MINISTRY OF HEALTH & FAMILY WELFARE

META DATA AND DATA STANDARDS FOR HEALTH DOMAIN

Interim Measures: Integration & Upgrade as per MDDS

Version 1

Released: Aug, 2018

Contents

I. HMIS – MCTS Mapping for Integration

The 2011 public health IT study report done by NHSRC, had found that public IT health systems currently exist in silos and there is total lack of standards in these systems in terms of - Technology architecture, Data standards and Interoperability standards. In absence of any guidelines, every system has done their own thing leading to data silos and chaos in the public health ecosystem.

Some states are using area-wise patient based reporting systems e.g. MCTS; whereas many states are doing facility-wise aggregate data reporting through HMIS and DHIS2. Operational challenges of dealing with area-wise patient based data from some states and facility-wise aggregate data from other states – is similar to comparing red apples with green apples. Therefore the desire has emerged to integrate the consolidated MIS data from these patient based systems and feed that into aggregate reporting system like HMIS and/or DHIS2.

We have classified all the Health IT applications in two categories – Historical and Clean-Slate.

I. **Historical Applications** – The current existing healthcare IT applications in public or private sector, which are already working for years and have a huge database storage. These applications cannot be retired immediately and will continue to work for another decade or so till the clean slate applications built on MDDS standard completely take over.

   Any recommendations for such historical applications which are running for years and users are quite familiar with it, should not attempt to introduce drastic change management which will be quite disruptive and not feasible to implement too, in most of the cases.

   Need to map the application specific concepts and common data elements as per MSD. The mappings should be defined for transformation of all concepts and codes either by defining map tables in their internal databases during point-to-point integration or mapping defined in an external message broker system. Such applications can take the common meaning of all concepts used in data interoperability by reading the meta data standard definitions (MSD) for each concept from a centralized meta data registry.

II. **Clean Slate Applications** – These applications will be designed in future and should be designed to use common data elements as a subset of their database universe. The use of common data elements for interoperability will bring same syntactic and semantic meaning of different data elements (concepts) during interoperability across all these application systems. Little transformation and mapping will be required during data integration since the application by design will incorporate the common data element standard definitions. These applications can easily integrate with any other application to form a decentralized health information exchange.

Realistic View - 100% implementation of MDDS is a Utopia for Healthcare – unlikely to happen. Healthcare is not like Banking where NEFT forced all Banks to upgrade their applications, processes and HR capacity to adopt standards or be left out of the electronic banking business. In healthcare historical and clean state applications will coexist at any point of time since the existing applications cannot be retired overnight. The clean slate applications will also go through a maturation cycle to comply with MDDS standards. Though the point-to-point integration can be an ultra-short-term solution for MCTS and HMIS; but the Health Information Exchange using an Intelligent Gateway will be a preferred solution for such an imperfect world of Healthcare.

The final approach should be based on introducing an intelligent gateway to define concept and code mapping and transformations at dynamic run time for all historical applications by defining centralized meta data registries and provide an integrated messaging standard based framework for all historical and clean slate applications to form a health information exchange based on centralized patient registry, physician registry, disease registry, payment registry , meta data registry and a common Data Warehouse for integrated reporting.

The formation of such a unified Health information exchanges based on intelligent gateways is to aid the ultimate goal of Universal Health Coverage as laid down in 12th plan objectives - Where the Govt will guarantee the healthcare for every resident of the country however Govt will not be the only provider of healthcare. Therefore there is an imperative need today to integrate data from all such silo systems both within and across the systems with the following 12th Plan commitments in mind:-

- Centre would specify its minimum information requirements- for policy, planning and monitoring.
- State/District Health Systems built for local action, but feed the centre's minimum information requirements. Same for vertical programmes - allow multiple systems but enforce integration.
- Integration: Less duplication, more use: Staff shouldn't have to enter same data into different systems; information in one system should be available to all systems through central repositories/portals.
- Ensure a multi-modal connectivity to ensure fail-safe connectivity down to the PHC, SC levels.
- M-health: speed up transmission of data and reduce burden of work in reporting, improve connectivity.

A. Technical Findings

As part of this project the consulting team was given a mandate to study and propose interoperability solution for historical applications such as 2 RCH systems at the national level – MCTS and HMIS Web Portal and 1 RCH system at the state level – DHIS2. MCTS is

reporting area-wise patient-based data whereas HMIS and DHIS2 are reporting facility-wise aggregate data.

The following issues are based on the assessment of interoperability issues and needs for interoperability standards in the above said public health IT systems.

I. The current state of these applications is that they are existing in silos and there is no interoperability of data between MCTS and HMIS applications which serve as a major lacuna in providing accurate and reliable data for Health Policy decision making process. Both applications provide Reporting and Analysis capabilities (indicators and standard reports). However there is huge difference in reporting data between MCTS and HMIS applications due to semantic difference in common data elements (concepts) across different applications.

II. There is lack of Interoperability standards in different MCTS and HMIS systems due to difference in data elements (concepts), lack of standard technical interoperability framework /standards and difference in masters across the different applications.

III. MCTS applications in centre and states also have difference in database schema and semantics of data elements (concepts) so no uniform standard is followed even within the same application systems across the country.

IV. One difference to note between HMIS and MCTS applications is the difference in facility structure. The MCTS data is unable to capture the services provided by the private sector while the HMIS tries to get information from the other/private facilities (Notional Facilities in HMIS). Thus the coverage of MCTS is lower than HMIS in most of the states.

V. Currently, MCTS Reporting is not happening in urban areas in absence of primary health centres/sub centres. Therefore, urban data is completely missing in the MCTS resulting in significant under estimation of cases. HMIS on the contrary makes effort to capture information from the urban areas as well.

VI. The HMIS follows the facility-wise reporting system while the MCTS follows the area-wise reporting system. Thus, in the MCTS, women moving to another area for services will be considered and entered as those who received services and the area from which she received the service will not be noted. On the contrary, in the HMIS wherever the woman receives services, she will be counted in that facility. Thus, in case of women moving from one area to another area for receiving services there are possibilities of differences between HMIS and MCTS in a particular area. However, large scale differences in the two data system due to movement of woman may not occur at the district or state levels but possible at lower levels.

VII. The concept of periodicity is not uniform across the different state level MCTS applications and HMIS system. Some state applications treat start of Month from every first day of Month while some other states treat start of Month from 5th or 7th of every month. This gives a difference in the data analysis from MCTS and HMIS applications.

VIII. HMIS provides a manual data entry forms for reporting aggregate data however there is no validation control mechanism in the forms to ensure that data manually entered by user is correct.

IX. Based on our study of individual applications, we have noted some system design constraints in HMIS application which can need attention before the integration of

this system with other applications. When MCTS and other application data starts flowing into HMIS and it is fully loaded, the system can experience scalability and performance issues. Some of these design issues require a thorough study and need to be addressed on priority before allowing integration and loading the data from other applications:

i. The database design has to be made scalable to be able to perform with Big Data growth. The HMIS System design will need upgrade to avoid performance issues when data for all districts are loaded in system and MCTS data also starts flowing into HMIS. Currently, 300+ districts are feeding into HMIS and the system seems to be reaching its limit. HMIS data scalability design may not scale up to take data for all 600+ districts.

ii. Logical database partitioning needs to be done. Currently data for all states is loaded in single database node which is causing HMIS performance issues and will aggravate when data from other applications will flow into HMIS.

iii. HMIS will have to adopt a Data warehousing cube model for data analysis. Currently HMIS application is using flat file approach to load data into Data warehouse. Else HMIS will likely take a performance hit on Data Warehouse with data coming from many other applications.

iv. HMIS application design uses lot of temporary tables and creation of dynamic database objects during compilation of data, this is known to cause data concurrency and performance issues.

v. HMIS uses embedded data element id in the HTML form based table objects and use these ID values for generation of XML and mapping the ids with MC id for data compilation in the form itself. By design keeping data element ID in HTML tables is a major security design issue and can lead to prospective loss of critical HMIS data if SQL injection attack and XSS vulnerability issues are not resolved. Using the IDs embedded in the HTML forms for data compilation is causing portal performance issues due to heavy computational logic embedded in HMIS portal forms. For this reason, HMIS application cannot take load of all web portal users if everyone starts using the system concurrently.

vi. Instead of using commercial DW licences, some open source DW should be used to provide MIS reporting capability to all users. Currently, HMIS loads weekly data from HMIS database server and is planning to use SAS for DW based MIS reports for selected power users only. High cost of SAS tool licenses inhibits making it available to all users.

X. Some of these applications have done limited local level integration. However most of the systems lack the integration standards like HL7 and XML. Also the master data is not tuned for integration. Also each IT system has a different way of looking at the master data.

XI. Local Data Analysis – Just as in the paper based system, the analytics was not provided at every level. Only the higher levels [Centre, State & in some cases District] had the analysis capability and the facilities in the lower hierarchy were at best given some fixed report formats. The lower facilities would be informed only on need to know basis. Therefore there was no motivation in the lower hierarchy to enter data in electronic systems. Planning at district level is not established. Data

analysis is not geared to meeting needs of the Decentralised user – what's in it for them.

XII. Most of the systems are currently working as a reporting tool rather than program management information systems. Part of the problem is due to the excessive burden of unnecessary data elements and lack of program monitoring indicators in the system. Indicators and reports which are available, merely focus on data entry and reporting completeness rather than supporting program management.

XIII. Wherever the functionality to generate reports is provided, Report generation is not user friendly. Many reports can't be seen online; to view they have to be downloaded on the local disk. User can't slice, dice, drill down or drill-up. Some systems use or planning to use SAS in the back-end for data analysis. Although SAS is a very powerful analytics engine; but these systems don't come across as using the power of SAS in the back-end.

XIV. The public health data makes more sense when integrated across different programs. There is a need to facilitate exchanging of health information across systems such that the big picture can emerge e.g. Malnutrition data of a block in one system and the deaths and incidence of acute TB and related infections from another system. This Big picture of Integration is completely missing in existing applications, at present.

Almost all the existing public health programs encounter the same/similar issues and there is a lot of commonality in the learnings across the different systems.

B. Solutions

The following 3 options are recommended for data interoperability between different systems.

Option -1 Point to Point Integration

This option can be used in case of historical applications as short term tactical integration solution for integrating the heterogeneous historical applications. In this approach, application specific adaptors are defined for integration of data from one application to another using a point to point network connection without using any intermediate enterprise application integration (EAI) message broker as mediator which is fairly simple when integrating only a pair of applications however the complexity of integration grows exponentially and becomes substantially difficult to manage as integration spaghetti grows. However this is a short term approach which can be initially used for data interoperability between few critical Historical applications without need of an expensive EAI framework in place.

In this integration approach, Application specific data model for exchange is modelled using XML which is a standard canonical data model for any application. XML allows the

flexibility to define the application specific XML tags to allow exchange of data between the heterogeneous applications. The data format and transformations are specific to integrating application partner needs and need to be done programmatically in each adaptor to transform data to/from every other application data format needs. This programming work will be done by the technical implementation teams for each application integration. We recommend a loose coupled mode of data exchange using REST/SOAP webservices which is a natural fit to prove as a transport carrier to exchange data in XML formats between the application adaptors of the integrating partners.

Case Study 1 – Integration between HMIS and MCTS applications.

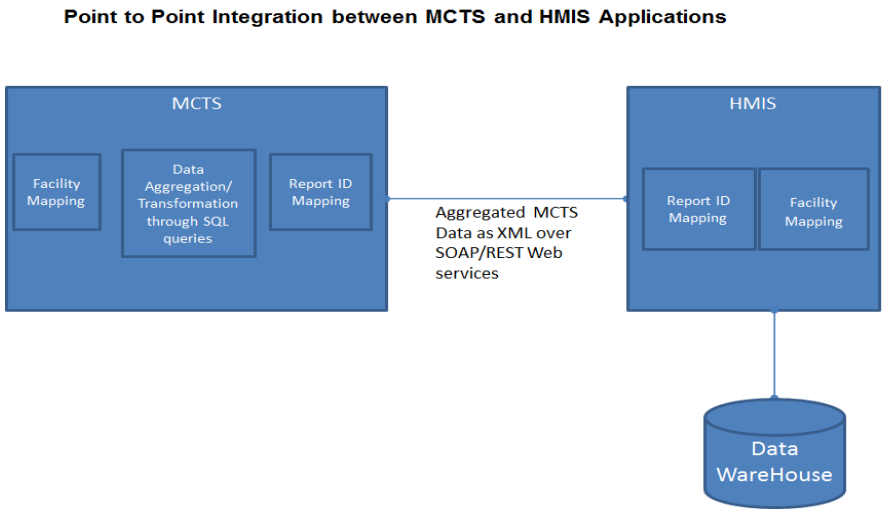

Figure 3: Schematic Presentation of Point to Point integration between MCTS and HMIS

The point to point integration option is specific to the application pairs so we are taking specific example of integrating MCTS and HMIS applications. However the same/similar concepts will be applicable for any point to point integration between other application pairs as well.

I. The point to point messaging integration requires setting up a REST or SOAP web service based integration without any broker, between two applications to allow data sharing in form of XML from source application (reporter) to target application (collector).
II. In point to point channel, each message (data as XML) can only be consumed by a single subscriber.
III. A prerequisite to data integration across different health IT systems is to maintain uniform facility master design (Facility and Facility Type code directories) across all the integrating applications (e.g. HMIS and MCTS). As part of MDDS project, we have defined master facility list design which can be downloaded as XML files from a central server or web site (DATA.GOV.IN) and the facility tables should be created

using these schema files in the internal databases of both MCTS and HMIS applications. If any application can map their existing facilities i.e. they can map the old facility tables with the new master facility list tables, then this can map all older data with new facility design. However, if this mapping between older facility tables and new facility design is not possible then the new facility design should be implemented by defining tables for new facility design in the application. This will provide new facility design mapping from the date when the new design is implemented and not for older data.

IV. The master database tables for new facility design in both MCTS and HMIS applications should be regularly synced up with data updated from master facility tables maintained on central Meta data registry server through a web service API or by downloading the data as CSV files from web site (DATA.GOV.IN) and uploading the data in database tables maintained in applications.

V. Urban and Private Facilities will be managed in master facility list by defining different facility types and these should be used in both MCTS and HMIS applications. No NOTIONAL facilities should be used to record private facility data as currently being used in HMIS.

VI. It is recommended that meaning of periodicity concept should be uniform across all MCTS and HMIS applications. The Month start date should be taken as every 1st of Month and year should be taken as financial year (Apr nnnn-1 – Mar nnnn) in all existing MCTS and HMIS applications.

VII. Since MCTS is a patient based reporting system, all the data should be aggregated before being sent to the HMIS application. The structure of XML DSD files used for data transfer will be application specific and unique for each integrating applications pair.

VIII. Aggregated Data from MCTS will be exported in xml format for corresponding HMIS Reporting Aggregated data elements. Any transformations on these xml files will be performed using XSLT files.

IX. The mode of Interoperability in point to point integration will be "PUSH MODE" where the sender application or reporter (MCTS) will push data to receiver application or collector (HMIS) by publishing the XML files containing aggregate data through Web service URL to HMIS portal or directly sending XML files to a queuing system using ODBC/JDBC. The current mapping between Historical MCTS and HMIS data elements have already been defined and provided as excel sheet (refer enclosure)

X. For several HMIS Aggregated data elements, there is no corresponding data elements captured in MCTS applications. MCTS application can extend their database schema to implement all these gaped database elements to map with all existing HMIS Report indicators on need basis. However this should be considered only if those HMIS data elements are very important for the program.

XI. The aggregation logic will be defined in SQL Stored procedures in MCTS applications to aggregate the data from various patient based concepts (database elements) in MCTS database and store the aggregated data in pre computed aggregated data tables before being sent to HMIS application.

XII. The data aggregated in MCTS application will be stored in these pre computed aggregated data tables and a unique ID value (MCTS Aggregated data element ID) will be defined in these aggregated tables for each data element aggregation type.

XIII. The ID values for the HMIS Aggregated data elements (HMIS Aggregated data element ID) for each facility type reports are pre-defined in HMIS and can be taken from facility wise HMIS Report format sheets (downloadable from HMIS site) and a transformation table will be created in MCTS application to map the MCTS Aggregated data element ID and their corresponding HMIS Aggregated data element ID.

XIV. The facility code, facility type code and periodicity values will be stored along with aggregated numbers in these precomputed tables for every report in MCTS database

XV. The transformation of aggregated data element IDs will be done in MCTS application before exchange of the data using XSL files.

XVI. The XML output generated after transformation of MCTS data will contain output data as per following meta data specification (MSD) XML format

```
<?xml version=”1.0” ?>
<Group group_id=”group id no”>
  <dataelement>
    <HMIS_dataelement>id=”HMIS_data_element_id” name=”Name of HMIS Aggregated data
element”</HMIS_dataelement>
    <MCTS_dataelement>
      id=”MCTS Aggregated data element id” value=”MCTS Aggregated data element value”
isChild=”T|F”,
      Parentdataelement=”ID of Parent HMIS Aggregated data element”
    </MCTS_dataelement>
  </dataelement>
  <FacilityCode> Unique facility Code</FacilityCode>
  <FacilityType>FacilityTypeCode</FacilityType>
  <REPORTING_PERIOD>
    <TYPE>”Monthly/Quarterly/Yearly”</TYPE>
    <FROM_VALUE>=”Start _value”</FROM_VALUE>
    <TO_VALUE>=”To Value”</TO_VALUE>
  </REPORTING_PERIOD>
</Group>
```

Example: Suppose data for HMIS Aggregated data element “Total Number of Pregnant Women Registered for ANC” and its related (or child Aggregated data element) “Of which Number Registered with in First Trimester “ indicator need to be exchanged between MCTS and HMIS

The mapping of HMIS and MCTS application historical application elements have been defined for this indicator and will be referred from MCTS-HMIS mapping sheet as follows.

HMIS Data Elements	MCTS Data Elements	Transformation Logic
Total Number of Pregnant Woman Registered for ANC	Mother or Pregnant woman ID Serial Number of ANC Visit Date of ANC Visit	Count of all Pregnant woman records (distinct MCTS ID) where serial number of ANC Visit =1 and Date of ANC Visit=’date of ANC visit’ AND reporting_peiod_type=”Monthly” AND FROM_VALUE”=”from_value” AND

		"TO_VALUE"="to_value"
Of which Number Registered with in First Trimester	Mother or Pregnant woman ID Serial Number of ANC Visit Date of ANC Visit	Count of all Pregnant woman records (distinct MCTS ID) where serial number of ANC Visit =1 and No of Months of Pregnancy not greater than 3 AND reporting_peiod_type="Monthly" AND FROM_VALUE"="from_value" AND "TO_VALUE"="to_value"

As per the transformation Logic defined in SQL stored procedure, the MCTS data for this aggregated data element will be aggregated and stored in a Data Element ID Transformation table.

MCTS Aggregated data element ID	HMIS Aggregated data element ID	Parent/Child	Reporting Period	Indicator Name
1	M1| 1.1	P	Monthy	Total Number of Pregnant Women Registered for ANC.
2	M1|1.1.1	C	Monthy	Of which Number Registered with in First Trimester

The HMIS Aggregated data element ID for a facility type report will be derived from the mapping sheets for various facility based reporting formats available from HMIS site. The corresponding MCTS Aggregated data element ID and Name will be defined by MCTS Implementation team in this mapping table. This table will be used by MCTS application to map the aggregate data for MCTS Aggregated data element with HMIS Aggregated data element ID (Header ID) and store in aggregated table inside MCTS database.

The aggregated MCTS data in Aggregate tables will be stored in MCTS database as follows

HMIS Aggregated data element ID	Facility Code	Facility Type	From_value	To_Value	Indicator Value
M1|1.1	00000000023	SC	July 2013	July 2013	100
M1|1.1.1	00000000023	SC	July 2013	July 2013	30

The aggregation of data can be done using a nightly batch job to avoid performance issues.

The aggregate data for each aggregated data element can be transformed using XSL and pass using REST/SOAP web services to the HMIS end. The URL of these web services will be published using a web server (in case of REST web services) or a web service application server (in case of SOAP web services).

The XML generated after transformation will look like this

```
<?xml version="1.0" ?>
<Group group_id=1>
<dataelement>
<HMIS_dataelement>id=" M1|1.1" name=" Total Number of Pregnant Woman Registered for ANC" Value"</HMIS_dataelement>
<MCTS_dataelement> id=1 value=100 isChild="F"</MCTS_dataelement>
</dataelement>
<dataelement>
<HMIS_dataelement>id=" M1|1.1.1" name=" Of which Number Registered with in First Trimester"</HMIS_dataelement>
<MCTS_dataelement> id=2 value=30 isChild="T"
Parentdataelement="M1|1.1"</MCTS_dataelement>
</dataelement>
<FacilityCode> 00000000023</FacilityCode>
<FacilityType>"SC"</FacilityType>
<REPORTING_PERIOD> <TYPE>"Monthly"</TYPE> <FROM_VALUE>="July 2013"</FROM_VALUE> <TO_VALUE>="July 2013"</TO_VALUE></REPORTING_PERIOD>
</Group>
```

Pros

I. This option can be used as a short term tactical approach for integration of existing few critical historical applications e.g. MCTS and HMIS applications without much disruptive changes in existing systems or waiting for an expensive infrastructure to put in place.
II. Only one eligible consumer application can receive message from a source application message channel so architecture is quite simple and easy to implement.
III. Data exchange is done using XML canonical data structures which allow the flexibility to the implementation team to define application specific data formats and data transformations to/from other application formats.
IV. The solution is not dependent on any specific EAI tool based framework so no big investment is required to implement this solution.

Cons

I. Direct channels between individual applications will lead to an explosion of the number of channels (Integration Spaghetti) leading to a web of application adaptors

to be managed as web of integration grows across the diverse applications. The arrow connection increases exponentially as number of integrating applications increase leading to complexity in management and maintenance of integration framework.

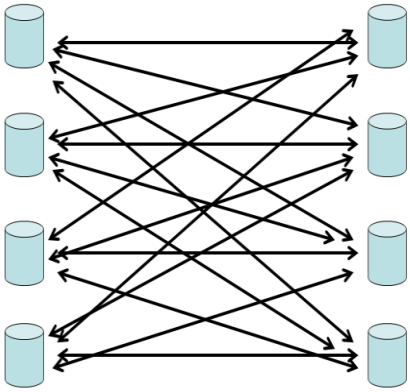

Figure 4: Integration Spaghetti

II. No uniform schema across different applications so change in application adaptors are required for each integration effort in defining application specific data structures as XML objects.

III. Mapping and transformation logic need to be programmatically defined in source applications using XSL files for each integration. Programmatic efforts are required in collector (target applications) to define message adaptors to transform and load data in their database.

IV. There is no intermediate broker in place between integrating applications which handle security , access and communication. So all these concerns have to be implemented programmatically by the technical implementation teams for each integration project with least reusable components availability, which would increase the cost of integration quite significantly.

V. Meta data based semantic interoperability using Meta data from a centralized MDR is difficult to achieve in this model as it would all be a manual effort in data transformation or mapping of application specific concepts and data elements with data standards as defined in MDDS work.

Option 2 - EAI (Broker) based Integration

Enterprise application integration is an integration framework composed of a collection of technologies and services which form a middleware to enable integration of heterogenous public health IT systems and applications.

Enterprise application integration is the process of linking such applications within a single organization or different organizations together in order to simplify and automate business processes to the greatest extent possible, while at the same time avoiding having to make sweeping changes to the existing applications or data structures. In the words of the Gartner Group, EAI is the "unrestricted sharing of data and business processes among any connected application or data sources in the enterprise.

One large challenge of EAI is that the various systems that need to be linked together often reside on different operating systems, use different database solutions and different computer languages, and in some cases are legacy systems that are no longer supported by the vendor who originally created them. In some cases, such systems are dubbed "stovepipe systems" because they consist of components that have been jammed together in a way that makes it very hard to modify them in any way. To address this problem, EAI integration framework offers several technologies and patterns based on use of a mediating EAI message integration broker which brokers between the integrating applications.

IN EAI architecture, the notion of a Message Router is central to the concept of a Message Broker. The Message broker is a software system that accept incoming messages (data as xml files) from the source application, validate them, transform them and route them to the correct destination (target application). EAI message broker system acts as the go-between or broker between multiple applications. Whenever an interesting event occurs in an application (for instance, new information is created or a new transaction completed) an integration module in the EAI system is notified. The module then propagates the changes to other relevant applications. This architecture alleviates the participating applications from having to be aware of other applications altogether because the message broker **brokers** between the applications hence reduces the network connection points between several applications.

The bus/hub in a message broker connects to applications through a set of adapters (also referred to as connectors). These are programs that know how to interact with an underlying business application. The adapter performs two-way communication, performing requests from the hub against the application, and notifying the hub when an event of interest occurs in the application (a new record inserted, a transaction completed, etc.). Adapters can be specific to an application (e. g., built against the application vendor's client libraries) or specific to a class of applications (e. g., can interact with any application through a standard communication protocol, such as SOAP, SMTP or Action Message Format (AMF)). The adapter could reside in the same process space as the bus/hub or execute in a remote location and interact with the hub/bus through industry standard protocols such as message queues, web services, or even use a proprietary protocol.

Data transformation and format translation can be managed centrally inside the broker system to avoid every adapter having to convert data to/from every other application's formats; EAI systems usually stipulate an application-independent (or common) data format. The EAI system usually provides a data transformation service as well to help convert between application-specific and common formats. This is done in two steps: the adapter converts information from the application's format to the bus's common format. Then, semantic transformations are applied on this (converting zip codes to city names, splitting/merging objects from one application into objects in the other applications, and so on).

An EAI system can participate in multiple concurrent integration operations at any given time, each type of integration being processed by a different integration module. Integration modules subscribe to events of specific types and process notifications that they receive when these events occur. Because of all these advantages in using a Message Broker for EAI , it can be considered as an interoperability solution for all existing Historical applications.

For all Historical applications, agreement would be done on data and Meta data specifications that need in data interoperability across multiple systems. Data transformation rules can be configured inside the broker using a rule engine which will help in application specific data transformations and even use of a standard data format between several integrating applications.

Since there is no registry objects maintained by a broker, all Meta data work defined in MDDS can be applied as standard data transformations by writing transformation rules for each application to map their data element/concepts with the domain specific Meta data as defined in MDDS. But this would be application specific and every integrating historical application has to conform to the standard format using data transformation logic inside broker which can prove a major performance bottleneck in future.

EAI message broker supports multiple formats in which data can be send/receive across integrating applications so it provide more flexibility in choosing a particular format in which data can be exchanged across multiple applications and no need to tie up to a particular technology (e.g. XML)

EAI Message Broker support SOA based architecture (service oriented architecture) which allows a loose coupled mediating or federated coupling across applications using web service based model.

A service directory of all published web services can be maintained by broker which alleviate the need of maintaining a rigid affinity list across the integrating applications (as happen in point to point integration option where hard coded connection URLs need at design time for application connectivity). In Broker based approach, application can discover the web services dynamically and use the URL invocation points based on message routing logic to integrate data with a specific application in a given data format based on message routing.

Message broker in a centralized Hub and Spoke model can receive messages from multiple destinations, determine the correct destination and route the message to the correct channel.

The Message broker achieves integration amongst diverse set of applications built on varying platforms through compliance with Interoperability Interface Protocol and Interoperability Interface Specifications (IIP/IIS) that are based on open standards such as the W3C XML and SOAP specifications.

Message broker provides both asynchronous and asynchronous mode of message transmission across the applications.

Message broker softwares are available both as proprietary EAI framework (e.g. NSDG) or open source brokers e.g. Active MSMQ or OpenESB with talend as ETL.

We recommend open source based message broker tools to be used for data integration in public health IT systems because of.

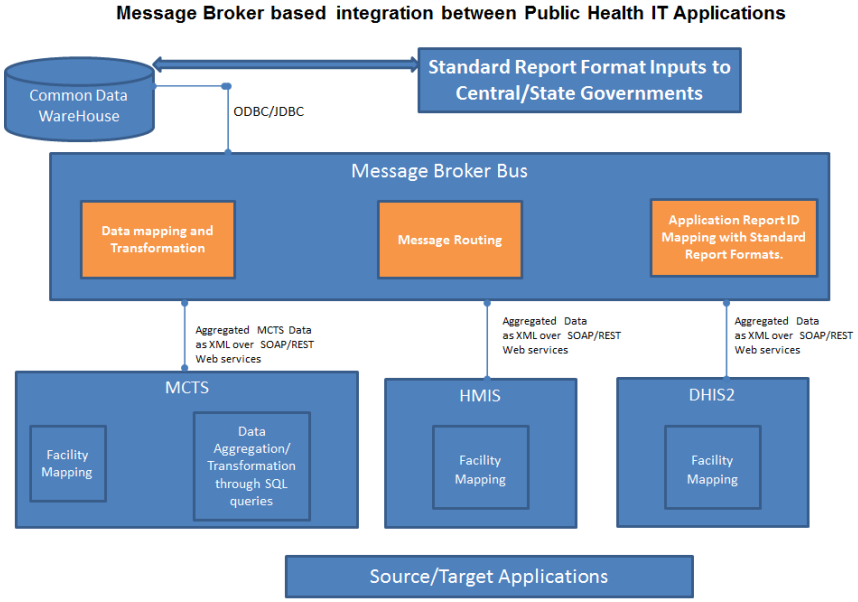

Figure 5: Schematic representation of broker based integration option

Pros

I. Message gateway service bus provide both asynchronous and synchronous mode of message transmission between different applications.
II. Message broker can be used to receive messages from different applications, transform and route the message based on recipient applications and send the message to recipient application (Hub and spoke architecture.)
III. Message broker middleware allows the centralized definition of all application specific data mapping/transformation rules based on message routing inside the broker rather than customizing the application adaptors for the same. The minimises the programming burden from the Integration implementation teams for the applications group.
IV. Broker provides different adaptors to send/receive data to/from applications and data can be exchanged in multiple formats (SOAP XML, SQL, CSV files etc.) rather than just XML.
V. Broker handles all cross cutting concerns e.g. security, access, and communication and applications don't need to implement these concerns at their ends.

VI. Broker allows to use SOA based architecture (service oriented architecture) which helps in reducing the connection points across the multiple applications and hence lesser complexity as Integration spaghetti grows.

VII. Broker EAI system acts as the go-between or broker between multiple applications. Whenever an interesting event occurs in an application (for instance, new information is created or a new transaction completed) an integration module in the EAI system is notified. The module then propagates the changes to other relevant applications.

VIII. We can use constellation of broker EAI components to create a unified integration of several integration constellations. This will help in creating unified data ware house from data collected from different applications mediated across the constellation of brokers.

IX. Brokers allow dynamic discovery of webservice endpoints by maintaining a service directory (registry) of web services which allow any application to talk to any other application deciding message routing dynamically.

X. Data from finite set of disperate applications can be integrated as a common data warehouse to provide standard report inputs to central/state governments.

Cons

I. Since there are no registry objects inside a broker, the data discovery and transformations have to be defined during implementation time and not dynamically at run time and there is no way to discover data location based on a service request (where patient data reside based on a request) Thus unified view of patient healthcare data cannot be realized in broker based architectural approach without bringing undue complexities in a broker architecture.

II. MDDS standard metadata concepts cannot be linked (data linking) dynamically using a centralized MDR) (Meta data registry). At best, either all applications need to map their application specific data elements and concepts with MDDS meta data during design time by downloading meta data structures from MDR and all concept and data element mapping can only be done by defining static data transformation rules in Broker Rule engine. That is why Broker based approach is not favoured for Clean slate applications and historical applications as coexisting and is appropriate as short or medium term approach for data integration of Historical applications only.

III. Constellation of broker Gateways to integrate different applications will lead to a highly complex architecture which is difficult to manage and maintain.

IV. Broker based integration architecture is complex and need specialization to manage it.

V. Heavy Mapping/transformation logic if defined inside broker for all applications will lead to major performance issues during data integration hence it is hard to avoid local application specific changes even using brokers.

VI. No provision of integrating different state and district level applications and state level Data Warehouses to generate a unified national common data ware house in simple broker architecture. Constellation of brokers can do it in limited way but without unmanageable program complexities and higher cost of implementation.

VII. Integration possible only among applications supported by a message broker or part of message broker constellations. No provision to register and discover the

application recipients from one broker system to another to form a unified health information exchange as there are no registry objects inside brokers. At best these brokers can be described as DUMB brokers with no brains of their own. To achieve UNIFORM HEALTHCARE GOAL, we need an intelligent broker which is Option 3.

VIII. Architecture does not support implementation of a centralized meta data registry to enforce semantic interoperability among applications within or outside domains.

Option 3 – Health Information exchange using an intelligent gateway

This option is recommended for all Clean Slate Applications as well existing historical applications to coexist to form a unified health information exchange based on decentralized data model.

Ultimately all Public and Private Health IT systems have to converge to a Health Information Exchange to realize the objective of patient's UNIVERSAL HEALTHCARE goal as laid down in 12th Plan.

This model address standards for data and meta data based on MDDS work to ensure semantic interoperability across all applications, data storage, data privacy and security, data integration, data retrieval, data analysis and information usage.

This model envisages the creation of local, regional and state health information exchanges [HIE] that feed the national health information network [NHIN]. A centralised health information exchange [HIE] has to emerge for every state that will be used for exchanging health information. All the Public and Private Health IT applications for that state will be integrated with the HIE exchange on decentralized model with their data repositories still maintained within application data centres/premises and applications exchanging their data using constellation of intelligent gateways and centralized registries.

The HIE will have a data warehouse to analyse the consolidated public health data. We should adopt a federated structure where the data is pulled on-demand; whereas we should stay away from central data repository model because it becomes unwieldy and too expensive over time. The HIE pulls up only that data that is required for consolidated data analysis or health record portability. The patient registry will have entries for the diseases being tracked and will also cater to population migrations where the portability of patient-based health record is important.

The HIE will support the centralized Meta data registry and register the standard Meta data specifications for all Health domain concepts. The data from Different integrating applications will be transformed to these standard concepts based on Meta data Registry lookups inside the intelligent gateways before passing the data to the requesting application.

Why Gateway is called Intelligent gateway here? Because the gateway will have the built in logic to discover the data provider applications which will provide the requested data based on the request generated from a requested application or a person. There will be no point to point integration between different applications. The patient health records will be discovered in different healthcare IT applications using meta data registered in centralized patient ,provider, physician and disease registries and the data will be served by the provider applications based on the request generated by the requesting entity. The gateway will be able to locate the records from different application repositories, apply dynamic transformations/code and concept translations or any data aggregation logic based on the rules configured in the rule engine component of the Intelligent Gateway.

The HIE model will specify data analytics framework so that it can become flexible and capable of catering to local, District, State and National analysis and reporting requirements. This includes:

a. National Data Warehouse – Define a National level data warehouse in the NHIN to analyse the consolidated data and produce indicator based reports from source systems.
b. Local Data Analytics -Define a local data mart in every State HIE. The exchange should provide online analytical processing [OLAP] for the users at all levels to generate their own reports needed to take local action. The users should be able to save the report format and define the frequency at which the reports should be populated with data and sent to them. This will significantly enhance acceptability, usability and adoption.

The HIE will provide the flexibility to allows inputs in consolidated [District-wise or facility-wise] as well as granular [patient-based] models. Based on readiness, allow the States to decide mode of data entry – consolidated, facility-wise or patient-based; as long as the published architecture and standards for vocabulary, data, input/output, storage, integration, hardware and network are followed. Patient-based tracking should not become a pre-requisite for any public health IT system. In the absence of patient-based EMR, the public health IT system should be able to work on consolidated numbers alone.

The HIE model envisages all public health IT systems to follow integration based on known standards such as *HL7, DICOM, XML* etc. Point-to-point integration is a short term approach. Ultimately all Public Health IT systems have to converge to a Health Information Exchange.

Field workers at District/CHC/PHC shouldn't be burdened to report on multiple systems. Multiple Disease specific applications are neither economical nor a good software design. Rather the Public Health IT product should follow the standard architecture [blue-print] and have a flexible design such that it can be applied to any disease and region specific reporting. The system should have flexibility to define its own aggregated data elements, forms, workflow, reporting frequency and report formats. That way it is easy to integrate the different implementations of the same architecture and aggregate the data at any level for

analysis. Also it takes off the load from the field staff, as they have to report in one system. This will go a long way in improving the adoption of Health IT systems.

Registries: - The heart of the HIE is a registry based model that has disease, facility and patient registries up to the district and state level. The registry will have metadata that points to the details in the source systems. The indicators derived from the state disease registries should be rolled up to the central disease registry for reporting. However drill down should be available to get granular data on demand.

Unique Identifiers - Patient, healthcare staff and health facility needs to be uniquely identified. System will generate a unique ID based on other IDs such as - Adhaar [UIDAI], Voter ID, Ration card ID, PAN# that can be used as a patient identifier for the patient registry.

Figure 6: Conceptual Architecture depicting the State Health Information Exchange [HIE] where all the different public health IT systems, patient based reporting systems and other related systems get integrated.

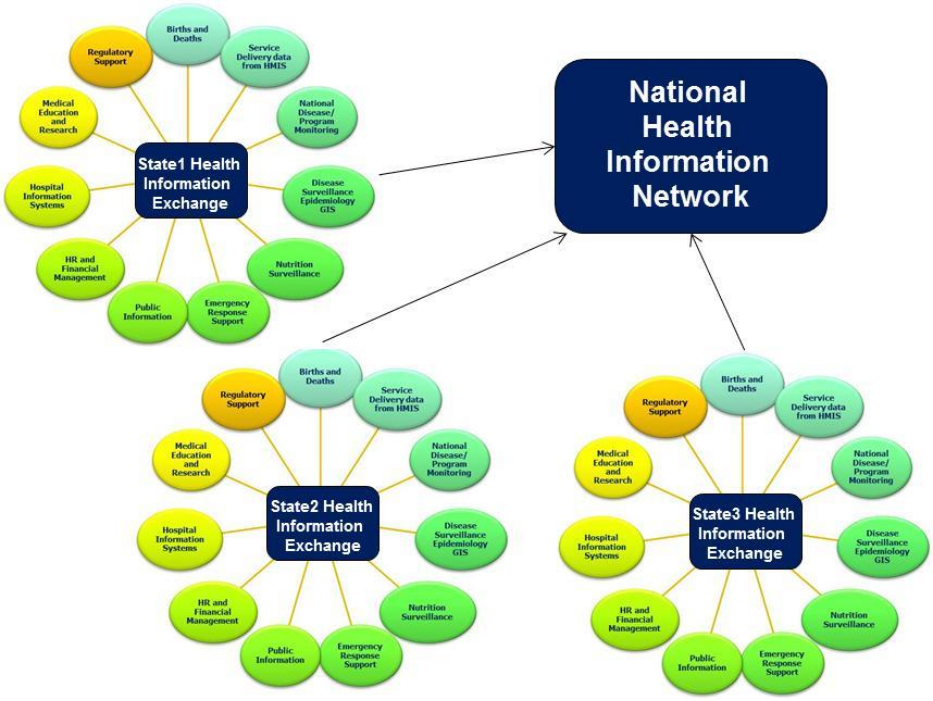

Figure 7: Conceptual Architecture of the National Health Information Network [NHIN] that is essentially an HIE too at the National level. HIE should be built at every State level and then aggregated into the NHIN at the National level.

Pros

I. Historical applications can never be done away due to their current high usage , substantially large database , user adoption and heavy investments done in developing these applications,. Using this model all existing Historical and Clean state applications can be integrated to form a unified health information exchange based on a federated data model without any disruption or application design changes in existing historical applications.

II. No application level changes are required to bring the standard concepts based on MDDS metadata standards in existing Historical applications. This will be a driving force as otherwise substantially huge investment would be required in modifying the existing Historical applications to adopt the Meta data and data standards or the project of data standardization will not see success.

III. The semantic interoperability in different applications can be ensured using a centralized metadata register using HIE based intelligent gateways having functions to register, discover, transform, notify, query and retrieve concepts and their meta data from centralized meta data registry.

IV. Registries in HIE provide the patient and patient data discovery and service of data on request basis. Thus unified patient records can be accessed from inside diverse Healthcare IT applications from anywhere, anytime with the intelligence of data discovery and data service based on registry Meta data built up in intelligent gateway in HIE. Applications don't need any design changes to implement these features.

V. The proposed HIE will be based on federated data architecture with application database repositories maintained with application providers and the meta data registered in centralized registries which will help to locate patient records across the applications within same HIE or different HIE. This model has already been implemented with success in Canada Infoway.

VI. The heart of the HIE is a registry based model that has disease, facility and patient registries upto the district and state level. The registry will have metadata that points to the details in the source systems. The indicators derived from the state disease registries should be rolled up to the central disease registry for reporting. However drill down should be available to get granular data on demand.

VII. State and national level integrated data ware house with integrated reporting system is quite possible using data shared from different applications across the HIE network.

VIII. Integration with other domain applications is quite easy.

Cons

I. Lack of awareness in India towards the need of a HIE which is apprehended by many as a complex thing to achieve which is just a negative perception and need to be corrected by proper education of this model.

II. DHIS- IHRIS Integration

A. Technical Findings

I. DHIS is an aggregate reporting system whereas IHRIS is a person based system having individual employee records.

II. Facility master structure is not uniform across DHIS and IHRIS applications.

III. iHRIS software maintans the following linkage person -> person_position -> position -> facility which may need to be customized as per Indian HR requirements.

B. Solutions

I. A uniform master facility list design should be implemented in both DHIS and iHRIS applications as a pre-requisite of data interoperability between these two applications.

II. For Facility master table design sync up, either the facility master data should be mapped with existing facilities in DHIS and iHRIS (if that is feasible) or new Facility master tables should be created inside the database of these two applications. In latter case, old historical data before the new facility design was implemented in both applications will not be available for interoperability using the same approach as described here (as we cannot compare apples with oranges).

III. SDMX-HD based statistical data exchange is recommended between DHIS and iHRIS applications.

IV. The reference architecture for DHIS-iHRIS interoperability in India can be taken from Zanzibar implementation work. Source code for SDMX-HD framework for DHIS-iHRIS integration in India can be downloaded from the link – https://code.launchpad.net/~his-interop/his-transform-tools/trunk

V. Here we are proposing the DHIS2-iHRIS interoperability solution based on our understanding of DHIS2, iHRIS, SDMX-HD and Zanzibar implementation work.

VI. In the source code directory, there will be four main directories created. There is a script runme.php" which processes these four directories according to the following logic.

- **Inputs**: this contains a series of linking the Data files which are the data lists. As an intermediary step, runme.php produces a file lists.xml which converts the .csv into a simple xml file for further XSLT processing.
- **Transforms**: The files here are used to generate the DSD, the xsd's and what other xml based files needed by the various systems.
- **transforms_dsd**. This directory contains the XSL which will operate directly on the DSD.
- **Outputs** -- this is where are the results are. (Everything under here is bzr ignored)

VII. CSV was chosen as it is easy to manipulate the links between the facilities in the various systems by non-programmers

VIII. **Linking the Data:** Data lists are linked between the various systems by the .csv files in the inputs directory. For example in inputs/facility.csv you have the columns:

- dhisid: the id used in DHIS for the facility
- dhisname: the name used by dhis for the facility

- ihrisname: the name used by iHRIS for the facility
- ihrisid: the id used by iHRIS for the facility
- sdmxhdid: the id used for sdmx-hd id. For now it is simply the DHIS id.
- comments: a place to keep track of the data linking process. for example indicate where you are not sure if the linkage is correct. we also indicate here that there are facilities in iHRIS which are not in DHIS -- this may be OK: for example the MOH Headquarters would not have any service data.

IX. Lists.xml

As an intermediary step, runme.php converts the .csv files into one large .xml file for processing. It has the structure:

```
<Lists version='1.0' day='22' month='05' year='1977' timestampUnix='233166000' timestampMysql='blahblah'>
 <List name='facility'>
   <row>
    <field column="sdmxhdid">14</field>
    <field column="ihrisid">cadre|14</field>
    <field column="ihrisname">ACCOUNTING</field>
   </row>
  <row>
    <field column="sdmxhdid">14</field>
    <field column="ihrisid">cadre|14</field>
    <field column="ihrisname">ACCOUNTING</field>
   </row>
   <!-- blah blah blah -->
 </List>
 <List name='job'>
    <!-- blah blah blah -->
 </List>
 <!-- blah blah blahbity blah -->
</Lists>
```

Here:

- The version attribute of Lists is hard-coded into ./runme.php
- The rest of the attributes are based on the time that ./runme.php is run (in iHRIS and the DSD we all of these attributes to version the modules)
- The name attribute used in the List element is produced by lopping off .csv from inputs/facility.csv
- The column attribute are simply the header columns in the respective .csv files

X. **The DSD:** This is generated from #lists.xml via the file:

- transforms/DSD/DSD.xml.xsl
- The only thing that really needs to be done here is to change the KeyFamily. If we can better named KeyFamilies we can standardize them across all implementations.

XI. **Schema :** The DSD will define a KeyFamily. The validator for exports via CrossSectionalDataSets is produced via:

transforms/schemas/KF_135.xsd.xsl

The name of this file and its internals will need to be adjusted for future implementations to reflect the new Key Family name, until we have named Key Families.

XII. iHRIS

All the transforms and setup files are maintained in transforms/iHRIS. There are three things to be done:

- Make the SDMX-HD codelists available as lists in iHRIS
- Link existing list members in iHRIS to the SDMX-HD code lists
- Produce the export report.

Make the SDMX-HD Code Lists Available

This is handled by creating a form for each of the code lists which maps iHRIS ids to SDMX-HD ids via the lists.xml file.

/transforms/iHRIS/iHRIS_IND_CodeList/SDMX-HD/DSD.xml.xsl

/transforms/iHRIS/iHRIS_IND_CodeList/iHRIS_CodeList.xml.xsl

Note, the former is simply a link to DSD.xml.xsl above so that it can be reproduced in the outputs for iHRIS.

Linking the Code Lists

The linkages for the codelists are handled by the files;

transforms/iHRIS/CodeListLink_Cadre/CodeListLink_Cadre.xml.xsl
transforms/iHRIS/CodeListLink_Facility/CodeListLink_Facility.xml.xsl
transforms/iHRIS/CodeListLink_Job/CodeListLink_Job.xml.xsl
transforms/iHRIS/CodeListLink_Gender/CodeListLink_Gender.xml.xsl
transforms/iHRIS/CodeListLink_District/CodeListLink_District.xml.xsl

Producing the Reports

No transform needs to be processed here and the file:

transforms/iHRIS/IND_SDMXHD_Reports/SDMX_Reports.xml

is simply copied over by runme.pho to the outputs directory. It contains the needed definitions for the relationship, report and report view. Note there is an .xsl inside of the report which produces the CrossSectionalDataSet based on the iHRIS Data.

Normally the linkage between people and facilities in iHRIS is like this

person -> person_position -> position -> facility

However any customization specific to indian requirements can be made in this linkage, if needed.

Finishing Up

Copy the files under outputs/iHRIS into the modules directory of your site. Then add something like the following to your site configuration .xml file:

```
<requirement name="sdmxhd-reports">
  <atLeast version="1.0"/>
 </requirement>
 <requirement name="IND-codelists">
  <atLeast version="1.0"/>
 </requirement>
 <requirement name="IND-sdmx-hd-cl-link-cadre">
  <atLeast version="1.0"/>
 </requirement>
 <requirement name="IND-sdmx-hd-cl-link-district">
  <atLeast version="1.0"/>
 </requirement>
 <requirement name="IND-sdmx-hd-cl-link-facility">
  <atLeast version="1.0"/>
 </requirement>
 <requirement name="IND-sdmx-hd-cl-link-gender">
  <atLeast version="1.0"/>
 </requirement>
 <requirement name="IND-sdmx-hd-cl-link-job">
  <atLeast version="1.0"/>
 </requirement>
```

III. HMIS to MDDS Mapping for Upgrade (examples)

SNo	HMIS Data Element	Roll Up from CDE to HMIS	Code Range (ICD/SNOMED)
1	Number of Home Deliveries attended by SBA Trained (Doctor/Nurse/ANM)	Code System Qualifier = SNOMED	
2	Number of Male Live Births	Code System Qualifier = ICD-10 Health condition Type = Chapter-21 , Persons encountering health services in circumstances related to reproduction, Health condition Code = Z37.0, Health condition name= single live birth Person gender = male	Z37.0
3	Number of Female Live Births	Code System Qualifier = ICD-10 Health condition Type = Chapter-21 , Persons encountering health services in circumstances related to reproduction, Health condition Code = Z37.0, Health condition name= single live birth Person gender = female	Z37.0
4	Number of MTP Conducted at Public Institutions Up to 12 weeks of pregnancy	Code System Qualifier = SNOMED	
5	Number of new RTI/STI for which treatment initiated for Male	Code System Qualifier = ICD-10 Health condition Type = Chapter-14 , Diseases of Male genital organs/ Chapter-1, Infections with predominantly sexual mode of transmission, Health condition code = N41 Health condition name = Inflammatory diseases of prostate Person gender = male	N41, N45, N48.1, N48.2, N49, A50-A64

IV. IDSP to MDDS Mapping

IDSP Data Element	Roll Up from CDE to IDSP	ICD-10 Code Range
Malaria	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** - Malaria **Heath Condition Category** - Presumptive (P) **Health Condition Code** - B54 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** - B50-B53	**(B50-B54)** Plasmodium falciparum malaria (B50) Plasmodium vivax malaria (B51) Plasmodium malariae malaria (B52) Other parasitologically confirmed malaria (B53) Unspecified malaria (B54)
Dengue	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** - Dengue **Heath Condition Category** - Presumptive (P) **Health Condition Code** - A92.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** - A90-A91	**(A90-A92)** Dengue fever [classical dengue] (A90) Dengue hemorrhagic fever (A91) Other mosquito-borne viral fevers (A92.9)
Viral Hepatitis	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** - Viral Hepatitis **Heath Condition Category** - Presumptive (P) **Health Condition Code** - B19 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** - B15-B18	**(B15-B19)** Acute hepatitis A (B15) Acute hepatitis B (B16) Other acute viral hepatitis (B17) Chronic viral hepatitis (B18) Unspecified viral hepatitis (B19)

Acute Diarrheal Disease	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** - Acute Diarrheal Disease **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A09 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A00-A08	**(A00 - A09)** Cholera (A00) Other bacterial intestinal infections (A04) Other bacterial foodborne intoxications, not elsewhere classified (A05) Amoebiasis (A06) Other protozoal intestinal diseases (A07) Viral and other specified intestinal infections (A08) Other gastroenteritis and colitis of infectious and unspecified origin (A09)
Bacillary Dysentery	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** - Bacillary Dysentery **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A03.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A03.0	**(A03.0, A03.9)** Shigellosis due to Shigella dysenteriae (A03.0) Shigellosis, unspecified (A03.9)
Enteric Fever	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Enteric Fever **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A01.4 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A01.0	**(A01.0, A01.4)** Typhoid fever (A01.0) Paratyphoid fever, unspecified (A01.4)

Chikungunya	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name –** Chikungunya **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A92.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A92.0	**(A92.0, A92.9)** Chikungunya virus disease/ Chikungunya (hemorrhagic) fever (A92.0) Mosquito-borne viral fever, unspecified (A92.9)
Acute Encephalitis Syndrome	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases ; Chapter 2, Diseases of the nervous system **Health Condition Name** – Acute Encephalitis Syndrome **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A86 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A83-A85, G04, G05	**(A83-A86, G04-G05)** Japanese encephalitis (A83.0) Tick-borne viral encephalitis (A84) Other viral encephalitis, not elsewhere classified (A85) Unspecified viral encephalitis (A86) Encephalitis, myelitis and encephalomyelitis in diseases classified elsewhere (G05) Encephalitis, myelitis and encephalomyelitis (G04)
Meningitis	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases ; Chapter 2, Diseases of the nervous system **Health Condition Name –** Meningitis **Heath Condition Category** - Presumptive (P) **Health Condition Code** – G03 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – G00, G02, A87	**(A87, G00-G03)** Viral meningitis (A87) Bacterial meningitis, not elsewhere classified (G00) Meningitis in other infectious and parasitic diseases classified elsewhere (G02) Meningitis due to unspecified causes (G03)

Measles	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Measles **Heath Condition Category** - Presumptive (P) **Health Condition Code** – B05 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – B06	**(B05-B06)** Measles (B05) Rubella [German measles] (B06)
Diphtheria	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Diphtheria **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A36.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A36.0 – A36.8	**(A36.0 – A36.9)** Pharyngeal diphtheria (A36.0) Nasopharyngeal diphtheria (A36.1) Laryngeal diphtheria (A36.2) Cutaneous diphtheria (A36.3) Other diphtheria (A36.8) Diphtheria, unspecified (A36.9)
Pertussis	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Pertussis **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A37.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A37.0 – A37.8	**(A37.0 – A37.9)** Whooping cough due to Bordetella pertussis (A37.0) Whooping cough due to Bordetella parapertussis (A37.1) Whooping cough due to other Bordetella species (A37.8) Whooping cough, unspecified (A37.9)
Chickenpox	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Chickenpox **Heath Condition Category** - Presumptive (P) **Health Condition Code** – B01 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – B01.9	**(B01 – B01.9)** Varicella [chickenpox] (B01) Chickenpox, unspecified (B01.9)

Fever of Unknown Origin (FUO)	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 18, Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified **Health Condition Name** – Fever of Unknown Origin (FUO) **Heath Condition Category** - Presumptive (P) **Health Condition Code** – R50	**R50** Fever of other and unknown origin (R50)
Acute Respiratory Infection (ARI)/Influenza Like Illness	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 10, Diseases of the respiratory system **Health Condition Name** – Acute Respiratory Infection (ARI)/Influenza Like Illness **Heath Condition Category** - Presumptive (P) **Health Condition Code** – J06 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – J09-J11	**(J06, J09 – J11)** Acute upper respiratory infections of multiple and unspecified sites (J06) Influenza due to certain identified influenza virus (J09) Influenza due to other identified influenza virus (J10) Influenza, virus not identified (J11)
Pneumonia	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 10, Diseases of the respiratory system **Health Condition Name** – Pneumonia **Heath Condition Category** - Presumptive (P) **Health Condition Code** – J18 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – J13-J15	**(J13 – J15, J18)** Pneumonia due to Streptococcus pneumoniae (J13) Pneumonia due to Haemophilus influenzae (J14) Bacterial pneumonia, not elsewhere classified (J15) Pneumonia, organism unspecified (J18)
Leptospirosis	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Leptospirosis **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A27.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A27.0 – A27.8	**(A27.0 – A27.9)** Leptospirosis icterohaemorrhagica (A27.0) Other forms of leptospirosis (A27.8) Leptospirosis, unspecified (A27.9)

Acute Flaccid Paralysis	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases **Health Condition Name** – Acute Flaccid Paralysis **Heath Condition Category** - Presumptive (P) **Health Condition Code** – A80.9 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A80.0 – A80.4	**(A80.0 – A80.9)** Acute paralytic poliomyelitis, vaccine-associated (A80.0) Acute paralytic poliomyelitis, wild virus, imported (A80.1) Acute paralytic poliomyelitis, wild virus, indigenous (A80.2) Acute paralytic poliomyelitis, other and unspecified (A80.3) Acute nonparalytic poliomyelitis (A80.4) Acute poliomyelitis, unspecified (A80.9)
Dog Bite	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 1, Certain infectious and parasitic diseases; Chapter 20, External causes of morbidity and mortality **Health Condition Name** – Dog Bite **Heath Condition Category** - Presumptive (P) **Health Condition Code** – W54 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – A82	**(A82, W54)** Rabies (A82) Bitten or struck by dog (W54)
Snake Bite	**Code System Qualifier** - WHO ICD-10 **Health Condition Type** - Chapter 20, External causes of morbidity and mortality **Health Condition Name** – Snake Bite **Heath Condition Category** - Presumptive (P) **Health Condition Code** – W59 **Heath Condition Category** - Lab Confirmed (L) /Clinically Confirmed (C) **Health Condition Code** – X20	**(W59, X20)** Contact with venomous snakes and lizards (X20) Bitten or crushed with non-venomous snakes or lizards (W59)

V. RNTCP to MDDS Mapping

RNTCP Data Element	RNTCP Data Element Instances	CDE	ICD-10 Code Range
Pulmonary Tuberculosis	Pulmonary Tuberculosis - Presumptive Values: A16	Code System Qualifier = WHO ICD-10 Health Condition Type - Chapter 1, Certain infectious and parasitic diseases Health Condition Name - Pulmonary Tuberculosis Heath Condition Category - Presumptive (P) Health Condition Code - A16	**(A15-A16)** Respiratory tuberculosis, bacteriologically and histologically confirmed A15 Respiratory tuberculosis, not confirmed bacteriologically or histologically A16
	Pulmonary Tuberculosis - Lab Confirmed Values: A15	Code System Qualifier = WHO ICD-10 Health Condition Type - Chapter 1, Certain infectious and parasitic diseases Health Condition Name - Pulmonary Tuberculosis Heath Condition Category - Lab Confirmed (L) /Clinically Confirmed (C) Health Condition Code - A15	
Extrapulmonary Tuberculosis	Extrapulmonary Tuberculosis - Presumptive Values: A18	Code System Qualifier = WHO ICD-10 Health Condition Type - Chapter 1, Certain infectious and parasitic diseases Health Condition Name - Extrapulmonary Tuberculosis Heath Condition Category - Presumptive (P) Health Condition Code - A18	**(A17, A19, B90, O98.0, P37.0)** Tuberculosis of nervous system A17 Tuberculosis of other organs A18 Miliary tuberculosis A19 Sequelae of tuberculosis B90 Congenital tuberculosis P37.0
	Extrapulmonary Tuberculosis - Lab Confirmed Values: A17, A19, B90, P37.0	Code System Qualifier = WHO ICD-10 Health Condition Type - Chapter 1, Certain infectious and parasitic diseases; Chapter 16 Certain conditions originating in the perinatal period Health Condition Name - Extrapulmonary Tuberculosis Heath Condition Category - Lab Confirmed (L) /Clinically Confirmed (C) Health Condition Code - A17, A19, B90, P37.0	

Annexure I HMIS-MCTS Data Element Mapping

S.No.	HMIS Element	Central MCTS Element(s)	Transformation Logic from MCTS to HMIS	Mapping Logic
1	Total Number of Pregnant Woman Registered for ANC	Mother or Pregnant woman ID Serial Number of ANC Visit Date of ANC Visit	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where serial number of ANC Visit =1 and Date of ANC Visit lies within reporting period.	A
2	Of which Number registered within first trimester	Mother or Pregnant woman ID Serial Number of ANC Visit Date of ANC Visit No of Months of Pregnancy	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where serial number of ANC Visit =1 and No of Months of Pregnancy not greater than 3 and Date of ANC Visit lies within reporting period.	A
3	New Woman Registered under JSY	Mother or Pregnant woman ID Serial Number of ANC Visit Date of ANC Visit JSY Beneficiary	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where serial number of ANC Visit =1 and JSY Beneficiary='Y' and Date of ANC Visit lies within reporting period.	A
4	Number of pregnant women received 3 ANC check ups	Mother or Pregnant woman ID Serial Number of ANC Visit Date of ANC Visit	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where serial number of ANC Visit =3 and Date of ANC Visit lies within reporting period. T	A
5	Number of pregnant women given TT1	Mother or Pregnant woman ID TT Dose number Date of TT Dose	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where TT Dose Number=1 and Date of TT Dose lies within reporting period.	A
6	Number of pregnant women given TT2 or Booster	Mother or Pregnant woman ID TT Dose number Date of TT Dose	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where TT Dose Number IN (2, 'B') and	A

			Date of TT Dose lies within reporting period.	
7	Number of pregnant women given TT2	Mother or Pregnant woman ID TT Dose number Date of TT Dose	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where TT Dose Number=2 and Date of TT Dose lies within reporting period.	A
8	Number of pregnant women given booster	Mother or Pregnant woman ID TT Dose number Date of TT Dose	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where TT Dose Number='B' and Date of TT Dose lies within reporting period.	A
9	Total number of pregnant women given 100 IFA tablets	Mother or Pregnant woman ID NO OF IFA TABS GIVEN(AFTER 12 WEEKS OF PREGNANCY Date of IFA Tabs given	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where NO of IFA TABS GIVEN>=100 AND Date of IFA Tabs given lies in reporting period.	A
10	New cases of Pregnant Hypertension (BP>140/90) detected at Institution			R
11	Number of Pregnant Woman having Hb level<11 g/dl (tested cases)	Mother or Pregnant woman ID Hb value Date of ANC Visit	Transformation rule - Count of all Pregnant woman records (distinct MCTS ID) where Hb value IN ('Moderate<11',' Severe<7') AND Date of ANC Visit lies in reporting period.	A
12	Number of Home Deliveries attended by SBA Trained (Doctor/Nurse/ANM)			R
13	Number of Home Deliveries attended by Non SBA (TBA/Relatives/etc.)			R
14	Number of newborns visited within 24 hours of home delivery	MCTS ID of child PNC Home Visit by ASHA	There is no PNC Visit Date in Central MCTS so records cannot be filtered out to give aggregation data based on reporting period.	R

15	Number of mothers paid JSY incentive for home deliveries	Mother or Pregnant woman ID JSY Benefits Paid Date	Count of al Pregnant woman records where JSY Benefits Paid Date lies in reporting period.	G
16	Deliveries conducted at facility	Date of Delivery Place of Delivery	Count of records where Place of Delivery= Facility and Date of Delivery within reporting period.	G
17	Of which Number discharged under 48 hours of delivery	Date of Delivery Place of Delivery Date of Discharge	Count of records where Place of Delivery= Facility and DateDiff (Date of Discharge, Date of Delivery) <2 and Date of Delivery within reporting period.	R
18	Number of cases where Janani Suraksha Yojana incentive paid to-Mothers	JSY Benefits Paid Date MCTS ID of Mother	Count of Mother records where JSY Benefits Paid Date is not NULL and lies within reporting period.	G
19	Number of cases where Janani Suraksha Yojana incentive paid to-ASHA	JSY Benefits Paid Date MCTS ID of ASHA	Count of ASHA records where JSY Benefits Paid Date is not NULL and lies within reporting period.	G
20	Number of ANM/AWW paid incentive for facilitating institutional delivery			R
21	Pregnancy Outcomes (in number)	Pregnancy Outcome Date of Delivery Place of Delivery	Count of Pregnancy Outcomes where Date of delivery lies within reporting period.	G
22	Number of Male Live Births	Pregnancy Outcome Date of Delivery Place of Delivery Gender of Infant	Count of live Pregnancy Outcomes where Gender of Infant='Male' and Date of Delivery lies within reporting period.	G
23	Number of Female Live Births	Pregnancy Outcome Date of Delivery Place of Delivery Gender of Infant	Count of live Pregnancy Outcomes where Gender of Infant='Female' and Date of Delivery lies within reporting period.	G
24	Number of Still Births	Pregnancy Outcome Date of Delivery Place of Delivery	Count of Still Pregnancy Outcomes where Date of Delivery lies within reporting period.	G

25	Number of Spontaneous or Induced Abortions	Pregnancy Outcome Date of Delivery Place of Delivery	Count of Spontaneous or Induced Abortions Pregnancy Outcomes where Date of Delivery lies within reporting period.	
26	Details of Newborn children weighed			R
27	Number of Newborns weighed at birth			R
28	Number of Newborns having weight less than 2.5 kg			R
29	Number of newborns breast fed within 1 hour	Breastfeeding started within 1 hour of birth MCTS ID of child Date of Delivery	Count of Child records (Distinct Child MCTS ID) where Breastfeeding started within 1 hr of Birth flag is 'Y' and Date of Delivery lies within Reporting Period.	G
30	Women receiving post partum check-up within 48 hours after delivery			R
31	Women getting a post partum check-up between 48 hours and 14 days			R
32	Number of new IUD Insertions At facility			R
33	Number of IUD removals			R
34	Number of oral pills cycles distributed			R
35	Number of condom pieces distributed			R
36	Number of centchroman (weekly) pills given			R
37	Number of emergency contraceptive pills distributed			R
38	Number of complications following sterilisation			R
39	Number of complications following sterilisation-Male			R
40	Number of complications following sterilisation-Female			R
41	Number of failures following sterilisation			R
42	Number of failures following sterilisation-Male			R

43	Number of failures following sterilisation-Female			R
44	Number of deaths following sterilisation			R
45	Number of deaths following sterilisation-Male			R
46	Number of deaths following sterilisation-Female			R
47	Number of Infants 0 to 11 months old who received immunization		count derived from summation of cases from serial no 48 to	A
48	Number of Infants 0 to 11 months old who received BCG- male	MCTS ID of Child Age Gender of Infant Date of BCG Birth Dose Date of BCG Dose	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of BCG Birth Dose lies within reporting period.	A
49	Number of Infants 0 to 11 months old who received BCG- female	MCTS ID of Child Age Gender of Infant Date of BCG Birth Dose Date of BCG Dose	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of BCG Birth Dose lies within reporting period.	A
50	Number of Infants 0 to 11 months old who received DPT1-male	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of DPT First Dose lies within reporting period.	A
51	Number of Infants 0 to 11 months old who received DPT1-female	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of DPT First Dose lies within reporting period.	A
52	Number of Infants 0 to 11 months old who received DPT2-male	MCTS ID of Child Age Gender of Infant	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is	A

		Vaccine number of DPT/Date of DPT Vaccine	Male and Date of DPT Second Dose lies within reporting period.	
53	Number of Infants 0 to 11 months old who received DPT2-female	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of DPT Second Dose lies within reporting period.	A
54	Number of Infants 0 to 11 months old who received DPT3-male	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of DPT Third Dose lies within reporting period.	A
55	Number of Infants 0 to 11 months old who received DPT3-female	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of DPT Third Dose lies within reporting period.	A
56	Number of Infants 0 to 11 months old who received DPT0-male	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of DPT Birth Dose lies within reporting period.	A
57	Number of Infants 0 to 11 months old who received DPT0-female	MCTS ID of Child Age Gender of Infant Vaccine number of DPT/Date of DPT Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of DPT Birth Dose lies within reporting period.	A
58	Number of Infants 0 to 11 months old who received OPV0- male	MCTS ID of Child Age Gender of Infant Date of OPV Birth Dose Date of OPV Dose	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of OPV Birth Dose lies within reporting period.	A
59	Number of Infants 0 to 11 months old who received	MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where	A

	OPV0- female	Age Gender of Infant Date of OPV Birth Dose Date of OPV Dose	Age between 0 to 11 months and Gender is Female and Date of OPV Birth Dose lies within reporting period.	
60	Number of Infants 0 to 11 months old who received OPV1-male	MCTS ID of Child Age Gender of Infant Vaccine number of OPV/Date of OPV 1	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of OPV First Dose lies within reporting period.	A
61	Number of Infants 0 to 11 months old who received OPV1-female	MCTS ID of Child Age Gender of Infant Vaccine number of OPV/Date of OPV1	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of OPV First Dose lies within reporting period.	A
62	Number of Infants 0 to 11 months old who received OPV2-male	MCTS ID of Child Age Gender of Infant Vaccine number of OPV/Date of OPV 2	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of OPV Second Dose lies within reporting period.	A
63	Number of Infants 0 to 11 months old who received OPV2-female	MCTS ID of Child Age Gender of Infant Vaccine number of OPV/Date of OPV 2	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of OPV Second Dose lies within reporting period.	A
64	Number of Infants 0 to 11 months old who received OPV3-male	MCTS ID of Child Age Gender of Infant Vaccine number of OPV/Date of OPV 3	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of OPV Third Dose lies within reporting period.	A
65	Number of Infants 0 to 11 months old who received OPV3-female	MCTS ID of Child Age Gender of Infant Vaccine number of OPV/Date of OPV 4	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of OPV Third Dose lies within reporting period.	A

66	Number of Infants 0 to 11 months old who received Hepatitis B0- male	MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of Hepatitis B Birth Dose lies within reporting period.	A
67	Number of Infants 0 to 11 months old who received Hepatitis B1-male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Hepatitis B 1	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of Hepatitis B First Dose lies within reporting period.	A
68	Number of Infants 0 to 11 months old who received Hepatitis B1-female	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Hepatitis B 1	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of Hepatitis B First Dose lies within reporting period.	A
69	Number of Infants 0 to 11 months old who received Hepatitis B2-male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Hepatitis B 2	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of Hepatitis B Second Dose lies within reporting period.	A
70	Number of Infants 0 to 11 months old who received Hepatitis B2-female	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Hepatitis B 2	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of Hepatitis B Second Dose lies within reporting period.	A
71	Number of Infants 0 to 11 months old who received Hepatitis B3-male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Hepatitis B3	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of Hepatitis B Third Dose lies within reporting period.	A
72	Number of Infants 0 to 11 months old who received Hepatitis B3-female	MCTS ID of Child Age Gender of Infant Vaccine number/Date of	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of Hepatitis B Third Dose lies	A

		Hepatitis B 3	within reporting period.	
73	Number of Infants 0 to 11 months old who received Measles -male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Measles	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Male and Date of Measles First OR Second Dose lies within reporting period.	A
74	Number of Infants 0 to 11 months old who received Measles-female	MCTS ID of Child Age Gender of Infant Vaccine number /Date of Measles	Count of all Infant records (distinct MCTS ID) where Age between 0 to 11 months and Gender is Female and Date of Measles First OR Second Dose lies within reporting period.	A
75	Total number of children aged between 9 and 11 months who have been fully immunized (Child given one dose of BCG, three dosages of DPT i.e., DPT 1, 2, 3; three dosages of polio i.e. OPV 1,2,3 and a dosage of Measles)	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Total of counts derived from above totals (BCG,DPT1,2,3,OPV1,2,3 and one Measles)	A
76	Total number of children aged between 9 and 11 months who have been fully immunized - Male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 9 to 11 months and Gender is Male and date of Vaccines (one BCG,DPT1,2,3,OPV1,2,3 and Measles) is not null and date of last vaccination lies within reporting period.	A
77	Total number of children aged between 9 and 11 months who have been fully immunized - Female	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 9 to 11 months and Gender is Female and date of Vaccines (one BCG,DPT1,2,3,OPV1,2,3 and Measles) is not null and date of last vaccination lies within reporting period.	A

78	Number of children more than 16 months who received immunisation			
79	Number of children more than 16 months who received DPT Booster- male	Age Gender of Infant Date of BCG Booster Vaccine MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age > 16 months and Gender is Male and Date of BCG Booster immunisation dose lies within reporting period.	A
80	Number of children more than 16 months who received DPT Booster- female	Age Gender of Infant Date of BCG Booster Vaccine MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age > 16 months and Gender is Female and Date of BCG Booster immunisation dose lies within reporting period.	A
81	Number of children more than 16 months who received OPV Booster- male	Age Gender of Infant Date of OPV Booster Vaccine MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age > 16 months and Gender is Male and Date of OPV Booster immunisation dose lies within reporting period.	A
82	Number of children more than 16 months who received OPV Booster- female	Age Gender of Infant Date of OPV Booster Vaccine MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age > 16 months and Gender is Female and Date of OPV Booster immunisation dose lies within reporting period.	A
83	Number of children more than 16 months who received MMR Dose- male	Age Gender of Infant Date of MMR Vaccine MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age > 16 months and Gender is Male and Date of MMR immunisation dose lies within reporting period.	A
84	Number of children more than 16 months who received MMR Dose- female	Age Gender of Infant Date of MMR Vaccine MCTS ID of Child	Count of all Infant records (distinct MCTS ID) where Age > 16 months and Gender is Female and Date of MMR immunisation dose lies within reporting period.	A

85	Total number of children aged between 12 and 23 months who have been fully immunised during the month			R
86	Total number of children aged between 12 and 23 months who have been fully immunised during the month- Male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 12 and 23 months and Gender is Male and date of Vaccines (one BCG,DPT1,2,3,OPV1,2,3 and Measles) is not null and date of last vaccination lies within reporting period.	A
87	Total number of children aged between 12 and 23 months who have been fully immunised during the month- Female	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Count of all Infant records (distinct MCTS ID) where Age between 12 and 23 months and Gender is Female and date of Vaccines (one BCG,DPT1,2,3,OPV1,2,3 and Measles) is not null and date of last vaccination lies within reporting period.	A
88	Children more than 5 years given DT5- male	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Count of all Infant records (distinct MCTS ID) where Age > 5 years and Gender is Male and Date of DT 5 dose lies within reporting period.	A
89	Children more than 5 years given DT5- female	MCTS ID of Child Age Gender of Infant Vaccine number/Date of Vaccine	Count of all Infant records (distinct MCTS ID) where Age > 5 years and Gender is Female and Date of DT 5 dose lies within reporting period.	A
90	Children more than 10 years given TT10- male	MCTS ID of Child Age Gender of Infant TT Vaccine number/Date of TT Vaccine dose.	Count of all Infant records (distinct MCTS ID) where Age > 10 years and Gender is Male and Date of TT 10 dose lies within reporting period.	A

91	Children more than 10 years given TT10- Female	MCTS ID of Child Age Gender of Infant TT Vaccine number/Date of TT Vaccine dose.	Count of all Infant records (distinct MCTS ID) where Age > 10 years and Gender is female and Date of TT 10 dose lies within reporting period.	A
92	Children more than 10 years given TT16- male	MCTS ID of Child Age Gender of Infant TT Vaccine number/Date of TT Vaccine dose.	Count of all Infant records (distinct MCTS ID) where Age > 16 years and Gender is Male and Date of TT 16 dose lies within reporting period.	A
93	Children more than 10 years given TT16- Female	MCTS ID of Child Age Gender of Infant TT Vaccine number/Date of TT Vaccine dose.	Count of all Infant records (distinct MCTS ID) where Age > 16 years and Gender is female and Date of TT 16 dose lies within reporting period.	A
94	Adverse Event Following Immunisation (AEFI)			R
95	Abscess Following Immunisation (AEFI)			R
96	Death Following Immunisation (AEFI)			R
97	Other adverse events Following Immunisation (AEFI)			R
98	Number of immunisation sessions during the month - Planned			R
99	Number of immunisation sessions during the month - Held			R
100	Number of immunisation sessions where ASHAs were present			R
101	Others (Japanese Encephalitis (JE) etc.	MCTS ID of Child Age JE Vaccine number/Date of JE Vaccine dose.	Count of all Infant records (distinct MCTS ID) where Date of JE Dose lies within reporting period.	A
102	Number of Vitamin A Dose administered between 9 months and 5 yrs	MCTS ID of Child Age	Count of all Infant records (distinct MCTS ID) where Age between 9 months and	A

		Vit A dose number/Date of Vit A dose.	5 yrs and Date of Vit A dose lies within reporting period.	
103	Number of Vitamin A Dose -1	MCTS ID of Child Age Vit A dose number/Date of Vit A dose.	Count of all Infant records (distinct MCTS ID) where Age between 6 months and 1 yr and Date of Vit A dose lies within reporting period.	A
104	Number of Vitamin A Dose -5	MCTS ID of Child Age Vit A dose number/Date of Vit A dose.	Count of all Infant records (distinct MCTS ID) where Age > 1 yr and < 3 yr and Date of Vit A dose lies within reporting period.	A
105	Number of Vitamin A Dose 9	MCTS ID of Child Age Vit A dose number/Date of Vit A dose.	Count of all Infant records (distinct MCTS ID) where Age < 5 yrs and Date of Vit A dose lies within reporting period.	A
106	Number of cases of childhood Measles reported during the month (0-5 years)			R
107	Number of cases of childhood Diarrhoea and dehydration reported during the month (0-5 years)			R
108	Number of cases of childhood Malaria reported during the month (0-5 years)			R
109	Number of Aanganwadi centers reported to have conducted VHNDs during the month			R
110	OPD Attendance (All)			R
111	Number of Hb tests conducted			R
112	Of which number having Hb < 7 gm	Hb value	Count of Records where Hb Value <7 gm.	G
113	Infant deaths within 24 hrs of birth			R
114	Infants deaths up to 1 week			R

115	Infants deaths up to 1 week by Sepsis			R
116	Infants deaths up to 1 week by Asphyxia			R
117	Infants deaths up to 1 week by Low Birth Weight (LBW)			R
118	Infants deaths up to 1 week by other reason			R
119	Infants deaths between 1 week and 4 weeks			R
120	Infants deaths between 1 week and 4 weeks by Sepsis			R
121	Infants deaths between 1 week and 4 weeks by Asphyxia			R
122	Infants deaths between 1 week and 4 weeks by Low Birth Weight (LBW)			R
123	Infants deaths between 1 week and 4 weeks by other reason			R
124	Infant / child deaths between 1 month and 11 months			R
125	Infant / child deaths between 1 month and 11 months by Pneumonia			R
126	Infant / child deaths between 1 month and 11 months by Diarrhoea			R
127	Infant / child deaths between 1 month and 11 months Fever related			R
128	Infant / child deaths between 1 month and 11 months by Measles			R
129	Infant / child deaths between 1 month and 11 months by Others			R
130	Child deaths between 1 year and 5 years			R
131	Child deaths between 1 year and 5 years by Pneumonia			R
132	Child deaths between 1 year and 5 years by Diarrhoea			R

133	Child deaths between 1 year and 5 years by Fever related			R
134	Child deaths between 1 year and 5 years by Measles			R
135	Child deaths between 1 year and 5 years by Others			R
136	Adolescent deaths between 6 and 14 years of age during the reporting month			R
137	Adolescents deaths between 6 and 14 years of age by Diarrhoeal diseases			R
138	Adolescents deaths between 6 and 14 years of age by Tuberculosis			R
139	Adolescents deaths between 6 and 14 years of age by Respiratory diseases including infections (other than TB)			R
140	Adolescents deaths between 6 and 14 years of age by Malaria			R
141	Adolescents deaths between 6 and 14 years of age by Other fever related			R
142	Adolescents deaths between 6 and 14 years of age by HIV/AIDS			R
143	Adolescents deaths between 6 and 14 years of age by Heart disease/hypertension related			R
144	Adolescents deaths between 6 and 14 years of age by Neurological disease including strokes			R
145	Adolescent/Adult deaths between 15-55 years of age during the reporting month			R
146	Adolescent/Adult deaths between 15-55 years of age by Diarrhoeal diseases			R
147	Adolescent/Adult deaths between 15-55 years of age by Tuberculosis			R

148	Adolescent/Adult deaths between 15-55 years of age by Respiratory diseases including infections (other than TB)			R
149	Adolescent/Adult deaths between 15-55 years of age by Malaria			R
150	Adolescent/Adult deaths between 15-55 years of age by Other fever related			R
151	Adolescent/Adult deaths between 15-55 years of age by HIV/AIDS			R
152	Adolescent/Adult deaths between 15-55 years of age by Heart disease/hypertension related			R
153	Adolescent/Adult deaths between 15-55 years of age by Neurological disease including strokes			R
154	Adult deaths above 55 years of age during the reporting month			R
155	Adult deaths above 55 years of age by Diarrhoeal diseases			R
156	Adult deaths above 55 years of age by Tuberculosis			R
157	Adult deaths above 55 years of age by Respiratory diseases including infections (other than TB)			R
158	Adult deaths above 55 years of age by Malaria			R
160	Adult deaths above 55 years of age by Other fever related			R
161	Adult deaths above 55 years of age by HIV/AIDS			R
162	Adult deaths above 55 years of age by Heart disease/hypertension related			R

163	Adult deaths above 55 years of age by Neurological disease including strokes			R
164	Maternal Deaths			R
165	Total maternal deaths due to abortions			R
166	Total maternal deaths due to Obstructed/prolonged labour			R
167	Total maternal deaths due to Severe hypertension/fits			R
168	Total maternal deaths due to Bleeding			R
169	Total maternal deaths due to High fever			R
170	Total maternal deaths due to Other causes (including causes not known)			R
171	Any death due to reasons such as trauma/accidents/burns			R
172	Any death due to reasons such as Suicide			R
173	Any death due to reasons such as Animal bites and stings			R
174	Other Disease Death			R
175	Any death due to reasons such as Known acute disease			R
176	Any death due to reasons such as Known chronic disease			R
177	Any death due to Causes not known			R
178	Number of Eclampsia cases managed during delivery			R
179	Number having severe anemia (Hb<7g/dl) treated at institution	MCTS ID of Mother Hb value [Hb<7, Hb>7] Facility name		A
180	Number of private institutional delivery cases where JSY incentive paid to Mothers	MCTS ID of Mother Place of Delivery JSY Benefits Paid Date	Count of Mother records where Place of Delivery is Facility and JSY Benefits Paid Date is not NULL and lies within reporting period.	A

181	Number of private institutional delivery cases where JSY incentive paid to ASHA	MCTS ID of ASHA Place of Delivery JSY Benefits Paid Date	Count of ASHA records where Place of Delivery is Facility and JSY Benefits Paid Date is not NULL and lies within reporting period.	A
182	Number of private institutional delivery cases where JSY incentive paid to AMN or AWW	MCTS ID of ANM Place of Delivery JSY Benefits Paid Date	Count of ANM records where Place of Delivery is Facility and JSY Benefits Paid Date is not NULL and lies within reporting period.	A
183	Number of Caesarean (C-Section) deliveries performed at PHC			R
184	Number of Caesarean (C-Section) deliveries performed at CHC			R
185	Number of Caesarean (C-Section) deliveries performed at Sub-divisional hospital/District Hospital			R
186	Number of Caesarean (C-Section) deliveries performed at At Other State Owned Public Institutions			R
187	Number of Caesarean (C-Section) deliveries performed at Private Facilities			R
188	Number of cases of pregnant women with Obstetric Complications and attended at PHC	Danger signs in Mother MCTS ID of Mother Date of ANC Visit PHC ID or name	Count of Mother records (distinct MCTS ID of Pregnant Woman) where Danger signs in Mother is not null and PHC ID = ID of given PHC and Date of ANC Visit lies within reporting period.	A
189	Number of cases of pregnant women with Obstetric Complications and attended at Sub-divisional hospital/District Hospital.	Danger signs in Mother MCTS ID of Mother Date of ANC Visit SDH or DH ID or name	Count of Mother records (distinct MCTS ID of Pregnant Woman) where Danger signs in Mother is not null and SDH/DH ID = ID of given SDH/ DH and Date of ANC Visit lies within reporting period.	A
190	Number of cases of pregnant women with Obstetric Complications	Danger signs in Mother MCTS ID of	Count of Mother records (distinct MCTS ID of Pregnant Woman) where	A

	and attended at Other State Owned Public Institutions.	Mother Date of ANC Visit Linked facility Type For Delivery	Danger signs in Mother is not null and Facility Type = type code of given Facility (Other State owned Public Institutions) and Date of ANC Visit lies within reporting period.	
191	Number of cases of pregnant women with Obstetric Complications and attended at Private facilities	Danger signs in Mother MCTS ID of Mother Date of ANC Visit Linked facility Type For Delivery	Count of Mother records (distinct MCTS ID of Pregnant Woman) where Danger signs in Mother is not null and Facility Type = type code of given Facility (Private facilities) and Date of ANC Visit lies within reporting period.	A
192	Number of Complicated pregnancies treated with IV Antibiotics			R
193	Number of Complicated pregnancies treated with IV Antihypertensive/Magsulph injection			R
194	Number of Complicated pregnancies treated with IV Oxytocics			R
195	Number of Complicated pregnancies treated with Blood Transfusion			R
196	PNC maternal complications attended	MCTS ID of Mother Date of PNC Visit (Mother Registration in PNC) Danger signs in Mother	Count of Mother records (distinct MCTS ID of Mother) registered for PNC visit where Danger sign of Mother is not null and Date of PNC Registration/Visit lies within reporting period.	A
197	Number of MTP Conducted at Public Institutions Up to 12 weeks of pregnancy			R
198	Number of MTP Conducted at Public Institutions More than 12 weeks of pregnancy			R
199	Number of MTPs conducted at Private Facilities			R
200	Number of new RTI/STI for which treatment initiated for Male			R

201	Number of new RTI/STI for which treatment initiated for Female	RTI/STI Date of ANC/PNC Checkup='Y' MCTS ID of Mother/Pregnant woman	Count of Pregnant women/Mother records (distinct MCTS ID) where RTI/STI='Y' and Date of ANC/PNC Visit lies within Reporting period.	A
202	Number of wet mount tests conducted			R
203	Number of NSV/Conventional Vasectomy conducted			R
204	Number of NSV/Conventional Vasectomy conducted At PHCs			R
205	Number of NSV/Conventional Vasectomy conducted At CHCs			R
206	Number of NSV/Conventional Vasectomy conducted At Sub-divisional hospitals/ District Hospitals			R
207	Number of NSV/Conventional Vasectomy conducted At Other State Owned Public Institutions			R
208	Number of NSV/Conventional Vasectomy conducted At Private facilities			R
209	Number of Laparoscopic sterilizations/ conducted			R
210	Number of Laparoscopic sterilizations/ conducted At PHCs			R
211	Number of Laparoscopic sterilizations/ conducted At CHCs			R
212	Number of Laparoscopic sterilizations/ conducted At Sub-divisional hospitals/ District Hospitals			R

213	Number of Laparoscopic sterilizations/ conducted At Other State Owned Public Institutions			R
214	Number of Laparoscopic sterilizations/ conducted At Private facilities			R
215	Number of Mini-lap sterilizations conducted			R
216	Number of Mini-lap sterilizations conducted At PHCs			R
217	Number of Mini-lap sterilizations conducted At CHCs			R
218	Number of Mini-lap sterilizations conducted At Sub-divisional hospitals/ District Hospitals			R
219	Number of Mini-lap sterilizations conducted At Other State Owned Public Institutions			R
220	Number of Mini-lap sterilizations conducted At Private facilities			R
221	Number of Post-Partum sterilizations conducted			R
222	Number of Post-Partum sterilizations conducted at PHCs			R
223	Number of Post-Partum sterilizations conducted at CHCs			R
224	Number of Post-Partum sterilizations conducted At Sub-divisional hospitals/ District Hospitals			R
225	Number of Post-Partum sterilizations conducted At Other State Owned Public Institutions			R
226	Number of Post-Partum sterilizations conducted At Private facilities			R
227	Number of IUD Insertions			R

228	Number of IUD Insertions At Other State Owned Public Institutions			R
229	Number of IUD Insertions At Private facilities			R
230	Number of Institutions having NSV Trained Doctors			R
231	Number of cases of Childhood Diseases reported during the month (0-5 years)			R
232	Number of cases of Diphtheria reported during the month (0-5 years)			R
233	Number of cases of Pertussis reported during the month (0-5 years)			R
234	Number of cases of Tetanus Neonatorum reported during the month (0-5 years)			R
235	Number of cases of Tetanus others reported during the month (0-5 years)			R
236	Number of cases of Polio reported during the month (0-5 years)			R
237	Number of cases admitted with Respiratory Infections reported during the month (0-5 years)			R
238	Number of patients operated for cataract			R
239	Number of Intraocular Lens (IOL) implantations			R
240	Number of school children detected with Refractive errors			R
241	Number of children provided free glasses			R
242	Number of eyes collected			R

243	Number of eyes utilised			R
244	Number of CHC/ SDH/ DH functioning as an FRU (First Referral Unit)			R
245	FRU Functioning - CHC			R
246	FRU Functioning - SDH			R
247	FRU Functioning - DH			R
248	Number of PHCs functioning 24X7 (3 Staff Nurses)			R
249	Status of PHCs functioning 24X7 (2 staff nurses posted for 24x7 deliveries)			R
250	Number of facilities having a Rogi Kalyan Samiti			R
251	Number of RKS meetings held during the month			R
252	Number of facilities having Ambulance services (Assured Referral Services) available			R
253	Assured Ambulance Service available on 24x7 - PHC			R
254	Assured Ambulance Service available on 24x7 - CHC			R
255	Assured Ambulance Service available on 24x7 - DH			R
256	Assured Ambulance Service available on 24x7 - SDH			R
257	Total Number of times the Ambulance was used for transporting patients during the month			R

258	Number of Institutions having operational Sick New Born Care Units			R
259	CHC having operational Sick New Born Care Unit			R
260	DH having operational Sick New Born Care Unit			R
261	SDH having operational Sick New Born Care Unit			R
262	Number of functional Laparoscopes in CHC/SDH/DH			R
263	Total number of patients admitted during the reporting month.			R
264	Total number of male Children < 19 Yrs admitted during the reporting month			R
265	Total number of female Children < 19 Yrs admitted during the reporting month.			R
266	Total number of adult males of age 19 years and above admitted during the reporting month.			R
267	Total number of adult females of age 19 years and above admitted during the reporting month.			R
268	Total number of male deaths in the facility due to any cause during the reporting month.			R
269	Total number of female deaths in the facility due to any cause during the reporting month.			R
270	In-Patient Head Count at midnight			R
271	Operation major (General and spinal anesthesia)			R

272	Operation minor (No or local anesthesia)			R
273	Number of patients seen by AYUSH practitioners, in the facility, during the reporting month.			R
274	Total number of dental procedures carried out during the reporting month			R
275	Total number of adolescents counseled during the reporting month.			R
276	Other OPD/ Procedures			R
277	HIV tests conducted			R
278	HIV tests conducted - Males			R
279	HIV tests conducted - Females Non ANC			R
280	HIV tests conducted - Females with ANC			R
281	Widal tests conducted			R
282	VDRL tests conducted			R
283	VDRL tests conducted - Male			R
284	VDRL tests conducted - Female Non ANC			R
285	VDRL tests conducted - Female with ANC			R
286	Malaria tests conducted - Blood smears examined			R
287	of which Plasmodium Vivax test positive			R
288	of which Plasmodium Falciparum test positive			R

Mapping Legends:

G= Mapping through summation logic,
A = Mapping through Transformation logic,
R = Not Mappable