Internship Training

at

HISP INDIA

Design and Development of Monitoring and Evaluation system for Nutrition

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Enrollment No: PG15/086

Under the guidance of

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New Delhi

(Completion of Dissertation from respective organization)
The certificate is awarded to

YOGESH CHAND

in recognition of having successfullycompleted his
Internship

and has successfully completed his Project on

Design and Development of Monitoring and Evaluation System for Nutrition

13.2.2017-13.5.2017

HISP INDIA

He comes across as a committed, sincere & diligent person who has a strong drive & zeal for learning

We wish him all the best for future endeavors

Training & Development

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that **YOGESH CHAND** student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from International Institute of Health Management Research, New Delhi has undergone internship training at **HISP INDIA** from 13.2.2017 to 13.5.2017.

The Candidate has successfully carried out the study designated to him during internship training and his approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

Dr. A. K. Agarwal

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The following dissertation title "**Design and Development of Monitoring and Evaluation System for Nutrition**" at "**HISP INDIA**" is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **Post Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

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HISP INDIA INFO SYSTEMS PVT. LIMITED

May 16, 2017

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This is to certify that **Mr. Yogesh Chand** , a graduate student of the **Post-Graduate Diploma in Health and Hospital Management** has worked under our guidance and supervision.Heissubmitting thisdissertationtitled"Design and Development of Monitoring and Evaluation System for Nutrition" at "HISP INDIA" in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management.**

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Mr. Nishikant Bele,
Assistant Professor,
IIHMR, Delhi

Ms.Arunima Mukherjee,
Lead Operations, IIHMR
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INTERNATIONAL INSTITUTEOFHEALTH MANAGEMENT RESEARCH

NEW DELHI

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This is to certify that the dissertation titled **Design and Development of Monitoring and Evaluation system for Nutrition** and submitted by **Yogesh chand** Enrollment No. **PG/15/086** under the supervision of **Mr. Nishikant Bele** for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from 13/2/2017 to 13/5/2017embodies my original work and has not formed the basis for the award of any degree, diploma, associateship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

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FEEDBACK FORM

Name of the Student: Yogesh Chand Pandey

Dissertation Organization: HISP India

Area of Dissertation:

Attendance: Regular

Objectives achieved: Contributed to prototype of the Nutrition System

Deliverables:

Strengths: Hardworking and attentive

Suggestions for Improvement: Understanding the Domain

Suggestions for Institute (course curriculum, industry interaction, placement, alumni):

Arunima Mukherjee
Lead-Operations

Date: May 12, 2017
Place: Delhi

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ACKNOWLEDGEMENT

I express my deep sense of gratitude to **HISP India** for providing me an opportunity to complete my Master Thesis.

A humble gratitude to the Almighty and I am grateful to **Mrs.Arunima Mukherjee, Dr.SaurabhLeekha, Dr.GeetikaArora,Dr.SumitTriphati**andother employees **of HISP India** for their generous help, perpetual encouragement, and interest in the project throughout the course of the training.

Furthermore I would also like to acknowledge with much appreciation to DrDr.SaurabhLeekha, Dr.AishaShamsi who gave the permission to use all required equipment and the necessary materials to complete my Project report. A Special thanks to my mentor at IIHMR, Delhi, Mr.Nishikantbele, who helped me to assemble the parts and gave suggestions about the project

I express my indebtedness to my colleagues who ceaselessly extended their co-operation in time of need. If there is any instance of failure to give proper credit where due, it is an unintentional omission.

Yogeshchand

 ABSTRACT

Design and development of DHIS system for monitoring and evaluation of the Suaahara program running in Nepal. The key data sources are from Commcare app used by the field supervisor for reporting data for respective checklists. Data is also reported for activities carried out by HKI and its partners at different levels in the hierarchy. The data for this is captured in DHIS2 whereas the data for the checklist will be pulled from Commcare into DHIS2.

The overall goal of the program is to reduce the prevalence of nutrition related anomalies such as being underweight, or suffering from stunting and wasting amongst the child population of less than 5 years of age. In addition, the prevalence of anaemia is also monitored in mothers as well as children. The Helen Keller International (HKI) is the lead partner of SuaaharaII, other partners include CARE, Equal Access, Environment, and Public Health Organization (ENPHO), FHI360, Vijaya Development Resource Centre (VDRC), and Nutrition Technical Assistance Group (NTAG).

In the overall Suaahara II program, there are three major data sources from which the data will be collected and analysed:

a. Community Census

The community census will be carried out in 40 districts which captures the data from each household with the basic information about the household, its residents, and from each household questions based on an equity tool are captured to generate a wealth and equity quintile. The census data collected is used for defining the targets for the program.

b. Annual Survey

The Annual survey will cover a number of 3600 households in 20 districts. The key target audiences which will be covered under this survey will be mother/father/grandmother of children (age < 5 years), adolescent girls (age 10-19 years), FCHVs and Health facilities.

c. District Level data collection from various check lists, FS Activity Reporting and District/PNGO/Center Activity logging.

The data collected from the households during the community census acts as defining the eligibility criteria for data collection for a number of checklists such as Household Checklists (3 in number), VMF checklist, FCHV checklist etc.

In addition to these checklists where information is collected from each household/household resident, the Field Supervisors also report data on a monthly basis about the work done by them in their respective VDCs.

At the district level, the district Suaahara teams, and the PNGO teams collect data for the activities conducted by them which are broadly divided into 6 major categories (training, orientation, meeting, events, distribution and workshops)

Abbreviation

DAG   Disadvantaged Group

DHIS   District Health Information System

ENPHO   Environment and Public Health Organization

FCHV   Female Community Health Volunteer

FLW   Frontline Worker

FP   Family Planning

HFP   Homestead Food Production

HKI   Helen Keller International

HMG   Health Mothers' Group

M&E   Monitoring & Evaluation

MER   Monitoring, Evaluation & Research

NACS   Nutrition Assessment Counselling and Support

NTAG   Nutrition Technical Assistance Group

ODK   Open Data Kit

PNGO   Partner Non-Governmental Organization

USAID   United States Agency for International Development

VDC   Village Development Committee

VDRC   Vijaya Development Resource Centre

VMF   Village Model Farmer

WASH   Water Sanitation and Hygiene

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Abbreviation

PART – 1 INTERNSHIP REPORT

INTRODUCTION

HISP India is a not for profit NGO specializing since more than a decade in designing and implementing solutions in health informatics for the public health sector in Indian states, and also recently in Bangladesh and Sri Lanka. They are not a solely technology focused Organisation, and pride ourselves for being multi-disciplinary and seeking to the knowledge domains of public health and informatics. They have a strong commitment to free and open source technologies, and work with a global perspective of the Health Information Systems Programmes (HISP) network, coordinated by the University of Oslo, Norway, and active in more than 20 countries in Africa and Asia.

The **District Health Information System** (**DHIS**) is a highly flexible, open-source health management information system and data warehouse. It is developed by the Health Information Systems Programme (HISP).The core development activities are managed and coordinated by the Department of Informatics at the University of Oslo, and supported by The Norwegian Research Council, NORAD, The University of Oslo, and The Norwegian Centre for International Cooperation in Education.

The solution covers aggregated routine data, semi-permanent data (staffing, equipment, infrastructure, population estimates), survey/audit data, and certain types of case-based or patient-based data (for instance disease notification or patient satisfaction surveys). The system supports the capture of data linked to any level in an organisational hierarchy, any data collection frequency, a high degree of customisation at both the input and output side. It has been translated into a number of languages.

About Organization

Vision

To strengthen the development and use of integrated health information systems within a public health inspired framework in India and the South Asian region.

Mission

To enable networks of collaborative action with like-minded actors who aspire to the ideology of open source software, open standards and decentralized decision-making to create complementary strengths in providing integrated and public health friendly health information systems

HISP India is both a node in a global network called HISP Global coordinated from University of Oslo, Norway, and is helping to create a regional node around Health Information Systems for South East Asia. HISP India is comprised of a dedicated team of professionals from the domains of informatics and public health, and also draws upon the global HISP network for specific expertise as and when needed. Likewise, HISP India contributes to strengthening the global HISP network when its expertise is required. HISP India subscribes to and supports the broader HISP agenda of creating "networks of action" which seeks to strengthen collaborative action by learning and sharing about health information systems, including around software, training material and implementation experiences, in a collective network. Learning in collectives is more effective than that done in singular sites, as we learn from each other and don't reinvent the wheel. This supports Global HISP and HISP India's strategy towards addressing challenges of scale and sustainability.

Objectives:-

- Create and contribute to advocacy networks that promote Open Source software and Open Standards in Public Health Systems

- Contribute towards research related to integrated Health Information architecture that has at its core, routine aggregate reporting systems, patient-based integrated District Hospital systems, Human resource for health information system, mobile-based reporting systems, and Geographic Information Systems (GIS)

- Contribute towards the design, development and implementation of integrated Health Information architecture including the core components described above

- Processes of design, development and implementation are based upon and guided by principles supporting participatory design and mutual learning

- Actively promote the cultivation of an information culture in Public Health Systems, such that health information becomes a strategic resource that contributes towards improving health outcomes, and is not just used for upward reporting

- Contributing to building internal capacity in health systems, such that they are able to internally sustain systems of assured quality, and scale them geographically and functionally based on their evolving needs

SERVICES

- DHIS2 (District Health Information System)
- DHIS2 Mobile
- DHIS2 Tracer
- DHIS Hospital

DHIS 2
Collect, manage, visualize and explore your data

DHIS 2 is the flexible, web-based open-source information system with awesome visualization features including GIS, charts and pivot tables.

Data management and analytics

DHIS 2 lets you manage aggregate, routine data through a flexible meta-data model which has been field-tested for more than 15 years. Everything can be configured through the user interface: You can set up data elements, data entry forms, validation rules, indicators and reports in order to create a fully-fledged system for data management. DHIS 2 has advanced features for data visualization, like GIS, charts, reports, pivot tables and dashboards which will bring meaning to your data.

GIS

DHIS 2 features awesome web-based GIS features that let you do thematic mapping of areas and points, view facilities based on classifications, visualize catchment areas for each facility. You can define custom legend sets and link them to indicators. The DHIS 2 GIS lets you put labels on areas and points and search and filter based on various criteria. You can overlay multiple layers and use Google Maps as background layer. You can move points and set locations on-the-fly. Maps can be saved as favorites and shared with other people.

Charts

DHIS 2 provides nice charting capabilities. It supports all the standard chart types like column, line, pie, stacked column and area charts. You can display trend lines, legends, titles, labels, target lines and baselines. Select easily from all of your indicators, Organizational units, time periods and other dimensions, and flip categories and series around as you like. Charts can be saved as favorites and shared. You can write interpretations of your chart data and discuss with colleagues. Charts can be downloaded as images and PDFs.

Pivot Table

DHIS 2 features a fully web-based pivot table which lets you analyse data along all data dimensions and arrange these on columns, rows and as filters at demand. You can include totals and subtotals and remove empty rows, and control display density, font size and digit group separator. Pivot tables can be saved as favorites and be downloaded and used as basis for offline MS Excel pivot tables.

Dashboard and social features

DHIS 2 provides a personal dashboard where you can put your favorite charts, maps and reports for fast access. You can search directly from the dashboard for analysis related to a particular subject or for other people. The dashboard features integrated messaging functionality which lets you communicate directly with other users. From the dashboard you

can view the data interpretation feed - data interpretations shared from the various analytics modules will appear here so that you can better understand your data and your Organization. From the feed you can comment on other people's interpretations and start discussions.

Data entry and validation

DHIS 2 lets you capture aggregate data on a variety of devices - it even works offline. If Internet connectivity drops during capture, data will be stored locally in the browser and you can continue working as before. When connectivity is back you can push data up to the online server. DHIS 2 can generate data entry forms automatically based on your data model, or you can design highly customized forms to cater for special needs. You can define auto-calculated fields inside the form, logical validation rules and set min and max values to improve data quality.

Individual data records (Tracker)

DHIS 2 enables you to collect, manage and analyse transactional, case-based data records. It lets you store information about individuals and track these persons over time using a flexible set of identifiers. You can capture information about anonymous events and cases as well. DHIS 2 lets you configure SMS-reminders, track missed appointments and generate visit schedules. You can create dynamic reports based on cases and generate on-the-fly statistical reports. For all programs you can easily create statistics and summaries on participation and completeness.

The DHIS 2 Tracker is an extension of the DHIS 2 platform and supports management, data collection, and analysis of transactional or disaggregated data. The Tracker shares the same design concepts as the overall DHIS 2 - a combination of a generic data model and flexible metadata configuration through the user interface that allows for rapid Customisation to meet a wide range of use cases.

Common for all the use cases is that the transactional data can be easily aggregated and fed into the main aggregated data warehouse in the same DHIS 2 system, making complicated inter-operability setups redundant.

In addition to being a powerful HMIS tool for following up health programs, DHIS2 Tracker is also a simple tool for sharing critical clinical health data across multiple health facilities. The DHIS 2 tracker currently does not aim at becoming an advanced EMR system to support clinical care, but rather a basic transactional system that is easy to set up and that builds on an existing and proven platform and available technical capacity. On a national level, one may wish to combine the use of DHIS Tracker for some facilities with more advanced EMR systems for other facilities.

Features

- Collect transactional data - set up automated aggregation queries - populate the aggregated data warehouse directly - all in one system!
- Enroll individuals into longitudinal and chronic programs - schedule visits - set up automated SMS reminders - track missed appointments - improve retention.
- Define your own programs with stages - decide what to collect at each stage - all through the user interface.
- Generate daily or weekly visit schedules (work plans) for your facility or community health workers.
- Tools for tracking and following up patients who do not come to scheduled visits.
- Collect detailed ICD-10 codes for inpatient admissions and deaths to enhance data analysis of morbidity and mortality.
- Set up detailed maternal or neonatal death audits - analyse your data using the tabular reports with both case-based data and ad-hoc aggregation.
- Collect detailed health facility surveys (e.g WHO's SARA) - link to aggregated indicators - analyse your results on maps, dynamic charts, and pivot tables
- Collect data using mobile phones - online in web browser or offline with java clients

Here are some use case descriptions outlining the possibilities of the DHIS 2 Tracker:

Use Case 1: Anonymous inpatient admissions and deaths with ICD-10 coding

Use Case 2: Longitudinal tracking of women through pregnancy, delivery and postnatal care

Use Case 3: Neonatal and Maternal death audits

Use Case 4: Educational events in the community

Use Case 5: Facility surveys (e.g. the WHO SARA)

DHIS Mobile

DHIS Mobile covers the wide area of mobile development related to DHIS2, with focus on a wide portfolio of solutions for utilizing mobile technology to expand the reach of the Health Information System. The clients can be deployed as a standalone mobile reporting system, or the clients can be used together with the web interface to support an integrated HIS system that reaches all levels of the health service, including community health workers and citizens.

Java mobile clients

There are two DHIS Java ME based applications for low-end Java phones, one supporting aggregate data entry and the second supporting name-based program tracking. These applications communicate with an online DHIS2 instance, downloading datasets, activity plans and program stages, and allow the health worker to enter data back into the online server. The main strength of these applications is that they work well even when the phone is "offline", which is when the phone has no data connection to the server. Data entered during offline-mode is stored and can be submitted at a later time. The Java clients are simple to use, run on cheap mobile phones and offer a fast way of rolling out data entry capability to a large number of staff.

Browser based mobile client

In contexts where mobile data coverage is good and health workers already have phones, using the mobile browser DHIS2 interface may be an important complement to other clients. Cheap, low end mobile phone support browser-based data entry through a simple mobile interface optimized for small screen sizes. You may also consider using a more advanced

user interface customized for Android smart phones. The Android smart phone interface also supports offline data entry using HTML5.

SMS based solutions

DHIS2 also supports a wealth of SMS-based functions. Because SMS is most widely available technology, these features can help you increase the scale of your information system. The SMS features of the system could be deployed as a standalone function, but is more commonly used together with the other mobile clients and the web based interface of the system, as a portfolio of technologies that caters for the specific user context. Some of the use cases that are supported through SMS include:

- A simple web based interface for sending SMS to individual or groups of health workers or patients.
- Automatic SMS sent to patients, for example to remind them of an upcoming or missed visit, or as part of a general education program related to a health program.
- Reporting data by sending an SMS to the system.
- Sending messages from SMS to users of the system, for example for support or feedback purposes.
- Registering and enrolling a patient into a health program by sending an SMS.
- Entering individual health data for a patient visit using SMS.
- Checking the status of a patient's follow up using SMS.

The SMS functions of DHIS2 is used for a wide range of functions, including tracking mother and child health, HIV reporting, lab sample tracking, as well as education and coordination.

WORK ASSIGNED

- **Data Elements and Indicators Creation**

  -Data Element

  -Data Element Group

  -Data Element Group Set

  -Data Element category Option

  -Data Element Category

  -Data Element Category combination

- **Dataset**

  -Data Set creation

  -Data Set Assignment

  -Designing Data entry Screen

  -Mapping Data Element

- **Organization Unit**

  -Organization Unit Group

  -Organization Unit Level

- **User creation**

  -User by Organization Unit

  -User

  -User Role

  -User Group

  -Delete Current User

KEY LEARNING

- Basics of DHIS2
- Worked on Aggregate system , Tracker system ,Event based system
- Creation of users
- User role Assign
- Creation of data elements, data elements group, creation of data elements sets
- Creation of data sets
- Creation of Organization Unit
- Creation of Validation rule
- Creation of Data entry form
- Updating data in DHIS2
- Mapping of the data elements

PART – 2 DISSERTATION REPORT

Objective:

Designing and developing monitoring and evaluation system for nutrition in Nepal.

Background and Scope

The Suaahara project funded by USAID Nepal has been successfully running for the last 4 years, and is now moving towards its second phase with HKI being the primary implementer, and working in collaboration with 6 other implementing partners, and taking support from community based organisations at the district level.

The overall goal of the program is to reduce the prevalence of nutrition related anomalies such as being underweight, or suffering from stunting and wasting amongst the child population of less than 5 years of age. In addition, the prevalence of anaemia is also monitored in mothers as well as children. The program envisages to use a multi-sectoral approach based on a result based framework with four components contributing towards changing the nutrition status of young children and mothers. The components include behaviour change communication for improving the household nutrition, sanitation and routine health measures, enhancing the use of quality nutrition and health services, increasing access of households to quality nutrition rich food, and working with the local government to roll out a multi sector nutrition plan.

For the first phase of the project, Optmis MIS was used as a data collection tool, but in terms of monitoring and evaluation of data the dashboard approach was not followed, which has been seen as the quintessential component for the Phase II. For phase II DHIS2 has been identified as a suitable solution for data collection and analysis, and with the GoN switching over to DHIS2 as their national HMIS, it will provide easy integration between the two platforms with the long term planning of GoN taking over the initiative in upcoming future. HKI and its implementing partners intend to use DHIS2 as their project data monitoring system for tracking the key indicators to understand the key area of interventions, the impact on health status, and making well-informed decision based on the data collected.

Review of literature

The acronym DHIS – translates to District Health Information **system.** IT is an integrated system of tools that help operators and planners – collect, collate and use health data and information for progressive action. The DHIS integrates the concept of an essential dataset with an electronic database (the DHIS2) to collate these dataset(s) into a platform that is multi-accessible and disseminated.DHIS reached across 60 countries, 25'000 users monthly.

What DHIS do?

▪ Capture, analysis and dissemination of data

▪ Handles routine data, events and surveys

▪ Integrated warehouse for essential data

▪ Self-service analysis and communication

▪ Open source, web-based software platform

DHIS 2 Components:

▪ Metadata Configuration – data element, datasets, and organization units

▪ Data capture, validation and approval

▪ Visualization and sharing – pivot tables, charts, GIS and dashboards

▪ Communication – messages and interpretations.

▪ Interoperability – Web API, import-export

▪ Security and access levels – User privileges and roles, User groups

DHIS 2 as an integrated data Repository

All data in one place – a central repository

▪ Supports collection of many different data sets (and can easily expand to new data requirements)

▪ Automated import from other systems like MFL, EMR, HR, Logistics etc. (planned for)

▪ Avoid duplicate systems for data collection and storage

Easy access to data to all online users

▪ Wherever you are, as long as you have Internet and a username you can access the latest data

▪ DHIS 2 becomes a data centre for all stakeholders with access

- Pre-defined analysis tools shared by all users

- Both one click report and custom data analysis

- Targeting different needs and skills

- User-defined dashboards to give a quick overview of the latest data/issues

- GIS interface to all the data

- Data aggregation to any level or period

- While data is collected and stored monthly by health facility, a report can show quarterly or yearly values by any level in the hierarchy

- Built in support for definition and calculation of indicators (coverage, incidence rates etc.)

- Makes use of population and other denominator data already in the system

- All reports and analysis tools support indicators and allow for powerful analysis and comparisons across areas and over time

- Instead of looking only at raw numbers or doing manual calculations in Excel

- Many output formats are supported; html, pdf, excel, jasper reports

- Fast reports due to separate and nightly updated analytics that does all the calculations in advance.

Methodology:

Study Area : Nepal

4.1 Phase I: Requirement elicitation and DHIS2 Orientation Workshop

The requirement elicitation exercise would involving the HKI country office in Nepal in order to carry out a requirement gathering exercise jointly between HKI, representatives from the implementing partners and HISP team to understand the key processes followed in terms data collection, and monitoring & evaluation for the operational projects. This exercise would help HISP team to understand the data points for which data is collected, the process of conversion of raw data into indicators, the analysis methodologies, and data dissemination mechanism followed between HKI and implementing partners.

The specific tasks to be covered in this phase will include:

    i.   The requirements elicitation process will start with the HKIidentifying the stakeholders who will play a key role in the system design, acting as the prime source of the information required to understand the information flow, and data needs. Amongst the stakeholders, proposed is the creation of an expert committee who can overview the important aspects and progress of the project. During the requirement understanding exercise HISP team will follow a bottom-up approach where smaller components will be integrated into sub- systems, and later these sub-systems will be integrated as a whole. Therefore, changes later in the requirements may lead to changes across the system, to avoid that the stakeholders in congruence with the expert committee are requested to analyse the requirements in detail internally before it goes into the design and development cycle.

    ii.   The HKI needs to shares all existing data input formats along with their reporting frequencies, the details of data quality protocols, and data approval protocols (if any) currently in use. This would help to assess and formulate a reporting protocol for HKIwhich would involve the data collection process, data quality management and approval, dissemination between various implementing partners.

    iii.   HISP team to study these formats, in order to carry out a rationalization exercise in order to come up with a standard reporting solution by removing redundancies, and maximize compatibility with identified monitoring indicators.

    iv.   Identify needs for mapping of legacy data. This will require understanding the data available in the existing system; its comparison with the new data collection formats being designed, in order to identify gaps/challenges if any and preparing the approach towards migration of legacy data. (if required)

    v.   Identify need for offline data entry where required depending upon the proposed mode

of implementation, as per the existing ICT infrastructure in the operational districts.

vi.   Study key indicators required for program specific M&E and determine whether these indicators can be required through the existing data entry forms, and gaps if any.

vii.   Study all output report formats required from the system, the periodicity of reporting, and the stakeholders to whom these made to be disseminated to.

viii.   Study the existing geographical/administrative structure in order to design the reporting hierarchies, and creation of organizational unit hierarchy, groups and group sets which can facilitate the data analysis.

ix.   Obtain access to existing data reporting mechanism or existing surveillance systems in use (which may or may not be DHIS2, and use other tools such as MS Excel, and study in detail to understand how it works, and how it can contribute towards creation of a standardised database.

x.   Study all requirements for all types of end users with required privileges and access rights for each type of user at HKI and implementing partners at intermittent levels, and finally at the point of care.

xi.   Study all shape files for GIS based analysis that need to be included in the application.

Phase I Deliverables:

At the end of the requirements gathering phase, HISP team would submit the following documents:

- **Requirements Analysis Document**

HISP team will submit a requirements document which will include the following components:

i. Requirements gathered from HKI, current data recording, reporting and analysis processes, and the same will be submitted to HKI for feedback.

ii. A comparison between 'As is' and 'To be' processes will be made, with proposed workflows mentioned which are expected to be followed once the system is in place.

iii. List down the available data collection formats which will be rationalized and their mapping will be provided with the respective output indicators.

iv. Develop design of dashboard mock-ups to enable effective program wise M&E for indicators at various levels in the hierarchy and amongst the six implementing partners.

v. Identify need for integration across the different systems

vi. Identify needs for capacity strengthening and a plan for the same

- **System Design Document**

Post the finalisation of the above document, the requirements agreed upon above will be included in the system design document, which will define how the above requirements can be classified under existing DHIS2 functionalities, and for which requirements custom development would be required which may be required for both, the inputs as well as the outputs. This document will help us define the timelines for each of the release.

- **System Design and Development Roadmap**

Once the functionalities are defined and agreed upon in the above document, a system design and development roadmap will be shared where the functionalities will be divided into number of releases, and each fortnight incremental releases will be given out to the HKI team for testing and providing feedback on the same.

All these documents will need approval and sign off from the expert committee(established in Nepal to oversee the technical progress of the project), once all the feedback/suggestions have been incorporated. These documents will be then used as a system blueprint which will define the system design and development.

4.2 Phase II: Design and Development of HKI DHIS2

Once HKI gives a sign-off on the above submitted document, HISP team would start working on the application which will include the following set of activities which have been divided into multiple prototypes. In this phase I was involved in the projects. The activities under each prototype have been defined below:

i. Design database and relevant standardized metadata in Excel sheets which includes the following:
   data elements
   datasets
   organization unit hierarchy
   programs
   specific indicators by different categories
   validation rules

   All these would be shared with the expert committee (established in Nepal to oversee the technical progress of the project) in MS Excel format for their feedback and approval.

ii. Develop first prototype of the database with rationalised data entry formats (including gaps in data in existing formats), datasets, reporting units and groups on the basis of feedback received from expert committee in DHIS2 application.

iii. Develop the required indicators and M&E framework within DHIS2 to facilitate data analysis using default DHIS2 functionalities.

iv. Customise GIS using the shape files provided by the HKI team.

v. Develop offline data entry facilities where required, and protocols for its usage.

vi. Develop the dashboards based on the above indicator framework designed.

vii. Import the legacy data provided by the HKI team (if required).

4.3 Phase III: Capacity Building

The capacity building component will be focused on end users. End user training of the identified users staff to support roll out the systems at field level will be carried out. We propose to have a central workshop at Kathmandu where designated focal persons from the thematic group as well as focal people from districts who can be trained in order to create super users, who can support the phasing out of the systems to the other point of care sites.

Training will include skill development on basic use cases from data entry, data quality checks, data analysis, monitoring & evaluation using dashboards by following the 'Train the Trainers' approach. All the training material developed will be released together with the user training process.

4.4 Phase IV: Pilot Implementation and Remote Technical Support

This phase will involve the field testing and implementation of the system with full functionalities (data input and output) in the sites proposed by HKI. The performance of the system during the pilot exercise will be closely observed, and remote support will be provided in order to have a smooth implementation of the system. Once the teething issues are resolved, the system would be then phased out to other point of care sites.

HISP India proposes to provide free of charge remote technical support during the first 3 months of the pilot implementation in phase IV. This will be followed by 3 months of paid support, where 5 days of support per month can be budgeted, to carry out the following tasks:

a. Routine troubleshooting support.
b. Remote server administration support, including upgrading with new versions of DHIS2 as and when required.
c. Carry out routine customization tasks such as changing user roles, adding new users, datasets, making changes to data elements, indicators, validation rules etc.
d. Creating new reports, or reconfiguring of dashboards.

1. Suaahara II Workflow

This section describes the project workflow including stakeholders involved in the process and the significant changes in the workflow expected on implementation of the system.

1.1 Stakeholders

The following broad business processes were observed in based on the information gathered:

i. Household

The households are the main point of contact for the Suaahara II team, who are the target population for the program.

ii. Field supervisor

They will collect routine monitoring data, using checklists on mobile devices, based on Commcare' s mobile applications and forms. GPS points will be recorded for each household allowing tracking at multiple levels of aggregation – household, village, ward, VDC, district, project. Each month Field Supervisors will collect data from their working area in the VDCS, including an estimated 10 households, 2 VMFs (where available), and 2 FCHVs. Field Supervisor monitoring will also be done by the District Team using Commcare.

iii. Field Coordinators

Field Coordinators are responsible for supervising the Field Supervisors in each district, reviewing and verifying data from Field Supervisors for data and holding monthly meetings to review targets, achievements, and compliance. They verify all data collected by Field Supervisor before submission to the district.

iv. Female community health volunteer (FCHV)

They are community level health worker providing major contribution to public health programs. They are (government) line counterparts for FS. The major role of the FCHV is to promote health and healthy behaviors of mothers and community people to promote safe motherhood, child health, family planning, and other community based health services. They will not be collecting any data, but will be working with HKI for the various activities they carry out on the field.

v. Village Model Farmers (VMF)

Their role is to demonstrate ideal HFP practices related to homestead gardening, backyard poultry, and egg production. VMFs role is to support improved HFP

practices at the household level, particularly among 1000-day women, by using model farms as demonstrations, organizing HFPB groups, facilitating trainings, etc. VMFs also work closely with FCHVs to establish a mechanism for identifying and engaging with target populations.

vi. Consortium Partner

They will mainly be responsible for activity reporting and some HF checklist.

vii. Data Analysis and Management Manager

They will support the district coordinators and their partner NGOs and will build capacity of the district level teams engaged in M&E activities to ensure the quality of the data collected and the proper analysis, reporting, and use of finding.

viii. District Coordinators

The district coordinators are program managers and are responsible for the M&E

activities.

ix. M&E Coordinator

The M&E Coordinator will work closely with the M&E Manager, in establishing the M&E system in all Suaahara II districts. They will help develop data collection tools, ensure data are collected per the PMP, conduct regular monitoring visits to PNGO to collect and verify data, and support local partners in using data for decision making.

x. Management Information System (MIS) Coordinator

The MIS Coordinator is responsible for ensuring that data collection tools are fit for purpose and link smoothly with the MIS. The MIS Coordinator will be trained in DHIS2 through regional DHIS2 trainings and the DHIS2 Consultant. The MIS Coordinator will work closely with the M&E manager and is the Suaahara contact person for ensuring DHIS 2 and Commcare linkages.

3.2 Business Process: Monitoring Evaluation &Research Activities

3.2.1   Census

The implementation of the Suaahara II program is initiated by conducting a community mapping census for understanding the nutritional status of women and children in 40 underserved rural districts of Nepal. Also, the purpose is to have denominators for many of the indicators that will be collected in the Monthly Household checklist. This activity will be the first point of contact between Suaahara II field supervisors and households and will provide the first field level data collection for Suaahara II.

The Field Supervisor from the Suaahara II team does an interview with an informed consent from the household, in which they capture basic demographic details such as name of household member, age, education, marital status, pregnancy and phone or mobile number of each household member. The checklist also contains questions which aid in defining the household equity status, thus identifying the number of disadvantaged households. GPS points will be recorded for each household allowing tracking at multiple levels of aggregation – household, village, ward, VDC, district, project. About 600 Field Supervisors will collect checklist data.

The community census is done to develop a list of all 1000-days mothers and adolescent which will help to implement the program activities effectively.

Data Collected: Household data, GPS point of each household, Equity Status of household

Data Captured in: Commcare

Actors involved: Household, Field Supervisors

Reporting formats:

Tool	Reporter	Frequency
Community mapping census	FS	One time/regular updating, Dec 2016 (pilot); Mar 2017 (in 40 districts)

3.2.2 Household checklists

These checklists are the primary tool to collect information about the Suaahara II's target beneficiaries – 1000-day women and children – three distinct checklists are created (called visit 1, 2, and 3) that represent three different groups of contact points that should occur sequentially for a 1000-day women and children. The relevant checklist is filled depending upon the temporal relevance of the visit.

The main objective of the monitoring household checklists is to monitor the reach of Suaahara II's interventions and identify coverage gaps, and to understand the knowledge, attitude, and practise for key promoted behaviours. This is not only helpful for monitoring of program activities but also for updating program intervention strategies (outputs) to best achieve program targets.

Checklist Visit 1 (Pregnancy & Delivery): The first visit covers contact points during the period between pregnancy and the first week post-delivery. For this, data will be collected from women who are 7-45 days post-delivery. The data collected will be retrospective, covering the entire period of their pregnancy.

Checklist Visit 2 (0-5months children): The second visit covers contact points during the period between the first week of delivery and 6 months of live birth; this data will be collected from mothers of children more than 6 months and less than 8 months of age.

Checklist Visit 3 (6-23months children): The third visit covers the period between a child's 6 months of life and before the child turns 2 year of age; this data will be collected from mothers of children more than 24 but not yet 27 months of age.

With each subsequent visit the monitoring contact points changes are taken care of in addition to the collection of basic information related to knowledge and practices promoted by Suaahara II.

Like the census exercise, the Field Supervisors collect the data using the household's checklist, through Commcare, using mobile phones. Based on data from the community mapping census, the Commcare app automatically generates (based on random sampling within the same VDC) a list of households to be interviewed using the household checklists each month. The field supervisor will be asked to only collect data in one VDC per month.

Data Collected: Post-delivery detail, contact point checks, key Suaahara practices, and Homestead food production awareness

Data Captured in: Commcare

Actors involved: Beneficiary Population/Household, Field Supervisor

Reporting Formats:

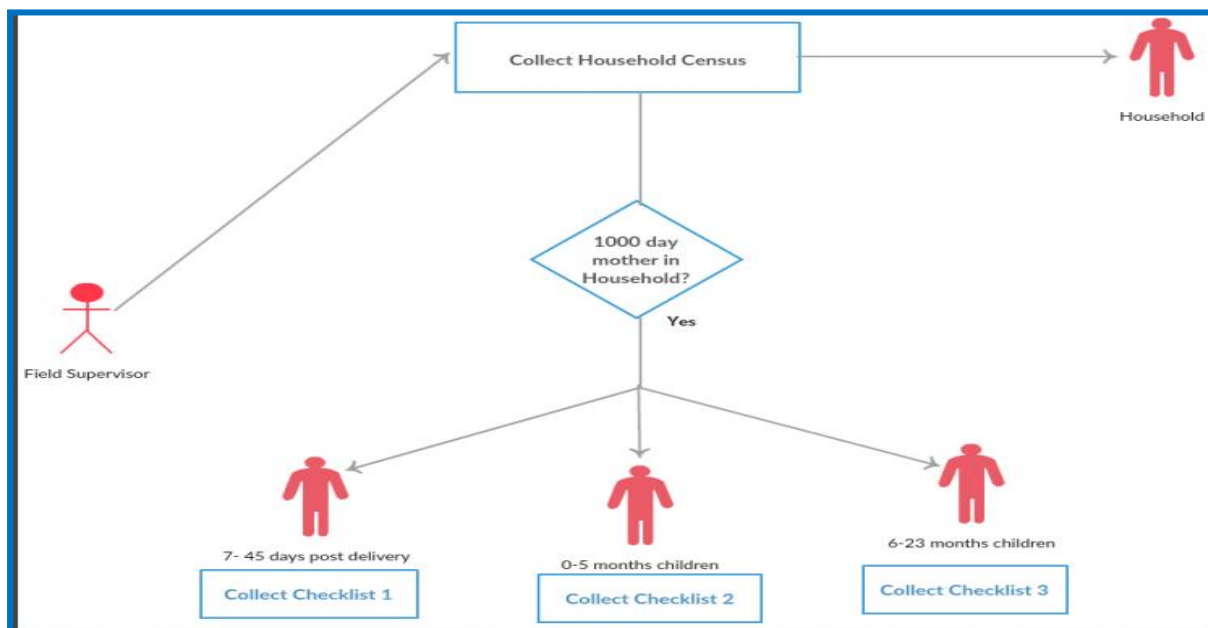| Tool	Reporter	Frequency
Household Checklist (3 visits)	FS	5-10+ per month Mar 2017 (40 districts)

Figure 1. Community Census& Household checklist workflow

Reference: project document

3.3.3 VMF checklist

Suaahara II's Homestead Food Production (HFP) model involves establishing village model farmers (VMFs) to demonstrate ideal HFP practices related to homestead gardening, backyard poultry, and egg production. VMFs support improved HFP practices at the household level, particularly among 1000-day women by using model farms as demonstrations, organizing HFPB groups, facilitating trainings etc.

In order to monitor VMF activities, a checklist has been created for data collection by Suaahara II field supervisors (FS). Each Suaahara II Field Supervisor (FS) should meet at least 2 VMFs per months in his/her supervision area The Commcare app will automatically complete the random sampling, so that the field supervisor knows which VMFs to interview each month.

The main objective of the VMF monitoring checklist is to generate regular information on how the VMF activities are being implemented in the communities and what gaps may exist to facilitate programmatic adjustments and to understand the degree of VMF participation in HFP activities designed and implemented by Suaahara II. The checklist would also help to understand the level of support delivered by VMFs to 1000-day mothers, their families, and the community through HFPB groups and other activities.

Additionally, it would provide an insight of the networks established between VMFs and local stakeholders (agriculture service centre/livestock service centre/citizen awareness centre/FCHV/Food and nutrition steering committee, etc.).

Data Collected: Homestead gardening knowledge, Backyard poultry and egg production knowledge, VMF-delivered support to population

Data Captured in: Commcare

Actors involved: VMF, Field Supervisors

Reporting formats:

Tool	Reporter	Frequency
VMF checklist	FS	2+ per month, where possible, Aug 2017 (40 districts)

3.3.4   FCHV checklist

Female community health volunteer are FLWs appointed by the government of Nepal. The FS meets 2 FCHV in a month for filling the checklist in the VDC where the household checklist and VMF checklist is being carried out.

Monthly FCHV data collection will provide data on program coverage in their respective areas and allow us to formulate a district level picture strengths and weaknesses in program implementation. This will allow programmatic improvements based on evidence and identification of gaps.

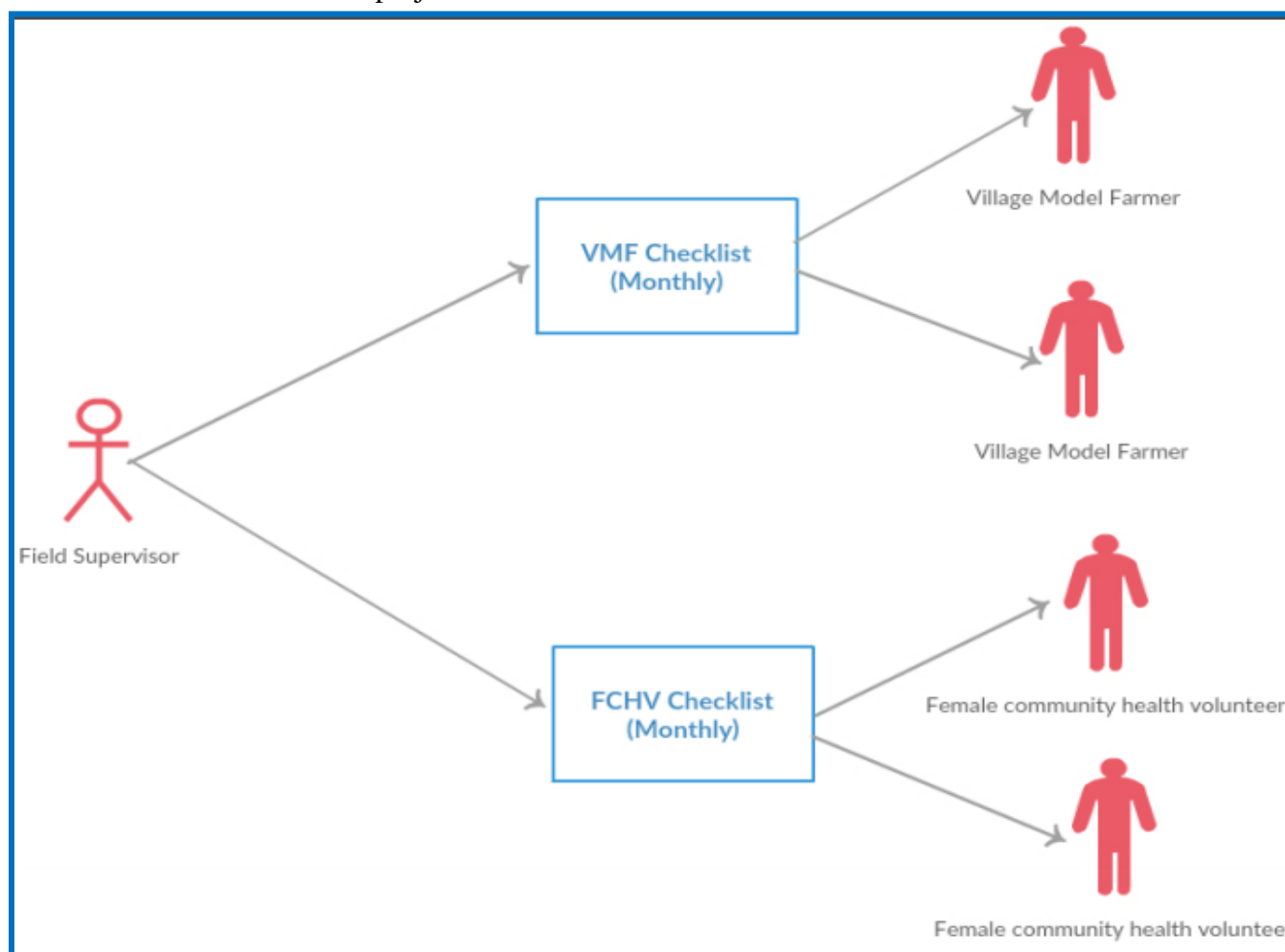The Field Supervisors collect the household's checklist, through Commcare app, using mobile phones.

Data Captured in: Commcare

Actors involved: FCHV, Field Supervisors

Reporting formats:

Tool	Reporter	Frequency
FCHV checklist	FS	2+ per month, where possible, Aug 2017 (40 districts)

Figure 2: VMF & FCHV checklist workflow
Reference: project document

3.3.5   FS's monthly reporting

The Field Supervisor's monthly reporting was added after the requirement visit. It is a FS's monthly Reporting which will be entered in Commcare by the FS. The data from the FS reporting is focussed on four monthly Activities the FS is involved in:

a) Contact with 1000day women
b) Observation groups attended
c) Meeting/Visit done/attended
d) Referrals done

Data Captured in: Commcare

Actors involved: Field Supervisor

Reporting Formats:

Tool	**Reporter**	**Frequency**
FS reporting	FS	Monthly

3.3.6 Homestead Food Production seasonal surveys

Homestead Food Production surveillance helps to understand the extent to which HFP interventions are driving improvements in horticulture and livestock management practice. This would indicate the substantial improvements in production needed to deliver changes in diets and income, which will contribute to improvements in nutritional status. The surveys will track the training, products and services that are accessed and received by households, together with seasonal production yields for all HFP fruits and vegetables and poultry. Data on diets, food security, and income/expenditure will also be collected.

Data will be collected monthly from HFP intervention. It will be collected electronically by Commcare. In the current scenario it is under construction by Suaahara Team and will be added once finalized.

Data Captured in: Commcare software

Actors involved: VDC

Reporting formats:

Tool	Reporter	Frequency
HFP seasonal surveys	Commcare HFP VDCs	1-2/month, April 2017

3.3.7 Health Facility Checklist

The Health Facility Checklist is done monthly to understand current nutrition and family planning services provided and to evaluate the capacity (human resource, equipment) to implement quality NACS services. The idea behind the checklist is that it will help to identify available nutrition and family planning services in the districts, capacity of health facilities for nutrition assessment and counselling as well as identifying any gaps in the nutrition and family planning services.

Sampling technique and sample size: Interview will be conducted in 10% health facility of each district. Sample health facility will be selected using convenience sampling.

Actors involved: District Team, District Co-ordinator, Suaahara central office

Data Captured in: In Commcare

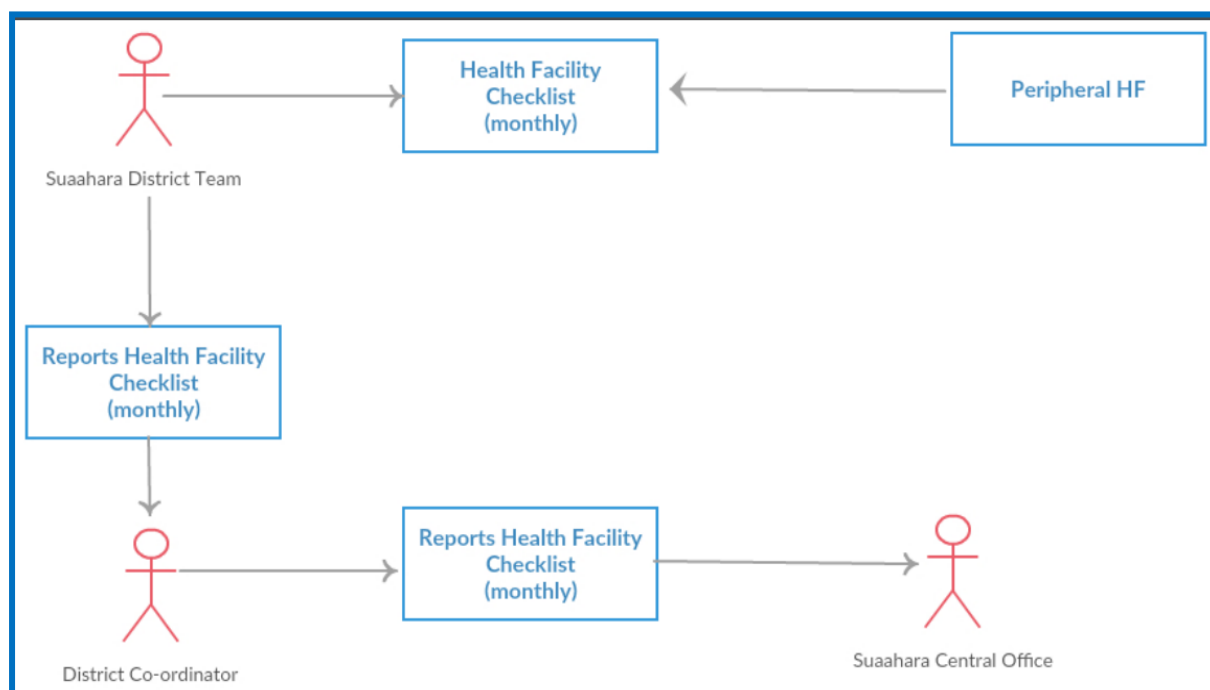| Tool	Reporter	Frequency
Health facility checklist	District team	Monthly. July/Aug 2017 (40 districts)

Reporting formats:

Figure 3: Health Facility Workflow

3.3.8 Annual Household survey

Annual surveys will be done to assess the extent to which anticipated changes in population level outcome indicators required to improve nutritional status are happening. Annual survey data will be used, together with household checklist data and implementation reports, to understand the extent to which the IRs are achieved. Analysis of whether alternative approaches to driving behaviour change are required, and to which behaviours and populations these alternatives should be targeted.

Annual beneficiary survey data will be collected electronically by an independent survey team on tablets using ODK and as per current plan not be part of DHIS

Data Captured in: ODK software

Actors involved:

Reporting formats:

Tool	Reporter	Frequency
Annual household surveys	Survey firm Sampled areas	1x per year March/April 2017

4. Activity Reporting

This includes 41 data entry points- 40 for districts and 1 for central level activities. All the activities are essential for each Intermediate Result to be achieved. Activity reporting can occur at any of the four levels. They are events conducted to achieve the outcomes of the

Suaahara II project.MER team will monitor the overall process for ensuring the quality, completeness, and timely reporting of information.

Activity Reporting will be under 6 main categories:
1. Training
2. Orientation
3. Meeting
4. Workshop
5. Event
6. Distribution

Data Captured in: DHIS 2

Actors involved: Beneficiary population/Household, Field Coordinators, Field Supervisors, Village Model Farmer, Female Community Health Volunteer, District Coordinators, Suaahara II MER team (in 40 Districts)

Reporting formats:

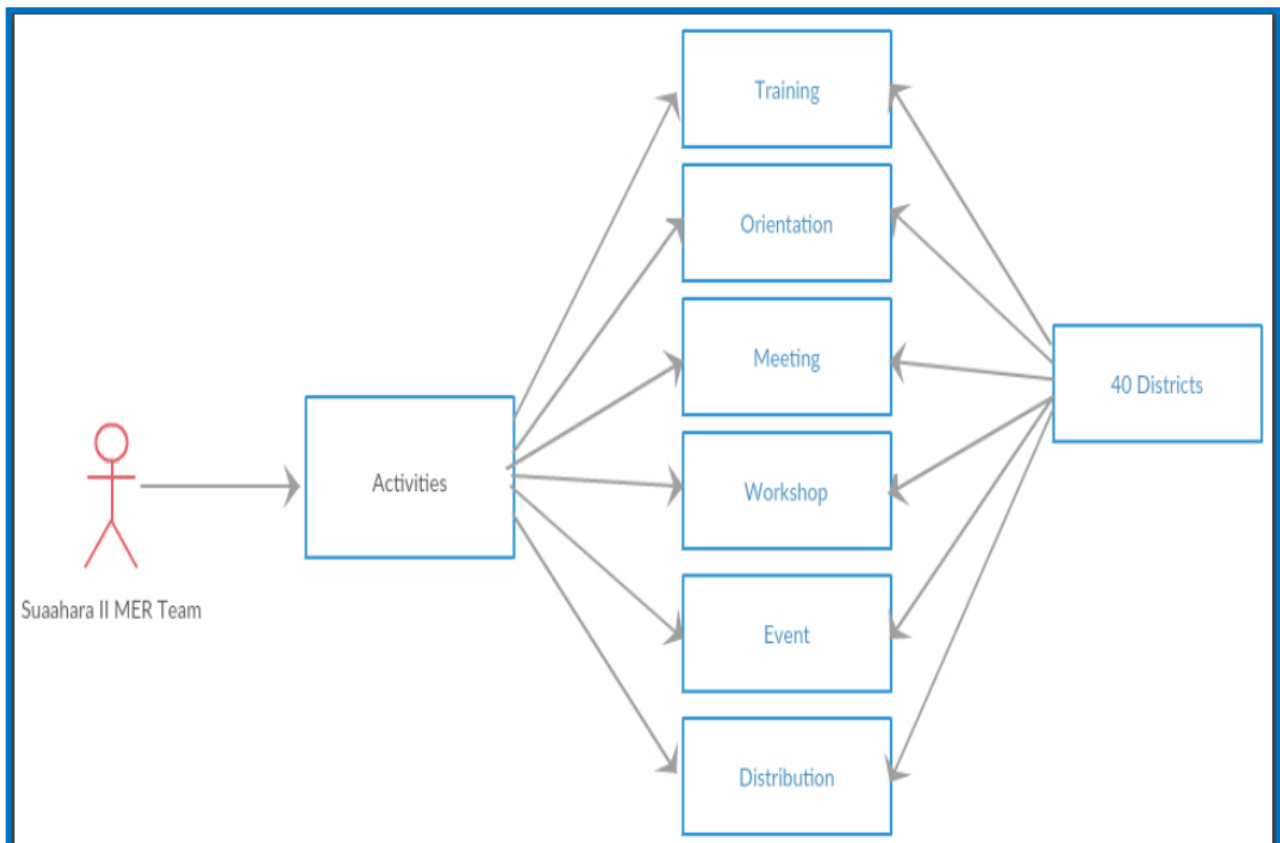| **Reporting Format**	**Reporter**	**Frequency**
Training	Consortium Partners with their Respective Budget Holders	
Orientation	Consortium Partners with their Respective Budget Holders	
Meeting	Consortium Partners with their Respective Budget Holders	
Workshop	Consortium Partners with their Respective Budget Holders	
Event	Consortium Partners with their Respective Budget Holders	
Distribution	Consortium Partners with their Respective Budget Holders	

Figure4. Activity Workflow
　　　　Reference: project document

1. **Summary of Identified Data Sources and Storage**

The Suaahara II data will be entered through the following process:

Tasks		Final Storage
MER Activities		
Community Census	Commcare	DHIS 2
House Hold Checklist (1,2,3)	Commcare	DHIS 2
VMF checklist	Commcare	DHIS 2
FCHV checklist	Commcare	DHIS 2
FS Reporting	Commcare	DHIS2
Health facility checklist	Commcare	DHIS 2
HFP seasonal surveys	Commcare	DHIS 2

Annual household surveys	ODK software	**-**
Activity Reporting		
Beneficiary Reach	DHIS 2	DHIS 2
Visits/Meetings	DHIS 2	DHIS 2
Group Discussions	DHIS 2	DHIS 2
Input Distribution	DHIS 2	DHIS 2

2. Data Analysis and Reporting

Monitoring of data will be done in DHIS2 using the dashboards and the Data Analytics.

Data will be presented in a thematic tabs/district on the dashboards, with aggregation and analysis and key data presented through a series of pre-programmed charts, graphs, and tables as per program manager requirements.

The dashboards will form the basis of monthly program reviews for Kathmandu Suaahara II and District Suaahara II and will facilitate in data driven decision.

3 Design and Development Approach

Input

The design is based on the default data model using a mix of aggregate, event and tracker capture depending upon the use cases performed by different stakeholders in the system. The data will either be entered by the users in DHIS2 for certain set of activities, or will also be pulled from Commcare for a defined set. The details of each have been mentioned ahead in the document.

The system configuration will be defined based on the type of data being keyed in by the users, or being imported from Commcare platforms:

- ✓ **Aggregate data**: All aggregate data reported against a set of services will be stored using the aggregate data entry app.

- ✓ **Event Capture**: All data reported as one time information such as census, household checklists, activity reporting which are not meant for longitudinal tracking of a person/entity will be stored using the event capture app.

- ✓ **Tracker Capture**: All data which requires tracking of person/entity for the services provided by Suaahara II will be stored using the tracker capture app.

3.1.1 DHIS2 Input

As per the current requirements and workflows the set of activities planned in the detailed implementation plan (DIP) will be entered directly into DHIS2. The Suaahara district office and PNGO team will collect all the data of implemented activities once they have been carried out the data will be entered into DHIS2. The data for the following activities will be entered into DHIS2 directly:

a. Training
b. Orientation
c. Meeting
d. Workshop
e. Event
f. Distribution

3.1.2 Integration between DHIS2 and Commcare

The integration between DHIS2 and Commcare would allow the users to send aggregate as well as event based data from Commcare to DHIS2 depending upon the outputs required to generated from the data collected from each component.

Data from Commcare to DHIS2 will be:

    a. Census
    b. Household Checklist
    c. VMF checklist
    d. FCHV checklist
    e. FS Reporting
    f. HF Checklist
    g. HFP Checklist

The information flows for each have been illustrated in the document below.

3.2 Data Processing

The data captured in DHIS2 as well as the data pulled from Commcare will be processed by creating the required set of indicators to be used for analysis and presentation. The indicator framework will be based on internal program monitoring and evaluation as well as for reporting the data to USAID and other relevant donors/stakeholders.

3.3 Outputs

3.3.1 Standard Reports

Standard Reports are the custom reports, which have a custom design and are generated in the designed formats for the defined periods and levels in the organisation unit hierarchy.

3.3.2 User Defined Reports

User defined reports are dynamic reports generated on the fly using various reporting and visualization tools/modules in DHIS2 as given below:
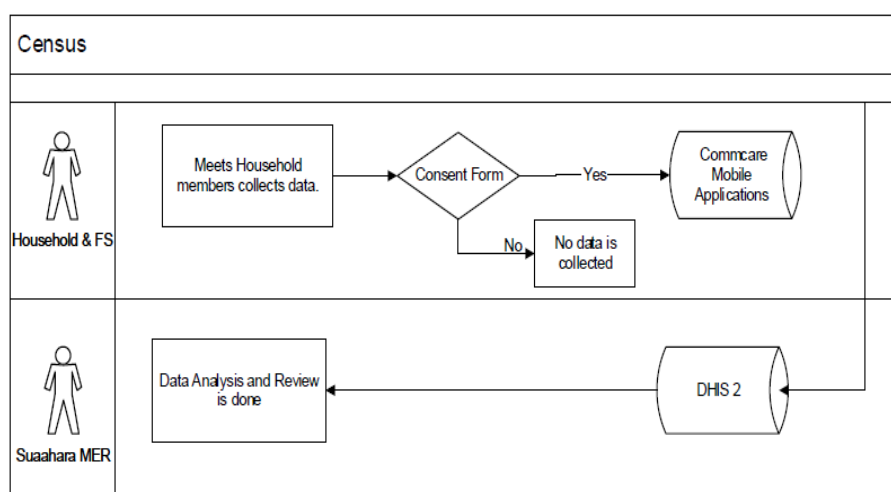
    a. **Data Visualizer**: used for generating user-defined charts and graphs.

    b. **Pivot Table**: used for generating user-defined tables.

    c. **GIS**: used for plotting data on maps and carrying out spatial analysis.

    d. **Event Reports**: used for generating reports with all individual events in the system.

4. Proposed Work Flow

4.1 Census

a. Field Supervisor collects data from each household that they are allotted to cover using the Commcare mobile application.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

c. The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholder created.

The census data will be stored as events as onetime information capture along with the coordinates of the household to support clustering of the number of household covered in each region on maps

Figure:5censusworkflowReferences: project document

4.2 Household C

The household ch........ ion process in its own right out as a separate exercise. During the census exercise, if the data collected falls into the criteria which qualifies for filling up a household checklist, the data can be collected at the same time, else will be collected monthly

a. The Field Supervisor collects data from the household on the women based on the information collected from them, and the checklist criteria they fall into. The following checklists will be used to capture data:

  ✓ **Checklist Visit 1 (Pregnancy & Delivery):** Data will be collected from women who are 7-45 days post-delivery

- ✓ **Checklist Visit 2 (0-5 months children):** Data will be collected from mothers of children more than 6 months and less than 8 months of age.

- ✓ **Checklist Visit 3 (6-23 months children):** Data will be collected from mothers of children more than 24 but not yet 27 months of age.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

c. The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholders created. Based on the assumption that we are not tracking women, the data collected for each checklist will be stored as events as a onetime information capture for the data collected. There will be separate programs in Event Capture app of DHIS2 for each checklist as defined above.
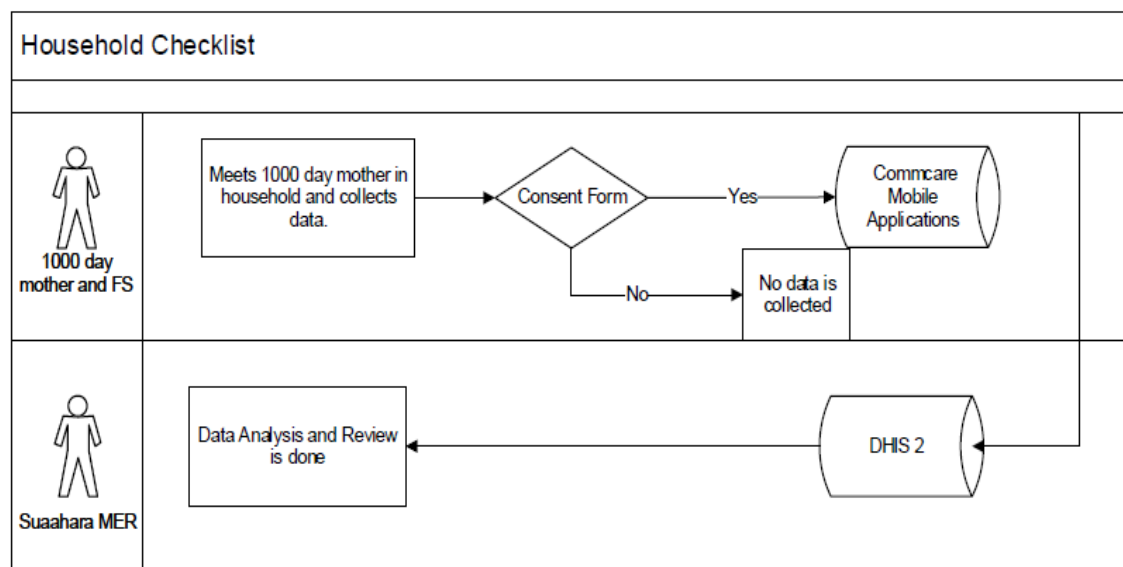

Figure :6 Household checklist workflow
References: project document

4.3 Village Model Farmer checklist

a. Field Supervisor collects data from each VMF that they are allotted to cover using the Commcare mobile application.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

c. The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholder created. The VMF checklist data will be stored as events as one-time information capture.
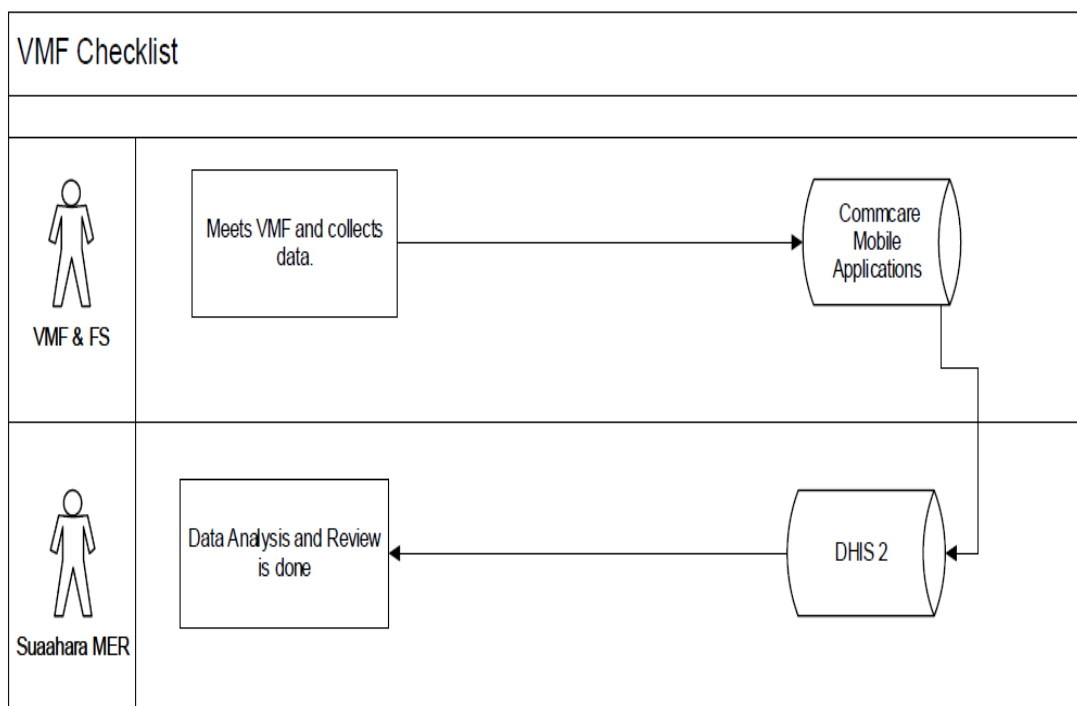
VMF Checklist

- VMF & FS — Meets VMF and collects data. → Commcare Mobile Applications
- Suaahara MER — Data Analysis and Review is done ← DHIS 2 ← Commcare Mobile Applications

Figure :7 Village model farmer workflow

References: project document

4.4 Female Community Health Volunteer Checklist

a. Field Supervisor collects data from each FCHV that they are allotted to cover using the Commcare mobile application.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

c. The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholder created. The FCHV checklist data will be stored as events as a onetime information capture.
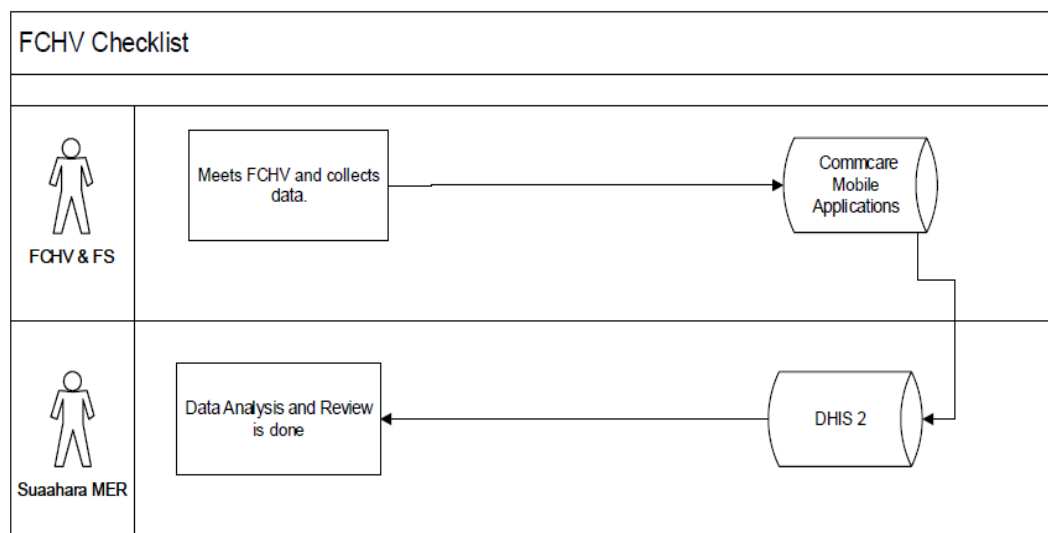

Figure :8 FCHV checklist workflow
 References: project document

4.5 Field Supervisor Reporting Format

a. Field Supervisor collects data each month of the Activities she does and enters it into the Commcare mobile application.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholder created. The Field Supervisor Reporting will be stored as events as onetime information capture.
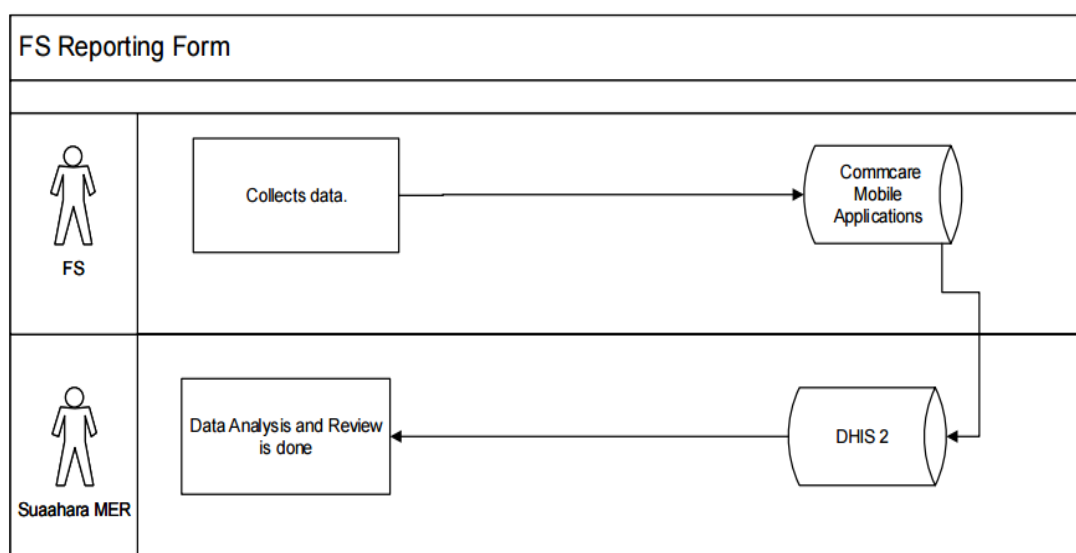
Figure:9 FS Reporting workflow

References: project document

4.6 Homestead Food Production Checklist

a. Data is collected from each HFP intervention area at least once in each season that is allotted to cover using the Commcare software.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

c. The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholder created.

d. The HFP checklist data will be stored as events as a onetime information capture.

NOTE: That this section is under construction by Suaahara Team and the workflow can be done once finalized.

4.7 Health Facility checklist

a. District Team collects data from Health Facility that they are allotted to cover using the Commcare mobile application.

b. The data gets synchronised with the Commcare cloud as and when device gets connected to the Internet.

c. The data gets pulled from the Commcare cloud into DHIS2, and gets stored in the placeholder created. The Health checklist data will be stored as events as onetime information capture.
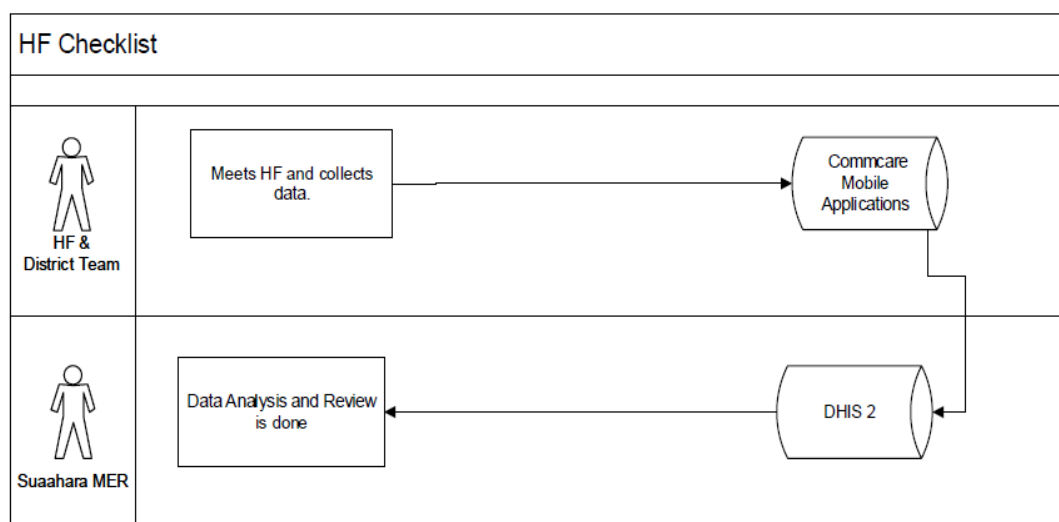
Figure :10 HF Checklist workflow

References: project document

4.8 Activity Reporting

A. Suaahara central office, and district office as well as the consortium partners team will collect all the data of implemented activities as they are covered in the program sites.

   Activity reporting is done in 6 categories:

   ✓ Training
   ✓ Orientation
   ✓ Meeting
   ✓ Workshop
   ✓ Event
   ✓ Distribution

a. Activity is executed by Centre/District level teams (district and field level co-ordinators) will be captured via tablets/laptops into DHIS2.

b. Data will be directly captured in the DHIS 2 system as events, where one activity of each type will be added as an event.

The use cases for activity reporting are provided as a separate document with the details captured against each activity.
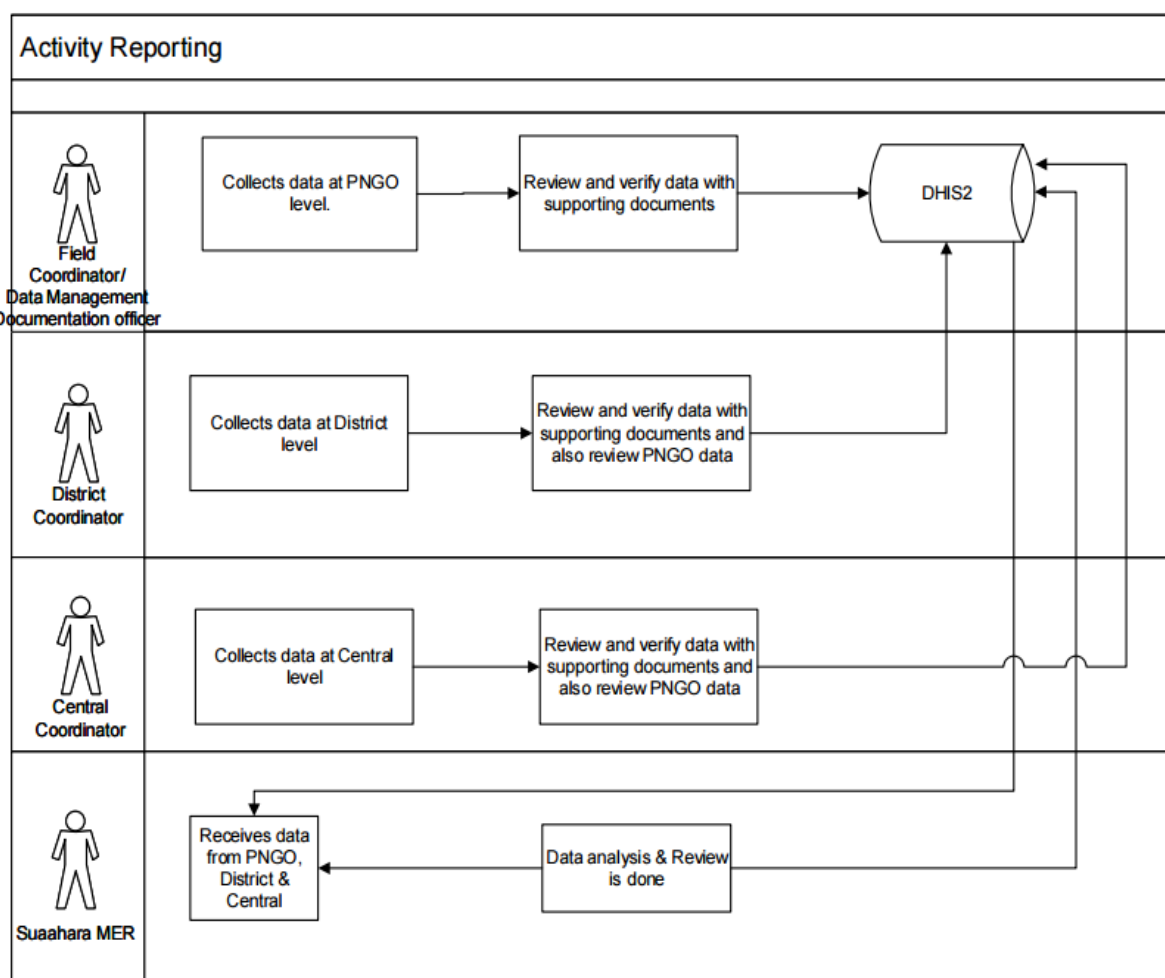
Figure :11 Activity reporting workflow
References: project document

5. Pre-requisites

5.1 Organization units/ Reporting Units and hierarchy

Organisation units refer to the reporting facilities in DHIS and are organized based on the hierarchy of reporting. The data reported by each facility is stored against the respective organization unit.

Organization Hierarchy for Suaahara II:

Facility Type	Level
Country	Level 1
District	Level 2
VDC	Level 3
Wards	Level 4

Administrative Hierarchy for SuaaharaII:

- ✓ Suaahara II

- ✓ Centre

- ✓ District

- ✓ District Office

- ✓ PNGO

In order to use data on GIS, it is imperative that the data is collected as per the geographical hierarchy. The administrative hierarchy will be implemented through the use of category and category combinations for data collection, category option group and group sets for analysis. The visualisation of data will be done both on the basis of geographical as well as administrative hierarchy.

5.2 User management

The following user roles and respective privileges have been identified, and this list will evolve over time. There is no restriction on number of users with different privileges, as the system evolves the user count increases which will be provided by HKI. The users will have access to all platforms which will get deployed based on the system design and subsequent configurations done. The following table covers the users which will have direct interaction with DHIS2, the Commcare data import would not be tied to a specific user, as it would be an automated process, only the System admin would have an access to the utility.

Role	Privileges
System administrator/ MIS Manager	Entity management, User management, and access to all programs for addition and updation of data, access outputs, access to Commcare linkages.
Suaahara II Central and District users	Add/Update data for activity reporting.
Consortium partners	Access to data reported for activities, add/update data for activity reporting.
DMDO	Access to all data in the system, add/update data for activity reporting.
Suaahara MER	Access to all data in the system, access to analysis modules, dashboards etc.
Field Co-ordinators/Field Supervisors	Access to data imported from Commcare (view rights only

6. Major System Capabilities

6.1 Modules in DHIS2

The modules in DHIS2 help in maintaining the essential components, which encompass the DHIS2 system; the major modules used in DHIS2 for customisation, maintenance and end user usage are given below:

a. **Users**

The users module allows adding new users and manages existing users in the DHIS2 application. Each user can be assigned certain privileges, and to certain organisation units for which they will be enabled to enter data on behalf of. A collection of privileges and authority can be grouped together to form a user role, which can be assigned to each user.

b. **Maintenance**

The maintenance module comprises of the following sub-modules which helps in defining the meta data and the system configuration components:

✓ **Organisation units**

This module allows the admin users to create organisation units and build up the orgunit hierarchy, which can comprise of administrative as well as service delivery units. Organisation units are added one by one as either root unit or a child of a selected unit in order to build a hierarchy. The hierarchy should be made on a geographic basis, as the hierarchy plays an important role in the GIS module.

✓ **Data Elements**

Data elements form the basis of DHIS2. Data elements define what is actually recorded in system. This module allows the user to add data elements in the system.

✓ **Indicators**

Indicators are composed of multiple data elements, and typically consist of a numerator and denominator. Calculated totals do not have a denominator. All other indicators except totals but are derived from combinations of data elements and factors such as per thousand, percentages etc.

✓ **Datasets**

A data set is a collection of data elements grouped together for data collection. The admin users can create multiple datasets based on the themes, and collection of data elements, by assigning them a frequency (reporting period) and an organisation unit.

c. **Data Entry Apps**

✓ **Aggregate data entry**

The aggregate data entry app allows users to enter aggregate numbers against a set of services which are compiled into a dataset. The data entered gets linked to a particular user selected service delivery point and a specific period.

✓ **Event Capture**

The event capture app allows capturing, modifying and listing events. The event capture app works with event-based programs in DHIS2. These programs are suitable for handling scenarios such as facility surveys, hospital registry summaries and training events. However, the app is not tied to any specific domain and can potentially be utilized for any scenario of event-based information.

✓ **Tracker Capture**

The Tracker Capture Android app allows to capture, modify and list tracked entity instances with its enrolments and events. The Tracker Capture app works with multiple event-based programs in DHIS2, which handles events linked to registered entities. These programs are suitable for handling disease programmes where multiple visits are required. The Tracker Capture app can be used for disease programmes such as tuberculosis and malaria. However, the app is not tied to any specific domain and can potentially be utilized for any scenario of multiple event-based information.

D .Data quality

The data quality module provides means to improve the accuracy and reliability of the data in the system. This can be done through validation rules, min max analysis for finding outliers and anomalies in the reported data.

E .Data visualizer

The data visualizer module enables end users to easily create dynamic data analysis and visualizations through charts, graphs and data tables. The end users can freely select content (like indicators, periods and organisation units) for analysis.

F .Pivot table

The Pivot table module enables users to create pivot tables, using all available data dimensions in DHIS2. A pivot table is a dynamic tool for data analysis, which lets the end users to quickly summarize and arrange data according to its dimensions. A pivot table can arrange data dimensions on columns, rows, and as filters.

H .GIS

GIS module enables the end users to plot data on maps to analyse data and trends geographically. It requires customisation where in the shape files, which hold the coordinates (latitude and longitudes), are integrated in the application based on the organisation unit hierarchy designed.

j. Dashboard

The dashboard module is designed to give the end users an overview of multiple analytical items like maps, charts, pivot tables and reports, which together can provide a comprehensive overview of the data for monitoring and evaluation.

k. Data Approval

Data approval module allows the users at different levels in hierarchy to approve data collected at the same as well as lower levels in the organisation unit hierarchy, so as to keep a close check on the quality of data entering in the system. The system allows the feature of allowing only the approved data to be a part of the data analysis, while the unapproved data is kept separate till the time it is approved.

l. Analytics

Analytics module facilitates the aggregation of data from the lowest to the highest level in the organisation unit hierarchy and arranges the aggregated data in flat tabular structure. The visualization module such as Data visualizer, Pivot table and GIS when used for data analysis fetch data from the analytics tables.

In order to understand the flow of information between the different modules, below is a brief description of the data model of DHIS2 which explains the basic parameters of DHIS2 which facilitate data capture.

6.2 Data Model

The data/domain model in DHIS2 is flexible in order to capture data and its different dimensions. The core unit of the model is the data value, which can be captured for any data element, period and source. Hence the data value represents a captured item for a certain time period and organisation unit.
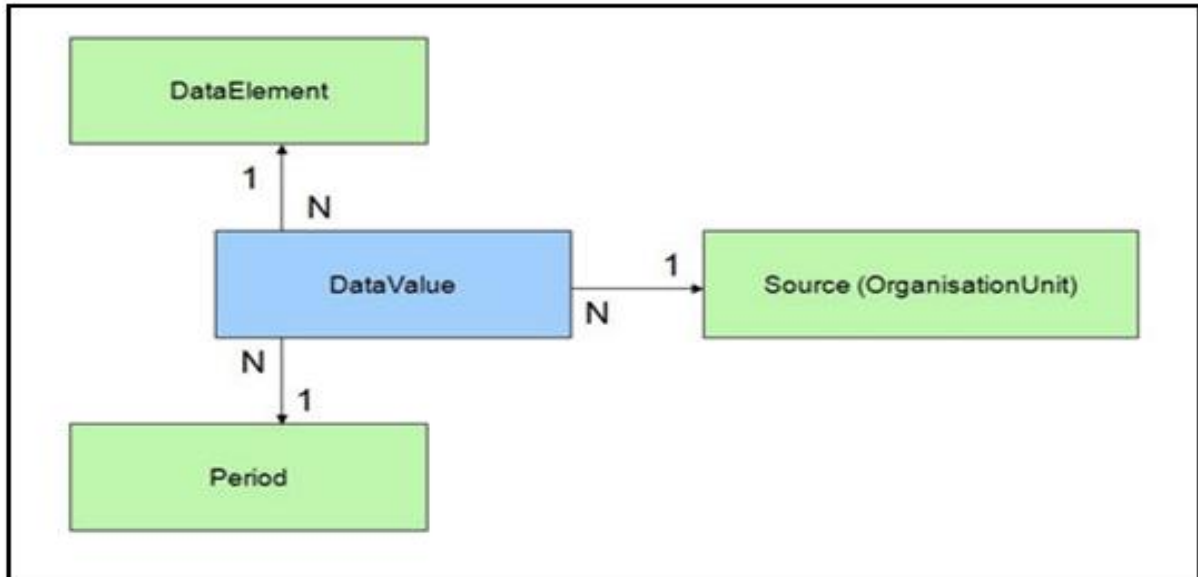
Figure 12: Data model
  References: project document

The central concept for data capture is a dataset, which is a collection for data elements. It is represented as a grid or custom designed form, and is linked with a period type, which represents the frequency of data capture

The central concept for data analysis is the indicator. Indicator is a mathematical formula, which is made by different combinations of data elements with operators. An indicator is associated with a factor to which the output is multiplied.

Other objects such as organisation units, data elements, indicators, validation rules etc. can be grouped to form corresponding group objects, which help in improving and enhancing data analysis.
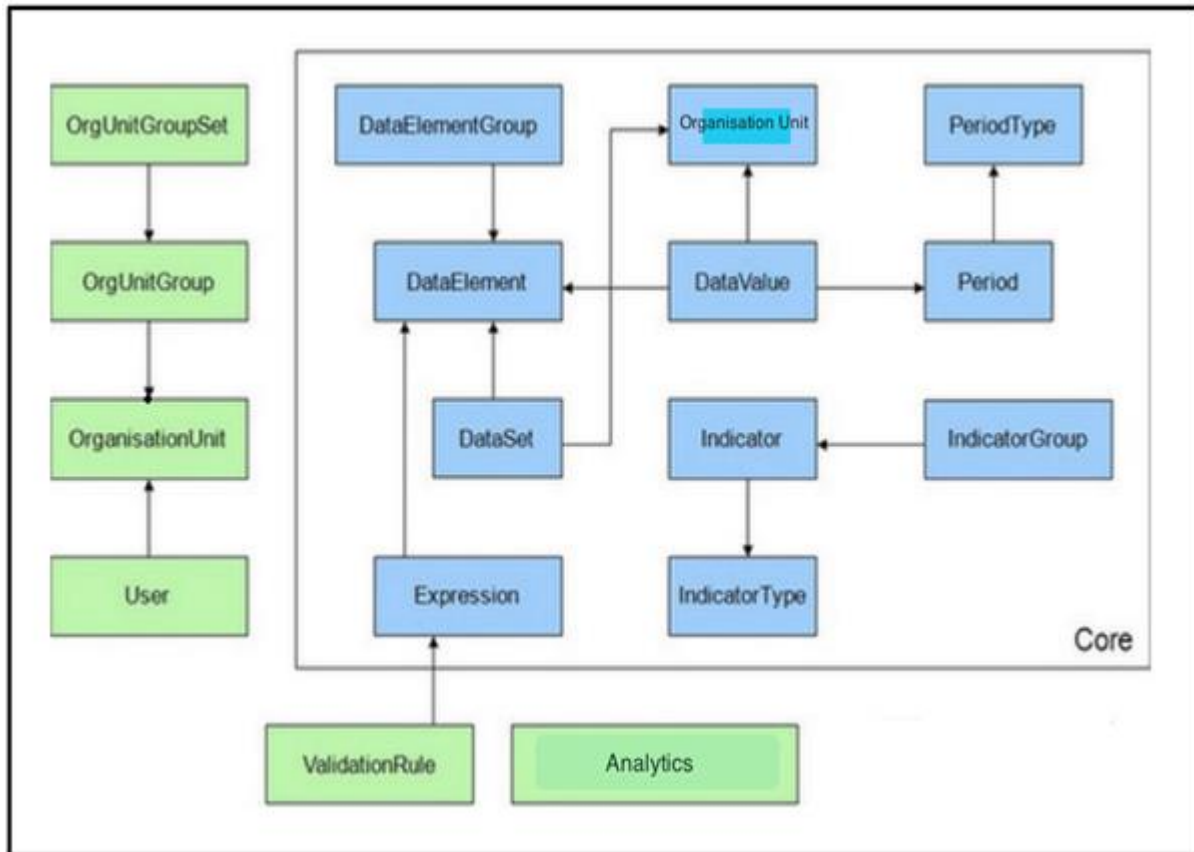
Figure13:overall data model

References: project document

7. System Interfaces

Web API

The Web API component makes it possible for external systems to access and manipulate data stored in an instance of DHIS 2. More precisely, it provides a programmatic interface to a wide range of exposed data and service methods for applications such as third-party software clients, web portals etc.

Import-Export Module

The import export modules allows importing of data from third party software into DHIS2 as well as exporting of data from DHIS2 to other systems in predefined formats such as CSV/Excel/XML, or default DHIS2 exchange format known as DXF2.

Using the above two system interfaces and in addition to the above, the Suaahara II DHIS will have the below mentioned apps made available for interfacing with third party applications:

DHIS2-Commcare Import App

This app will act as bridge between the DHIS2 and the Commcare applications. The app would have functionalities built in to pull data from the Commcare cloud for various sets of data reported, and place that data in the placeholders pre-defined in DHIS2.

DHIS2 Event/Tracker Import App

This app will allow importing of data coming from external systems, and also importing any legacy data (if required) via Excel or CSV files into the pre-defined placeholders in DHIS2.

8. Security Requirements

8.1 Security Mechanisms

Firewall: The systems used a firewall to manage ports available for local applications to listen on. Check about ufw for a simple IP tables-based solution.

Proxy Setting: A reverse proxy is a proxy server that acts on behalf of a server. Using a reverse proxy in combination with a servlet container will enhance the application speed and security.The use of nginx (http://wiki.nginx.org) as reverse proxy due to its low memory footprint and ease of use is recommended. To get the latest version it is recommend installing it from source.

The following security mechanisms are in place which keep track of the activities carried out by the users:

User authentication mechanism:

Passwords are stored in the database in encrypted format; password is stored as a salted MD5 hash, with username used as the salt. The MD5 hash of password is a one-way function where password recovery is not possible, only resetting it is possible. The complexity requirement for password is one-capital alphabet and at least one number and minimum of 8 characters.

Session Management Detail:

When user logs in session will be created and maintained till the user logs out. Also if the user leaves the system idle default session time is set to 30 min, which can be configured by system admin.

Access Logs and Audit Trails

Access logs are being maintained, when any user logs in, the user id with the IP address by which user is logged in is stored in the log, also audit trail is also being maintained. All the changes made in metadata and data entered like data element, organisation unit, dataset etc. are logged in with respect to the user who has made the changes.

Security Certifications

The Standardisation Testing and Quality Council (Department of Electronics and Information Technology, GOI) have certified DHIS2 for quality assurance (STQC).

8.2. Backup Management

Two types of backup's strategies are to be maintained in order to be preparing for any emergencies:

Local back up: A daily backup is taken overnight using automated scripts, and the database backup is stored at the local server on-site, so in case of any abnormality the last back up can be replaced to normalize the operations.

Remote backup: In case of dealing with disaster recovery, a remote backup using automated scripts will be also maintained on a daily basis at a remote site in case of a calamity at the local site.

Both these backup strategies are followed irrespective of the mode of deployment, which can be a physical server or cloud. For storing the local back up, a system would be required on premises, and same for remote backup either a system in place for storing backups on a remote location, or it can also be stored on cloud.

9. System Acceptance Criteria

The system acceptance criteria will be defined in the use case documents as well as the test cases where the actions to be taken by users and the corresponding actions to be taken by the system will be defined. For each functionality, if the system is found to perform the activities as defined in the use/test cases the system would be considered as meeting the acceptance conditions.

10. Deployment modality

A summary for all the options available for hosting the application has been mentioned below with pros and cons of each of the options.

Predominantly, there are two web server options for the hosting of Suaahara II DHIS2 application.

1. **Dedicated Server Web Hosting Service**

2. **Cloud Computing Web Hosting Service**

Dedicated Web Hosting

Dedicated web hosting is owned and devoted entirely to your website, we may purchase our own server or pay for access to a server owned by someone else, like data centres, if you own your own server and have it stored in someone else's facility, you are using what is known as collocation hosting. In any type of dedicated hosting you can have full control over its use and administration. We can host the dedicate server in office premises or any data-centre.

Cloud Solution

Cloud Hosting Services provides hosting for websites/application on virtual servers which pull their computing resource from extensive underlying networks of physical web servers which is being shared by multiple users. The users share the resources of the server but the server space is strictly divided into allocated percentage. It follows the utility model of computing in that it is available as a service rather than a product. Broadly their resources utilized as much as it is required, depending on the demands of their website/application, and they will only pay for what is being used.

Following is the suggestive list of cloud hosting vendors:

LINODE Web Services: Official web site for plan and all the configuration related detail including billing cycle etc. https://www.linode.com/

AMAZON web Services: Official web site for plan and all the configuration related detail including billing cycle etc. http://aws.amazon.com/

Note: For standard cloud based specifications, the minimum recommendation is of 16 GB RAM and 8 core CPU or above cloud solutions.

Recommendations

HISP recommends use of Cloud based hosting based on the following advantages on offer:

a. Quick deployment: No upfront hardware costs, time and resources.
b. Pay as per the usage pricing
c. Scalability: the configuration can be scaled as and when required.

Suaahara Server

The Suaahara team made the decision to purchase their own server for hosting the DHIS2 system for Suaahara II.

DISCUSSION

Under Following Points:

1. **Open source**

   DHIS 2 is free and open source software released under the liberal BSD license. It is developed in Java and runs on any platform with a JRE 7 installed. DHIS 2 is web-based and follows HTML 5 standards. You can download the WAR file and drop it into a Web container like Tomcat. Or download the Live package and simply click the executable file.

2. **Internationalized**

   The DHIS 2 user interface comes fully translated into 8 languages. In addition DHIS 2 lets you translate your database content into as many languages as you like. Each user can easily switch between languages on the fly. If you need to translate the user interface into a new language that's easy, too.

3. **Highly scalable**

   With DHIS 2 you can have thousands of concurrent users and hundreds of millions of data records using only a single, standard web-server. It lets you analyse and explore your data and get answers within tenths of a second. DHIS 2 is being used as national health information systems in a large number of countries and has thousands of days in production leading up to a high-performing and mature system.

4. **Interoperability**

   DHIS 2 comes with great capabilities for system interoperability and features its own format for meta-data and data exchange called DXF 2 as well as the SDMX-HD standard. Most parts of the system can be accessed through the extensive REST-based Web API, making interoperability with third-party clients like Android apps, Web portals and other information systems easy. You can even set up scheduled integration jobs in order to periodically synchronize with or import data from other sources.

CONCLUSION

HISP aims to support the improvement of health care systems in the southern hemisphere by increasing the capacity of health care workers to make decisions based on accurate information.

The primary focus of the HISP India is to developed and design the system for the activity reporting for the project for activity reporting data right now the activity reporting system has been made and testing from the client side is going on. HISP also provides training and support for users of the District Health Information System (DHIS) software.

The DHIS 2 is a tool for collection, validation, analysis and presentation of aggregate (statistical) data, tailored to know the prevalence of nutrition related anomalies such as being underweight, or suffering from stunting and wasting amongst the child population of less than 5 years of age.. It is a generic tool rather than a pre-configured database application, with an open meta-data model and a flexible user interface that allows the user to design the contents of a specific information system without the need for programming.

Limitations

- The whole system is designed based on the customised forms which include manual mapping of the elements that takes much time.

- To verify manual mapping rounds of testing required to make sure all elements are correctly mapped at the place.

- Programs are divided activity wise and defined as per donor and partner NGO so it was difficult to identify and link programs to specific donor and activity.

- Expressions of indicators were complicated to define to generate correct output and outcome based on the input provided to the system.

- Continuous feedback to redesign meta data model involves rework.

RECOMMENDATIONS

System design is based on customized form where mapping is done manually that need to be take in to consideration

REFFERENCES

- **http://hispindia.org**
- **http://dhis2.org**
- **HKI Project documents**