connection is not available or connection speed is an issue. Through the first option, eHMIS users can easily upload locally entered data to the eHMIS database server and update their local database with the latest data from the eHMIS server as well.

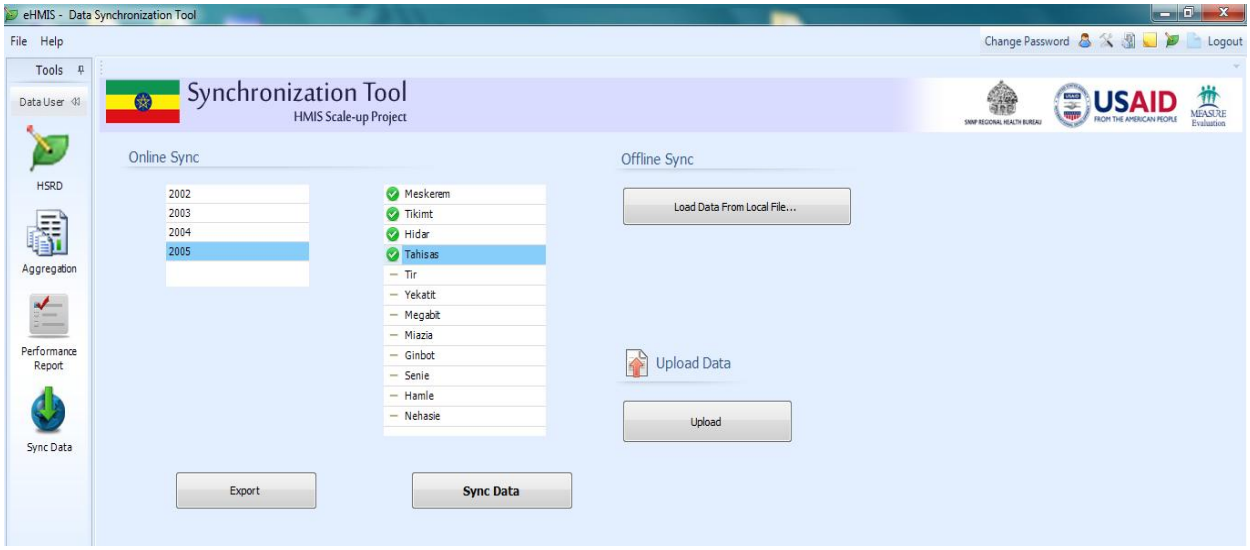


Figure 16: Data Synchronization Tool

Even though the expansion of Internet service throughout the country and particularly in SNNPR is encouraging, there is still significant number of places, particularly woredas that do not have access to the Internet. For this reason, as alternative option, data entered at woreda and/or zone level could be sent to RHB through external media such as CD-ROM, Flash Disk, External Hard Disk, or any other Memory Stick. And, also zones, woredas, health centers and hospitals can fetch the latest data available at eHMIS database server (at RHB) and update their local database.

5 Interoperability

eHMIS is designed and developed using state-of-the-art technology with local talent. Unlike on-shelf systems, the design and implementation process has been given due consideration to requirement engineering, design models, technology selection, implementation strategies, and nonfunctional requirements.

Hence, the system is designed as a desktop application with future considerations to web access. At the back end the system is designed in a manner where it can be used via web, desktop or mobile interfaces but for practical reasons, the desktop application approach has been considered. Currently, HSRD has a web version which can be implemented. Moreover, the system is designed to with paramount importance to extensibility and scalability with due consideration on future interoperability with other systems.

To this end, eHMIS can be installed in any Regional Health Bureau and in Federal Ministry of Health (FMoH). In this way FMOH can pull data from any RHB.

Alternately, access can be granted to other external systems that the FMOH uses. The external system can be granted permission to pull data from eHMIS server (at any RHB). In both ways, data access to eHMIS database server can painlessly be achieved.

6 eHMIS Implementation Status

The SNNPR is composed of 19 administrative health units which include 14 zonal health departments, 4 special woreda health bureaus and 1 city administration health office. Since the start of eHMIS implementation in 2010 in the region, the main implementation strategy is to promote ownership of the system by end users. To this end, the eHMIS tools have undergone significant changes and modification so as to satisfy the needs and incorporate requirements of the regional health bureau, zonal health departments, woreda, and town health offices.

Table 4 provides a general overview on the status of eHMIS implementation including the number of zones/special woredas trained on eHMIS, and number of woredas that are already using eHMIS.

Table 4: eHMIS Status in SNNPR

No.	Zone/Special Woreda	Type	No. of Woredas	HMIS Started	eHMIS at Zones	Woredas with eHMIS
1	Basketo	Sepecial Woreda	0	Yes	No	0
2	Bench Maji	Zone	11	Yes	Yes	2
3	Dawro	Zone	6	Yes	Yes	3
4	Gamo Goffa	Zone	17	Yes	Yes	15
5	Gedeo	Zone	8	Yes	Yes	8
6	Gurage	Zone	15	Yes	Yes	15
7	Hadiya	Zone	11	Yes	Yes	11
8	Halaba	Special Woreda	0	Yes	Yes	0
9	Hawassa	City Admin	0	Yes	Yes	0
10	Kafffa	Zone	11	Yes	Yes	2
11	Kembata	Zone	8	Yes	Yes	8
12	Konta	Special Woreda	0	Yes	No	0
13	Segen	Zone	5	Yes	Yes	5
14	Sheka	Zone	5	Yes	Yes	2
15	Sidama	Zone	21	Yes	Yes	21
16	Silte	Zone	9	Yes	Yes	9
17	South Omo	Zone	10	Yes	Yes	9
18	Wolayta	Zone	15	Yes	Yes	15
19	Yem	Special Woreda	0	Yes	Yes	0
	Total	19	152	19	17	125

In addition, as part of the implementation strategy, potential system users from planning departments including planning heads and HMIS focal persons from regional health bureau, zonal health departments, woreda health offices and town administration health offices have

been offered practical and on-site trainings on how to use the system, and handle their daily routines and make sound decisions based on figures (from the ground) on timely bases.

Relevant staffs from each zones/special woredas and woreda/town health offices have been given a two day practical training. The Project field staffs together with IT staffs of the regional health bureau make sure that the system is installed and is properly functioning and all users have working knowledge on the system. Furthermore, well trained IT staffs of the regional health bureau provide continuous technical support and follow the status of the system.

Hence, as illustrated on Table 5, so far 32 staffs from zones/special woredas/town admins and 304 from woreda health offices have been trained on eHMIS making the total number of trained staffs 336. Besides, these trained staffs are continuously advised to locally train other staffs to makes sure the sustainability of the system in case of staff outflow.

Table 5: eHMIS Training Status

No.	Zone/Special Woreda	Type	No. of Woredas	Trained (Zone)	No. of staffs trained (in the zone/sp. woreda)	Total no. trained (from all woreda)	Total Trained
1	Basketo	Sepecial Woreda	0	Yes	2	0	2
2	Bench Maji	Zone	11	No	0	0	0
3	Dawro	Zone	6	Yes	2	12	14
4	Gamo Goffa	Zone	17	Yes	2	34	36
5	Gedeo	Zone	8	Yes	2	16	18
6	Gurage	Zone	15	Yes	2	30	32
7	Hadiya	Zone	11	Yes	2	22	24
8	Halaba	Special Woreda	0	Yes	2	0	2
9	Hawassa	City Admin	0	Yes	2	0	2
10	Kafffa	Zone	11	No	0	0	0
11	Kembata	Zone	8	Yes	2	16	18
12	Konta	Special Woreda	0	Yes	2	0	2
13	Segen	Zone	5	Yes	2	10	12
14	Sheka	Zone	5	No	0	0	0
15	Sidama	Zone	21	Yes	2	42	44
16	Silte	Zone	9	Yes	2	18	20
17	South Omo	Zone	10	Yes	2	20	22
18	Wolayta	Zone	15	Yes	2	30	32
19	Yem	Special Woreda	0	Yes	2	0	2
				Total	32	250	282

Mobile version of eHMIS, also known as, Mobile Executive Decision Support System (MEDSS) that provides relevant and timely selected eHMIS data to zonal, special woreda and town admin health bureau heads has been pilot tested and implemented in SNNPR. To this end, smart phones with the MEDSS installed have been provided to 6 zones, 2 special woredas and 1 town administration.

Table 6: MEDSS implementation status

No.	Zone/Special Woreda	Type	MEDSS
1	Gedeo	Zone	Yes
2	Gurage	Zone	Yes
3	Hadiya	Zone	Yes
4	Halaba	Special Woreda	Yes
5	Hawassa	City Admin	Yes
6	Kembata	Zone	Yes
7	Sidama	Zone	Yes
8	Yem	Special Woreda	Yes
		Total	8

7 Pros and Cons

The eHMIS provides the following advantages that make it stand out as a robust electronic application for supporting HMIS data management.

A. **Data Quality**

This includes the totality of features and characteristics of data that bears on their ability to satisfy the given purpose

- eHMIS provides a consistent and authenticate data throughout the hierarchy starting from the level it is entered the first time.
- It provides smart features to identify exaggerated numbers

B. **Report Timeliness**

- eHMIS supports that reports arrive in a timely manner for decision making at each level and it solves manual aggregation and related problems.

C. **Sustainability**

- eHMIS is able to evolve cost-effectively in response to changes in the environment, usage profile, and demands. It is adaptable as amenable to technology changes or data element changes and expansion of use

D. **Usability**

Ease of use is an important factor influencing user acceptance and usage behavior of information systems. Intrinsic motivation is one of the factors that determine early perceptions about the ease of use of a new system.

- eHMIS offers an efficient to use system; it takes less time to accomplish a particular task including data entry, transmission, aggregation and analysis
- Easier to learn — it is easier to learn by the end user
- More satisfying and motivating to use

E. **Feasibility**

- Operational feasibility – eHMIS is easy to operationalize. It can be installed at any level from regional level to health facility level with relative ease. It is easy to train the end users having only the basic computer skills.
- Resource feasibility – the type and amount of resources required to implement and maintain the system are easily manageable by the Regional Health Bureau, Zonal health Departments and Woreda Health Offices.

F. **Maintainability and Support**

Maintainability involves a system of continuous improvement - learning from the past in order to improve the ability to maintain systems, or improve reliability of systems based on maintenance experience.

- eHMIS is adaptable to meet the evolving requirements using the available staffs and resources
- Once fully functional, eHMIS can be easily handed over to the government with minimal external on-site and/or virtual support required for its functioning.

G. **Security**

The objective of computer security includes protection of information and property from theft, corruption, or natural disaster, while allowing the information and property to remain accessible and productive to its intended users. It includes the collective processes and mechanisms by which sensitive and valuable information and services are protected from publication, tampering or collapse by unauthorized activities or untrustworthy individuals and unplanned events respectively.

- eHMIS provides built-in security of the data and the system.
- It has a well defined data recovery and back-up system

H. Ownership

Ownership includes system and data ownership as who upgrades the system, who maintains it, who controls the data and who makes sure the system is official.

- In case of eHMIS, the SNNP RHB fully owns the system. The RHB IT Staff are fully involved in its maintenance and controlling data entry and use privileges.

8 Future Opportunities

So far, eHMIS has scored remarkable achievements in alleviating heavy burdens of data entry and processing at woreda, zonal and regional levels with greater data quality and access to relevant reports on timely fashion. This in turn facilitates sound decisions, supported with facts and reliable figures, to be made and actions to be taken.

Currently, out of 152 woredas in SNNPR 125 are using the eHMIS. And, upon the request from woredas, zones and the region the system is being improved and relevant reports and tools that are essential to support HMIS tasks are being incorporated. Thus far, the system has been implemented and being used from RHB to woreda health bureaus. However, the system can also be deployed and readily available at health centers level.

Moreover, as the need to incorporate more information is growing, eHMIS can easily integrate detailed human resource information within the system so that the system can be comprehensive for planning resources. The service availability data (such as Lab, X-Ray etc…) and further expansion of the existing GIS information in HSRD are also part of the plan.

Furthermore, to strengthen availability of data from everywhere at any time, there is a future plan to launch the eHMIS web version and allow authorized users have access to HMIS data.

Taking advantage of the Data Element Definition, Reporting Form Designer and health facility database i.e. HSRD, the system (eHMIS) application can be expanded to collect, aggregate and analyze Integrated Disease Surveillance Report (IDSR) data weekly. In this way the system will provide the added advantage of conducted weekly Data Entry, Aggregation of data for any given period of weeks (e.g. 12 weeks, 24 weeks, 36 weeks, and 48 weeks), Report Tracker and Weekly Data View to analyze current trends and compare with the threshold levels based on historical data used for determining epidemic levels.