Report on UiO mission to Sindh

May 30, 2018

Background

University of Oslo (UiO) was invited by UNICEF Pakistan in May 2018 to undertake a scoping visit to Punjab and Sindh province..

The government of Sindh has requested UNICEF to support in strengthening the capacity of the government pertaining to analysis of health data by assisting in development of unified integration system. This integrated system (MIS) is expected to play an important role in visualizing the data developed by multiple partners into one unified integrated dashboard linked with LMIS and HMIS.

The SoW for the Sindh mission was to examine the existing MISs and provide detailed report/roadmap with recommendations on ways to integrate different fragmented systems, and to best implement visualization of the data developed by multiple partners into one integrated dashboard and translation into DHIS2 with linkage with LMIS and HMIS.

Report on meetings

Quick summary of meeting conducted during the one-day mission.

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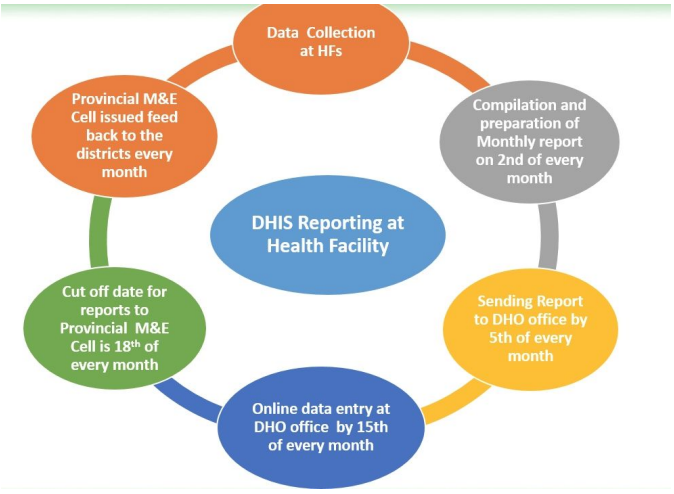
Sindh HMIS

Sindh is one of the southern provinces of Pakistan touching the shores of Arabian sea . The total population is around 47 Million with growth rate of 2.4%. Urban population of 52% with adequate health facilities and rural population of 47% with very little or no health services at all.

Systems demonstrated in this meeting:

DHIS
DHIS is the backbone in SHIS(Sindh Health Information System) ecosystem.
The online version of historically adopted paper based HMIS system was developed in 2015. Its objective was to collect quality and relevant data about health services and resources and then generate meaningful information emerging from the data patterns. This information would be useful for policy overhaul and effective decision making. As a matter of fact, online data collection coverage has not been implemented throughout the province and there are still facilities which collect paper based data and then enter it into the system manually.
System is capable of generating basic dashboards/reports for example monthly report from PHCs, Indicator based reports and error summary reports.



vLMIS

http://v.lmis.gov.pk

Presented by the USAID partner Chemonics who is supporting this national initiative.
Key points:

- Three major modules
  - Inventory management
  - Stocks consumption reporting
  - Stock requisition module
- Seems to overlap quite a bit with both EPI MIS and DHIS in terms of reporting routine immunisation services
- Expressed interest to set up interoperability solutions with the other systems

MERF (Medical Emergency Resilience Foundation)

Parallel logistic management system but functional only at 2 locations. It mainly cover Stock forecasting, Consumption Monitoring and Expiry Management.

LHW (Lady Health Worker)

LHW/LHS is a online database for tracking worker in the field with comprehensive Information about their geographic location and visits in the field. System is capable of generating analytical dashboards and LHW monthly reports.

IHS (Integrated Health Services) Systems

Under Public Private Partnership Act 2010, a performance-based partnership agreement was signed between Department of Health Government of Sindh and Integrated Health Services in March 2015. Under this agreement 111 Health Facilities, including 105 RHCs and 06 THQs in 20 districts of Sindh, were contracted out to Integrated Health Services. Systems which are operating under IHS umbrella are listed below.

- **MLMIS (Medical Logistic Management Information System)**
  MLMIS handles stock procurement, storage, consumption and supply chain management. It is a desktop based application and currently it has been partially deployed.

- **PMS (Patient Management System)**
  Online system for patient data record. It maintains a complete history of treatment for the patient. Doctor can fill out the form with diagnosis and prescribe medication. Data is then sent to the dispenser, who issues medicines to the patient. This pilot system is currently deployed at 2 locations.

- **HFDR (Health Facility Daily Reporting)**
  Reports data on daily basis covering different aspects for example OPD numbers, surgeries, vaccinations, deaths, etc. District or Regional managers can fetch data and analyse performance of their respective facilities.

- **Health Facility Staff Attendance**
  Android application which is going to be used for medical staff attendance. Facility manager can create & manage shifts, define attendance policies, track every field worker in order to make sure health facilities are provided right on time. Currently this system is not functional at any location.

Zindagi Mehfooz

Digital immunization registry for increasing immunization coverage and timeliness. Online web interface with the support of mobile application for child/mother registration. Vaccinators can be tracked with GIS module and SMS notifications are used for reminder/alerts.

Debrief meeting

The debrief meeting followed right after presentations from different organisations involved in EPI/MNCH data collection with all the key stakeholder. UiO team gave a debrief presentation followed by an open discussion.

This Technical Brief was intended as a practical aid for people involved in discussions about integrated health services and provide recommendations for establishing unified integrated system for dashboards and reporting. It constituted :

1. Facilitate integrated data analysis for decision-makers across all health programs –at all levels
2. Up to date key indicators from all health programs available in one place with easy access to all levels of the health system
3. Bring together data from different data sources allowing for more powerful data analysis and a holistic view of the health system
    a. Service data from facilities, hospitals and community, HR data, stock data.
    b. Lab diagnostics data
    c. Population/Demographic information
    d. Disease Surveillance data
    e. Public and private sector

There was a small discussion on capability of DHIS2 being used as EMR/Patient system. In that regards DHIS2 does have potential to collect patient level data but that data is confined in the scope of one single program. In other words cross program data visibility is not provided by DHIS2. Nevertheless, both EMR and Integrated System for reporting does not contradict with each other. In fact reporting and analysis will get strengthen with availability of EMR.

At the end of the presentation we outlined a possible way forward and this will be covered in detail later in the report. Key message was to establish an integrated data repository on top of the many existing systems, extracting standards-based data from the underlying system and enabling data analysis in integrated dashboards following recommended data analysis guidance from WHO. This does not have to pose a threat or radical changes to the many existing systems, but rather try to bring data from these systems together in an integrated way.

The discussion after the presentation was quite energetic specifically with Dr Ayaz Okeli (Program Manager for Automation). He was keen to have a completely digitized Hospital Management System with all the modules (Patient Registration, Disease Surveillance, Lab Diagnostics, HR Portal, Medicine Inventory etc) apart from unified integrated reporting system.

Identified challenges

The IT environment in the healthcare domain is one of the most complicated, as a single clinic can use its own software solutions to collect, store, and analyze data. To integrate these individual applications with central data repository, enabling them to communicate with other systems in the healthcare industry, is a real challenge. Healthcare data integration services involve integrating teams, concepts, and technology to create the infrastructure capable of housing big data and using it in a meaningful way, while addressing data accessibility, ownership, and privacy.
The identified bottlenecks include:

- **Fragmented Systems**
  Fragmented and multiple overlapping and/or duplicate sub-HIS is negatively affecting the overall health services in Sindh province. Different formats, inflexible systems, differences in how data is defined/understood and procedures for the various actors involved are challenges of integrated HIS. Integration can solve some of the existing challenges of fragmentation, but it will also require negotiations and alignment of interests between the myriad of actors involved.

- **Lack of regulatory authority**
  One of the fundamental reasons of being ended up in fragmented health information systems is the lack of regulatory authority. These systems fully comply with unilateral short term requirements but due to non existence of regulatory authority these systems collect data and keep it with them instead of reporting it at regular intervals to a centralised data repository. So the data is both neither shared nor converted into information for decision making.

- **Data duplication**
  Various vertical programmes imposed their unilateral data requirements upon their staff, resulting in duplication and wastage of time and resources. Apart from that multiple systems are involved in collection of similar data in same geographic regions without any collaboration or data sharing.

- **Data incompleteness and low quality**
  Routinely collected facility-based data has known limitations. It does not capture all the cases that exist in a community. Nevertheless, it can inform precisely about the people who have visited health facilities for consultation and health services. Completeness of facility-based routine data is a big problem. Data are incomplete in several ways. A number of facilities are not sending reports at all. Some other facilities are not sending reports regularly. The facilities regularly sending reports are nevertheless not reporting data on each element every month. Moreover definitions of data elements are not clearly understood. Consequently, incorrect diagnosis, and entry of wrong fields are commonly observed problems

- **Lack of competence hub**
  Though there are many online systems currently in place, until quite recently, there was no government effort to digitize data collection in health services and this lead to the creation of different fragmented system operating within their boundaries. In addition no centralized hub could have been established with key domain/technical competencies.

- **Problem of the willingness**
  Besides the pure technical challenges of clinical data integration, there's a problem of the willingness and ability to collaborate between players, healthcare providers and patients. So data collection, storage, integration, and analysis still is a broken process.

- **Unorganized and muddled data**
  Much of the data is collected and stored in multiple places and formats. There is no standardized data capture process being followed.

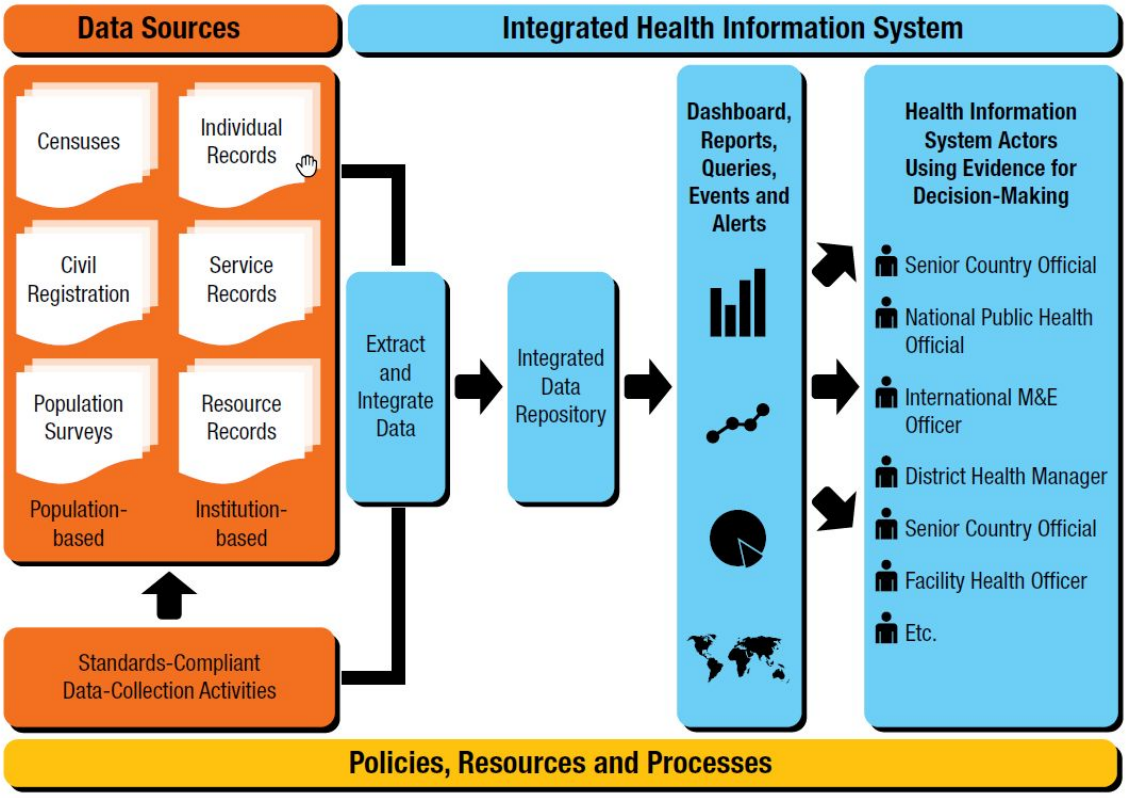
Guiding principles for HIS integration and development of integrated data analysis tools

The following section provides some key concepts and guidance to establish an integrated data analysis platform, that we believe is also highly relevant for Sindh. Although this outlines a long term process and significant work in terms of governance, awareness raising, capacity building and software development, we believe that this can be addressed in a stepwise manner with several short term benefits. The suggested next steps for Sindh follows after this more general description of the concepts and processes.

Key principles

The need for a more integrated approach to management and use of HIS data has been identified in the WHO HMN Framework. The heart of an integrated HIS architecture is a standards-based data management system that enables data to be integrated from data sources such as individual records, service records, resource records, population surveys, civil registration and census, and makes this data available for data analysis and information use across stakeholder groups and levels of the health system.

The drawing (WHO HMN Framework) below illustrates the architecture of such an integrated system with all the different data sources and sub-systems on the left, the integrated data repository in the middle, and the dashboards for data analysis serving various decision-makers on the right.



In developing such a system there is a need for an approach that takes into account 4 key processes:

1) Standardization of indicators and data collection systems across all HIS data sources
2) Advocacy and awareness-raising of the benefits of an integrated HIS
3) Long term capacity building on data management and information use
4) Development of appropriate ICT-based solutions (integrated data repository and dashboards for integrated data analysis) for an integrated HIS

To move from a silo-style system towards an integrated one there is a need to standardize and rationalize data collection systems across health programs and other data collection initiatives. The rationale behind an integrated HIS applies equally at all levels, and the integrated data repository should thus be introduced at both national and local levels, independent of what technology is selected. An integration of data management structures is also important, with one dedicated HIS group at each level supporting the data repository.

HIS integration is a politically sensitive process that might require substantive change to how organizations operate. Key stakeholders at all levels need to be aware of the benefits of integration and information sharing and be allowed to actively participate in the change process in order to allow for change. Only through long term focus on capacity building on data management and information use, and strong commitment to change across the stakeholder groups an integrated HIS can be achieved.

Information and Communication Technologies (ICTs), specifically within the are of data warehousing can make a real difference to an integrated HIS in terms of data storage, transport, processing, analysis, visualization and dissemination and be a key support function in strengthening evidence-based decision making. However, the computerized solution will only be as good as the HIS it is meant to support, and its success depends heavily on the other three processes.

A multilevel approach to high quality data repositories for decision making

Most of the key data sources of the integrated HIS are found at the lower levels of the health system, and data collection, management and use at the local level to a large extent dictate the data quality of the national-level data repository. All levels of the information chain from the health facilities up to the central level both influence the quality of the data and are also equally dependent on high quality integrated information for decision making.

An effort to develop a national data repository that neglects the local levels is highly unlikely to succeed. The health district is often the first level of the health system where most of the important data sources meet and as such forms a natural first level for an integrated data repository to operate. While the district data repositories might not be as extensive in terms of data sources, required data processing, or of applied technological tools they are still crucial to get right in order to achieve a well functioning integrated HIS a the central level, and more importantly will have a real impact on the ability to do evidence-based decision making at these levels.

Therefore the 4 key processes of data repository development listed above are equally important to apply at least down to the district level, and in terms of capacity building the community and health facility levels are crucial in terms of strengthening the first level of data collection, data quality control, and information use. Electronic transmission of data from a local data repository to the higher levels also improves timeliness and quality of reporting.

A stepwise prototyping approach to software development

Developing an ICT-based solution to support the integrated data repository and dashboards for analysis is a complicated task, and there are more examples of failures than successes. Here are some key principles that can help you in this challenging task, but the most important advice is to fully understand that this work will only succeed within a broader approach focusing on all key 4 principles listed above.

1) Quickly come up with an attractive prototype to illustrate the key benefits to the main stakeholders to get buy in for your project, a visual example can say more than a thousand words.
2) Keep in mind future expansion of the system, and adhere to global standards for future data transmission.
3) Plan for a collaborative process with participation from a wide range of stakeholders at all levels and be responsive to feedback by allowing for an iterative development process that is flexible to change. Use the prototype actively in interaction with the users.
4) Involve local IT and HIS staff in all phases of development and emphasize learning by doing
5) Let the organizational needs drive the process, the end goal is to strengthen information use at all levels and not necessarily an advanced technological solution .
6) Don't reinvent the wheel, there a many data warehousing tools available for customization and use.
7) Keep it simple and sustainable, and scale up based on available local capacity and resources.
8) Make sure your solution fits well with the context of use, both in terms of human capacity to use and maintain the integrated data repository and dashboards, and the ICT infrastructure needed to run your solution.
9) Give due emphasis to capacity development. Local knowledge about the importance of use benefits all levels through local interest in data quality. As the user maturity increase, typically data quality will improve, and more functionality will be requested.

Prioritising indicators for integrated data repository and dashboards

What data to integrate? Which systems to interoperate with? Where to start?

The data landscape of a health system is complex and is typically addressed through a range of specialised sub-systems each with limited scope and focus on specific program and health intervention needs. The range of technology solutions in place to support data collection and analysis in these sub-systems is typically broad and vary from basic paper tools on one side to advanced web-based and mobile solutions on the other. In developing the integrated data

repository and dashboards it is easy to get lost in the jungle of subsystems, and for each of them in the technical challenges of developing interoperable solutions and the organisational change needed to establish data sharing agreements.

To gain attraction and to maintain momentum for the benefits of integrated data analysis, it will be key to approach this development in a stepwise manner, and to start with high-priority information needs and gaps. Instead of starting with all systems and data points at once, rather start with some key analytical outputs e.g. some key dashboards and visualisations that address real needs, and then map where the data needed for these indicators are located across the various sub-systems. Then prioritise your interoperability development on these identified sub-systems and the data so that you can quickly populate the minimum indicators and dashboards.

In short, start with the high-level information needs and drill down towards the sub-systems and the discrete data points required to do the analysis:

1. Identify key interventions and M&E analytical outputs
2. Design mock-ups of the dashboards and visualisations needed
3. Identify indicators and their finer data elements and disaggregations needed
4. Map out which systems and their data points are needed to extract
5. Develop processes for extracting this data from the identified sub-systems

Suggested plan of action - next steps

Data integration is the key to unlocking the value of data. And, keeping in mind the massive increases of the data types, sources and velocity of data collection in healthcare industry, it is better to start data integration initiatives to assist health facilities in improving business processes, advancing care, and betterment in outcomes. There are a lot of modern technologies (Cloud, Android and new generation Databases), which are designed to integrate and securely distribute valuable data.

There are no quick-fixes to developing a sustainable integrated HIS that is actively used by decision makers at all levels, but as stated earlier we believe in addressing this in a stepwise manner and to ensure that there are short term benefits along the longer route to a truly integrated and standards-based system.

Short term plan (6 months)

Objective:develop a functioning integrated data repository and key dashboards demonstrating the strength and capabilities of integrated data analysis.

Steps

0: Infrastructure Assessment
Infrastructure assessment can help the team to find out which formats and concepts are used in the current system and to create road maps for data integration implementation. The analysis of legacy system helps to define the ways of integration of clinical document systems.

1: Define key dashboards and analytical outputs

Start by defining some high priority analytical outputs, e.g. some key dashboards for EPI and RMNCH that brings together a summary service data, logistics data and HR data that are useful for health managers to monitor the overall situation and key health interventions. Health managers and data managers from the programs and IT experts from Automation department should work sit together and agree on these dashboards and draw up some mockups.

The DHIS2 WHO Health App and related curriculum for integrated data analysis developed by WHO HQ and UiO in collaboration was presented at the debrief meeting. This work can be an important source of inspiration when selecting some key dashboards to start with. As of now, the WHO dashboards and DHIS2 modules include HIV, TB, Malaria and EPI dashboards, but future expansions to RMNCH and Nutrition is under way.

2: Identify indicators and data points needed for the selected dashboards

Working from the selected dashboard mockups, identify the indicators needed and where the necessary data is collected. For this process it will be important to involve the data managers that use the systems and the IT developers that understand the underlying database schemas and how to extract the data. It is likely that to get complete data on a particular indicator there is a need to connect to multiple systems, as different applications may be in use to collect the same service at different levels (hospitals, lower level facilities, community, public and private facilities etc.).

To make sure the extracted data from the different systems is compatible when added together it will be important to have very clear definitions of the indicators, data points/variables and the disaggregation (age, sex etc). Another metadata dimension that needs standardisation for data to be compatible is the organisational/geographical dimension. Health facilities and districts need to be clearly defined and match up across the various sub-systems before the data can be brought together. Automation department has mentioned a health facility register with standard coding scheme, but it may not be in use across all the systems yet. Establishing these standard definitions is the beginning of establishing a standard data dictionary and metadata registries for the health services in Sindh, a key building block of the integrated data repository. Again, we advise to focus on the data needed for the selected dashboards, so scope is limited, but the processes established should be forward-thinking and aim at establishing routines that can scale when additional dashboards are needed and the integrated data repository grows is scope.

3: Set up the data structures for the integrated data repository using DHIS2

We recommend setting up an instance of DHIS2 to act as the integrated repository. DHIS2 comes with the necessary functionality and has been used successfully for this purpose in many countries around the world. The metadata management features allow system administrators to build powerful metadata registries with standard definitions for indicators, data elements (variables) and disaggregated, as well as structured and coded lists of health facility and other levels of the health system, including geo-codes (coordinates and polygons).

DHIS2 comes with open and well documented Web APIs, interfaces that allow other software applications to set up automated data import and export processes using the standard metadata definitions for data variable and health facilities. In addition to import/export direct API endpoint can also be used for pulling data. Using direct API endpoint will be much faster for one specific data type.

With guidance from DHIS2 experts we believe that Automation department can quickly take ownership of DHIS2 system administrators and take the lead in this work of defining the necessary metadata in DHIS2. In addition to following online documentation and training material, we recommend that a core team of system administrators from Sindh to attend the regional DHIS2 Academies available in Asia. More information on the DHIS2 Academy can be found on dhis2.org/academy. It is recommended that the ministry early on identifies a core team of 3-5 people (can e.g. a mix of ministry staff and Automation department) to become

system administrators so that capacity building investments can be more effective. More information and recommendations on the core team approach is available in the DHIS2 implementation guide chapter 1 here:
https://docs.dhis2.org/master/en/implementer/html/ch01s03.html

The DHIS2 configuration at this point should include the following steps at this point:

- Set up the facility list and the full hierarchy of the health system with geo-coordinates
- Based on the identified data needs in step 2; set up the indicators, data elements and data element categories
- Define key user roles and access control needed both for external systems (for interoperability) and for system administrators

4: Extract data from the sub-systems and populate the integrated data repository
Based on the identified data needs and systems in previous step, extract data from the various systems on the format required by the integrated data repository (DHIS2) as configured in step 3.

Depending on the ability of each of the sub-systems and their developers, choose the appropriate mode of importing data to the DHIS2 data repository, either manually using standard import files and the import user interface in DHIS2, or automated using the Web API (also using standard templates for data imports as required by DHIS2).

DHIS2 experts can work with the local software developers at Automation department and provide guidance on the data export formats and on the use of the Web API. There is also extensive documentation, as well as training generic material freely available on these topics on dhis2.org.

5: Design dashboards on top of the integrated data repository
Once the data structures have been defined and data imported it's time to develop the dashboard outputs. DHIS2 comes with a built-in dashboard app for this purpose, but these dashboards can also be developed as an external dashboard application that connects to the DHIS2 Web API. Given the experience in Sindh, local dashboard developers need to learn how to get the data out of DHIS2 using the Analytics Web API, again this is well documented on dhis2.org, and DHIS2 developers from UiO and partner organisations can guide on its use if necessary.

After these steps a fully functional integrated data repository and dashboards demonstrating the strength and usefulness of integrated data analysis, will be established. The scope will of course be limited to a few selected dashboards and will need to be gradually developed over time, but should be sufficient to gain attraction in a relatively short time frame. The new system and capacity developed through these 6 months will be a solid foundation for further expansion.

6: LMIS interoperability

LMIS(Chemonics) is already in place and capable of exposing data through their APIs. Though the developers from Automation department need to sit with Chemonics in order to have better understanding of API structure and data format. Once a middle layer is developed for conversion of data format then it can also be pushed into DHIS2. As a result, stock data will be available in shared dashboards, displaying health service and stock data next to each other.

However there is an logistic system MLMIS developed by IHS (integration health services). This is desktop application and is partially deployed. Stock data maintained by MLMIS is shareable with other applications.

Costed plan for technical assistance to the short term plan (6 months)

The following costed plan outlines the cost of bringing in external expertise from UiO to provide training, guidance and quality assurance to the short term plan and activities described above. This plan assumes that there is available local staff that are allocated to these activities and do most of the work, with guidance from the experts/TA. The TA provided is a combination of on-site TA (approx. 3 weeks) and remote support. It is recommended that a core technical team is appointed ahead of these activities to have dedicated local IT staff managing the integrated data repository and dashboards. The TA will then train and support this team in all activities. This team is preferably a mix of staff across the following departments; Automation, DHIS, and one with collective knowledge of other system e.g MERF, IHS etc.

Activity	**Local staff needed**	**Timeline**	**TA days**	**Cost (USD)**
1: Define key dashboards and analytical outputs	Program managers, provincial decision makers and DHIS2 core team	Month 1	3	3,024
2: Identify indicators and data points needed for the selected dashboards	Data managers and system developers for the source systems identified and DHIS2 core team	Months 2-3	3	3,024
3: Configure DataSets and DataElements for the integrated data repository using DHIS2	DHIS2 core team.	Months 2-3	15	15,120
4: Extract data from the sub-systems and populate the integrated data repository	DHIS2 core team.	Months 4-5	15	15,120
5: Design dashboards on top of the integrated data repository	DHIS2 core team. Program managers for feedback.	Months 5-6	8	8,064
Total TA costs			44	44,352
Other costs			# (units)	Cost (USD)
International travel (flight, hotel, per diem)			3	12,000
DHIS2 Academy participation	DHIS2 core team.		4	14,000

Total cost				**70,352**
Daily rate	1,008			
International travel (1 week)	4,000			
Academy participation (travel and fee)	3,500			

Longer term (1-2 years)

We are not at this stage outlining a detailed plan for the long term, but outline a few key processes we recommend as possible next steps after the first 6 months.

Gradually build out the integrated data repository and dashboards

Given that the short term objective of gaining attraction among key stakeholders for the integrated approach worked, the natural next step following the first 6 months will be to gradually build out the integrated data repository and dashboards with more analytical outputs and indicators. The steps involved in doing so will be very similar to the short term steps outlined above. Again the WHO recommended dashboards that comes with pre-configured DHIS2 modules can be an source of inspiration, and even imported directly if desired.

The WHO curriculum for data analysis that comes with these dashboards is a powerful package that can help strengthen data use at all levels in the health system. As the dashboards are developed and ready for use, the next step will be to train managers at all levels in the use of dashboards and on best practices for data analysis.

Harmonisation of data collection and use of common standards across systems and programs

The short term plan does not attempt to change any of the existing systems and data collection processes, but rather suggests a less radical approach of adding a new layer “on top” of these to facilitate data integration and analysis in a structured way.

As outlined in the general guidance on building integrated data repositories the quality of the data in the HIS is determined by the data collection processes at the lowest levels of the health system. The total burden of data collection at a health facility will affect the quality of the data collected, and in order to improve quality it is crucial to look at ways to harmonise data collection across vertical programs and sub-systems.

Our rapid assessment of the situation in Sindh indicates that there is quite a bit of overlap in terms of data collection with multiple systems collecting the same data from the same sites. Hence in the longer run, a major step to improve the quality of the data in the integrated data repository would be to streamline how the data is collected across the many departments and programs.

Another important aspect of harmonising the data collection is to use common standards across subsystems that are used to collect the same services, but for different parts of the health system, e.g. public vs private or hospitals vs primary level. A process towards more standards-based data collection across the whole health system will be a key step towards improving data quality and will greatly simplify the process of integrating these multiple data sources in a common repository.

The concept outlined in the short term plan step 3 is a first step in towards establishing structured and harmonised data collection tools. The goal should be to develop master lists or registries for indicators, data elements/variables, and for health facilities with a proper coding scheme and to make these available to all system developers. DHIS2 can help with the structures and functionality to store and disseminate these standards, but this is first of all an organisational process where multiple programs that are used to work in isolation need to come together and agree on common standards and on a more streamlined way to collect data without duplication across the health system.