ICT Strategy for Healthcare Service Delivery

Government of Nagaland

Date: 24 June, 2014

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Vision of ICT Program

"Create an integrated, multi-sectoral healthcare service delivery system for all residents of Nagaland to deliver better accessibility, affordability, awareness, quality and operational efficiency"

ICT in Healthcare in Nagaland - 360° view of the strategic plan

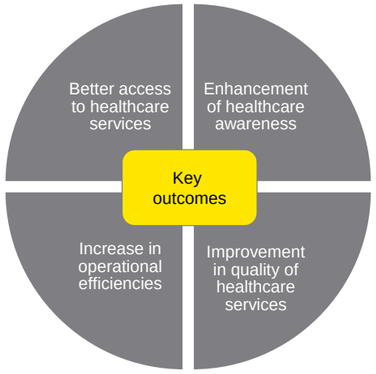
VISION

The Vision of the Department of Health is to...

- Prioritize the fulfillment of health needs of women & children in all areas possible
- Address the health needs of the adolescent and youth
- Focus on prevention, stigma & discrimination, care and support in addressing the issue of HIV/AIDS
- Deliver basic quality health care to the grassroots level
- Develop ownership & participation by Communities in strengthening health services
- Develop an efficient Health Management Information System (HMIS) for evidence based planning

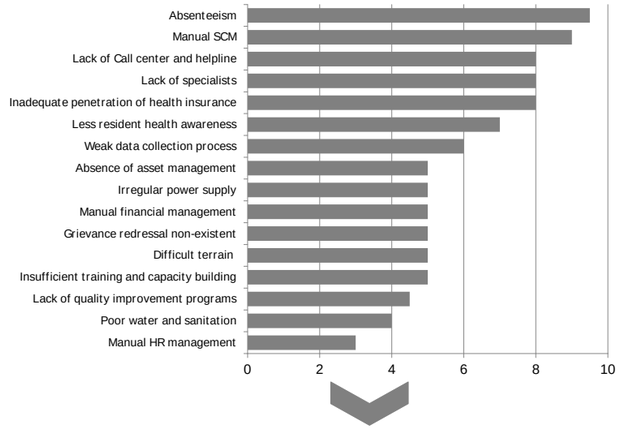
OBJECTIVES

This requires four strategic objectives to be delivered



CHALLENGES

However there are 16 challenges to be addressed to achieve these objectives



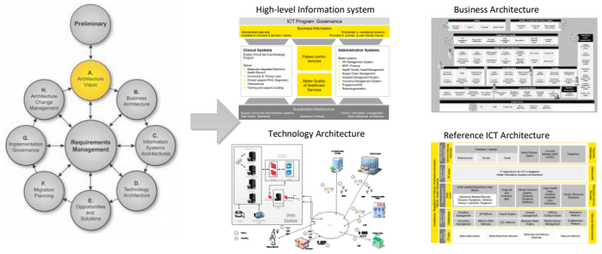
STRATEGY

Integrated 3-stage implementation delivered by a single Managed Service Provider

Outcomes expected	Timeframe				
	Year 1	Year 2	Year 3	Year 4	Year 5
Phase-1 – Laying the foundation and commencing solution deployments	• MSP on-boarded • Infrastructure layer completed • Connectivity readiness • Data sets digitized • Core solutions deployed at Department of health				
Phase-2 – Accelerated solution deployment, IEC and capacity building	• Roll out commenced in 2 districts; all FLWs mobile enabled • Capacity building and IEC programs in full swing				
Phase-3 – Sustaining results and showcasing success stories	• Showcase success stories • Roll-out of solutions in rest of the 9 districts • Period refresher trainings • Impact Assessment studies				

ARCHITECTURE

These ICT initiatives require the creation of a future state enterprise architecture

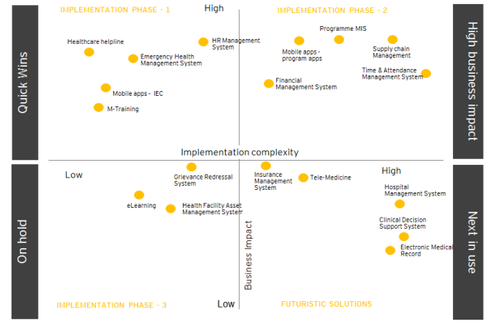


INITIATIVES

6 strategic IT initiatives are shortlisted to address these challenges

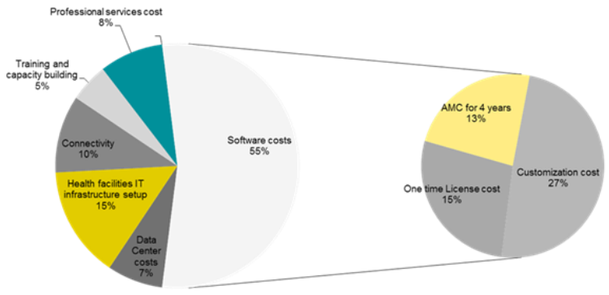
Shortlisted Initiatives

- Supply Chain Management
- Finance Management System
- HR Management System
- Program Management Information System
- M-Training and Mobile Apps for Information, Education & Communication
- Healthcare Helpline and Emergency Health Care Management System



INVESTMENT

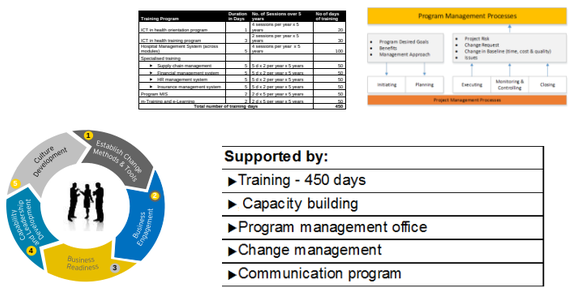
Through an investment of INR 33-36 Cr. in priority areas



GOVERNANCE

With the support of a strong program governance and change management plan

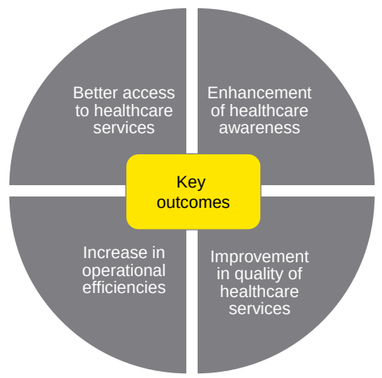
Training Program	Duration in Days	No. of Sessions over 5 years	No of days of training
ICT in health orientation program	1	4 sessions per year x 5 years	20
ICT in health training program	2	4 sessions per year x 5 years	40
Hospital Management System (across facilities)	5	4 sessions per year x 5 years	100
Specialised training			
▶ Supply chain management	5	5 d x 2 per year x 5 years	50
▶ Financial management system	5	5 d x 2 per year x 5 years	50
▶ HR management system	5	5 d x 2 per year x 5 years	50
▶ Insurance management system	5	5 d x 2 per year x 5 years	50
Program MIS	2	2 d x 5 per year x 5 years	50
m-Training and e-Learning	2	2 d x 5 per year x 5 years	100
		Total number of training days	460



Supported by:

- ▶Training - 450 days
- ▶ Capacity building
- ▶Program management office
- ▶Change management
- ▶Communication program

OBJECTIVES ACHIEVED



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Executive summary

The Government of Nagaland intends to improve the state's healthcare delivery system for its residents and accelerate progress towards delivering quality healthcare. The Government wants to create an "***Integrated Healthcare Service Delivery Model***" that will provide better access to healthcare services to care seekers. In this context, EY has been engaged to develop a five year ICT roadmap for the Department of Health, Government of Nagaland to enable improved healthcare service delivery in Nagaland.

The ICT Strategy for Nagaland was developed using a five-step approach as shown below.

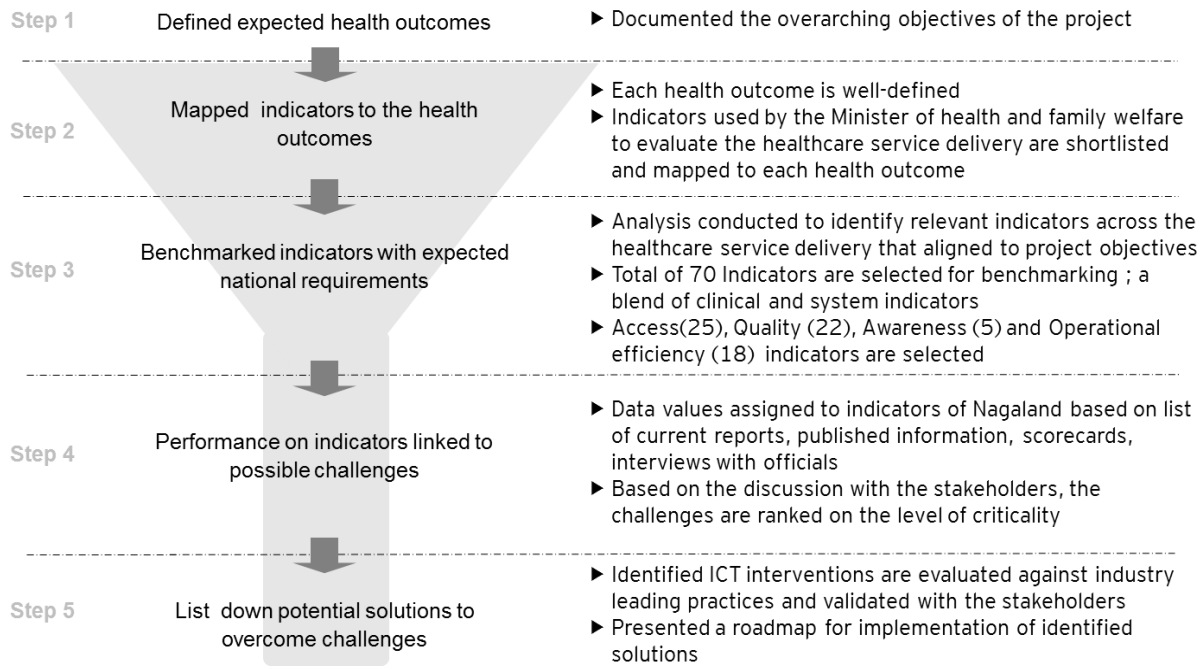


Figure 1: 5-step Engagement Approach

The outcomes of steps 1 to 4 leading upto prioritization of challenges have been covered in a separate current state assessment report submitted earlier. This report is the synthesis of the work done in steps 4 and 5 in terms of identifying the challenges to be addressed and the ICT interventions and implementation roadmap required to address them.

The ICT strategy focuses on addressing existing service delivery challenges and achieving four key health outcomes

One of the first steps in preparing the ICT strategy was to clearly define the outcomes expected and the challenges that need to be addressed to achieve the outcomes. During the current state assessment phase, the EY team has conducted extensive field study and stakeholder consultations across three districts and 21 health facilities in Nagaland. Stakeholder consultation was done across all levels of healthcare ecosystem in a grounds-up fashion at facility, block, district and state level. This helped in obtaining in-depth understanding of state public healthcare system functioning and the IT infrastructure that supports it today. It also helped in assessment of healthcare service delivery and challenges.

The following key challenges were identified to be addressed through the ICT strategy. Through stakeholder workshops, these challenges were scored and a prioritized list as shown in the diagram below was created.

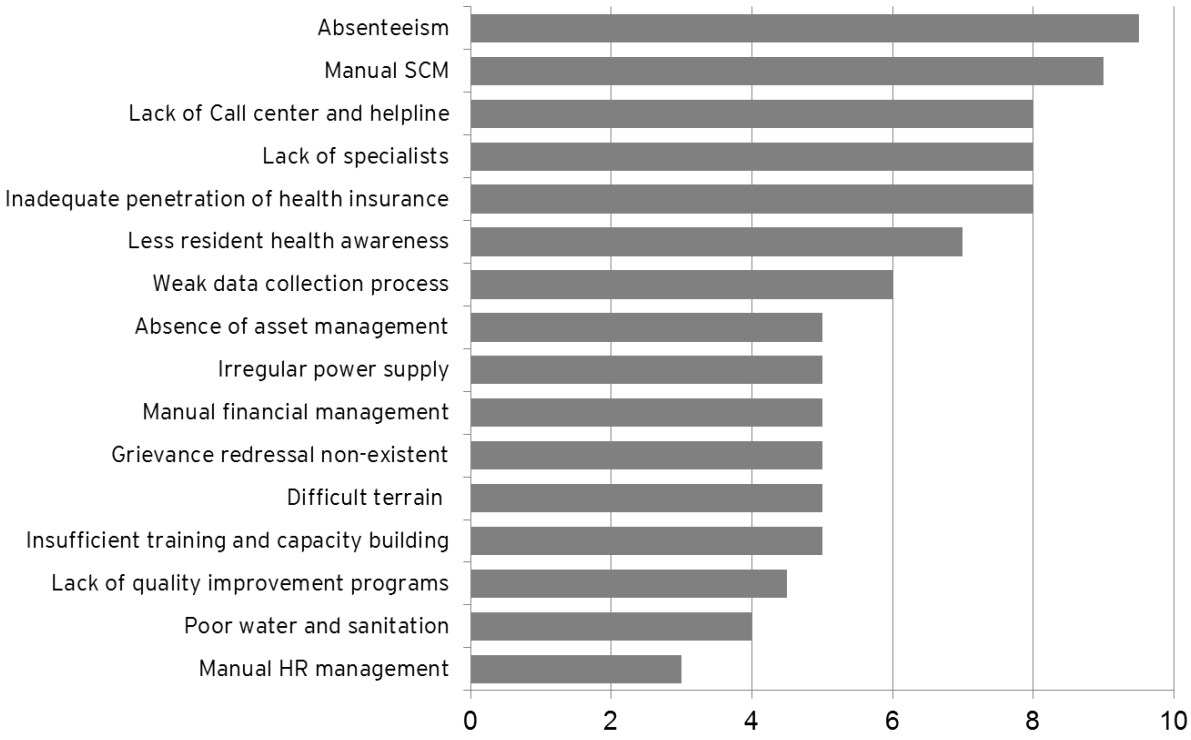


Figure 2: Key challenges with priority scores

These challenges were analyzed further and summarized in the form of four key health outcomes to be achieved through theICT in Healthcare Program of Nagaland as shown below.

Figure 3: Key Health Outcomes of the ICT Program

Based on the above health outcomes, the following Architecture Vision was established for the ICT in Health Program.

The Architecture Vision of the ICT in Health Program is to "***Create an integrated, multi-sectoral healthcare service delivery system for all residents of Nagaland to address the challenges of accessibility, affordability, awareness, quality and operational efficiency"***.

An ICT Reference Architecturewas created through the study of 36 leading global ICT practices in Healthcare

In order to achieve the health outcomes addressing the challenges identified, a survey of leading practices was done and nearly 120 ICT initiatives in healthcare were identified.Extensive field analysis, secondary research conducted and discussions with key stakeholders helped us in shortlisting the leading practices that can be replicated in Nagaland keeping in mind the nature of challenges observed. A total of 36 ICT initiatives were shortlisted from the database of leading healthcare practices across the world.These are discussed in detail in the leading practice section of this report. Based on the leading practice study, the below **ICT Reference Architecture**was arrived at. Based on leading practices, the entire ICT landscape was divided into two categories, viz. ***Clinical Systems*** and ***Administrative Systems*** which are delivered on the foundations of strong Information Management and IT Infrastructure and supported by ICT Program Governance mechanisms.

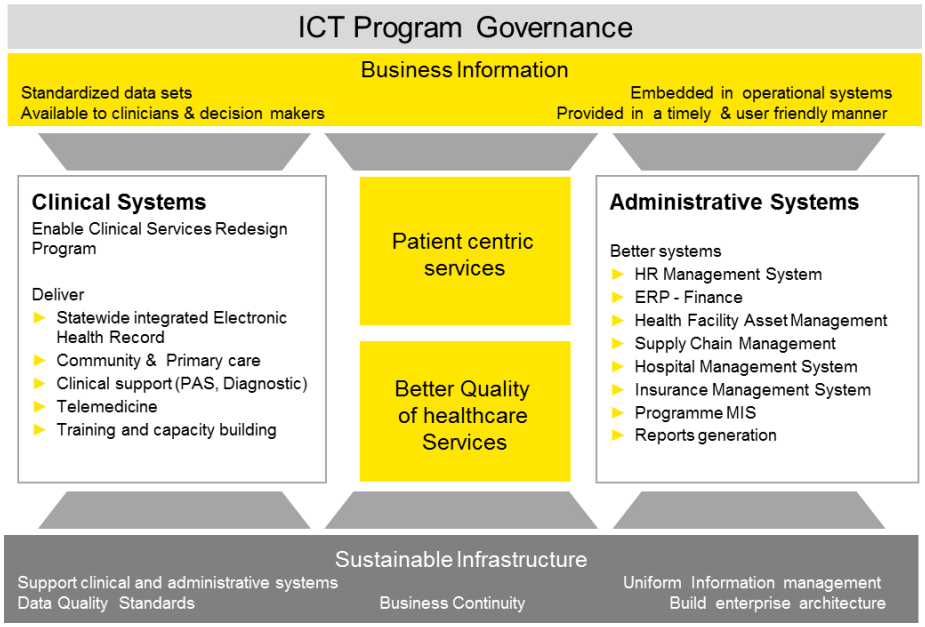


Figure 4: ICT Reference Architecture

Based on the Reference Architecture, the ICT Architecture and Implementation Roadmap for Nagaland was developed using TOGAF® methodology

With the Reference Architecture in place, it was felt that TOGAF Enterprise Architecture methodology would be the appropriate methodology to develop the ICT Architecture and Implementation Roadmap and establish a robust Architecture and Program Governance in place. To detail the Program Governance aspects further, the Program Management Framework of PMI was adopted as the reference.

One of the first steps in developing the ICT Architecture was to establish the Business Architecture and define the high level Information Systems needs. This involved identification of the stakeholders and defining the high level information systems requirements they have. This is detailed in the Business Architecture artefact presented below.

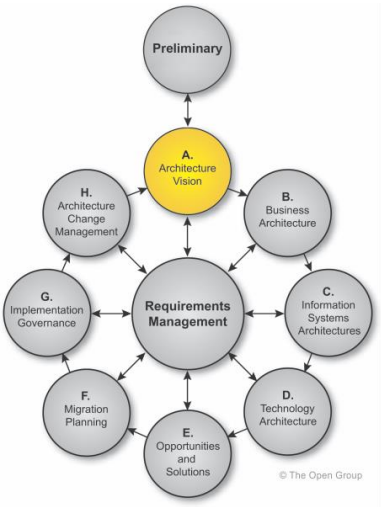


Figure 5: TOGAF Framework

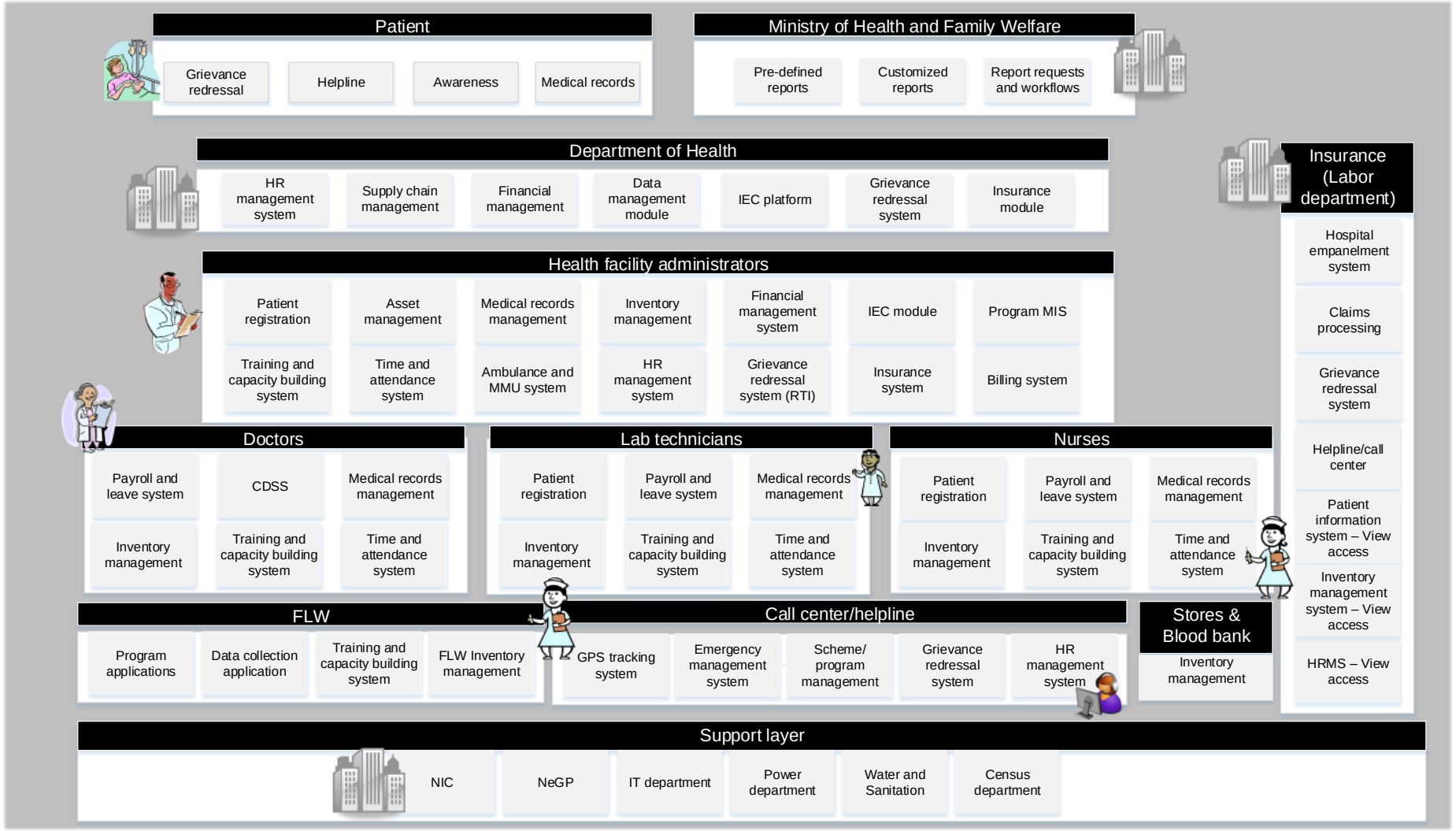


Figure 6: Business Architecture & Information System Needs

IT intervention opportunities were prioritized and six Strategic IT initiatives identified for implementation

In total, 18 IT initiatives were identified which were put through a prioritization matrix as shown below. Based on the prioritization **six** strategic IT initiatives have been identified for implementation. These are initiatives that are either ***Quick Wins*** or are expected to have ***High Business Impact***.

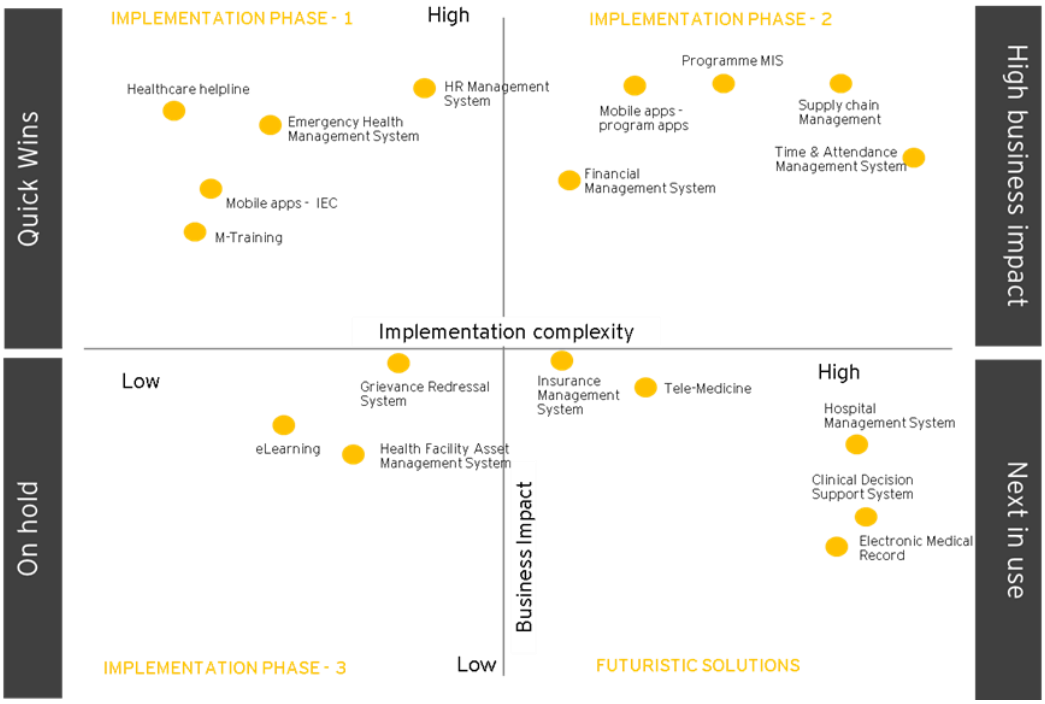


Figure 7: Prioritization matrix of the initiatives

The following are the six strategic IT initiatives identified and the key outcomes they support.

Initiative	Theme and Key outcomes supported
Supply Chain Management	• Strengthen Medical Supply Chain management in Nagaland • Enable better quality of healthcare through timely availability of medical supplies • Improve operational efficiency in healthcare system
Finance Management System	• Strengthen Financial Management to enable faster approvals, streamline budgetary allocations and track expenditures against outcomes
HR Management System	• Strengthen HR management functions of the Department for streamlined payroll processing, better leave management and enable stronger career management processes • This is expected to improve operational efficiencies, address problems around absenteeism and contribute to better quality of healthcare services
Program Management Information System	• Streamline administration of Schemes and programs • Improve data gathering about scheme/program impact by enabling supporting mobile apps for program data gathering
M-Training and Mobile Apps for Information, Education & Communication	• Mobile based solutions to enhance reach of IEC initiatives • This is expected to enhance healthcare awareness and help in better control of communicable diseases and address age/gender group specific health issues
Healthcare Helpline and Emergency Health Care Management System	• Support Emergency Management and improve access to healthcare

Managed Service Provider-centric Implementation Strategy is recommended

The IT architecture envisaged in this roadmap requires an integrated approach to procurement of IT services which at a high level includes the following:

- IT infrastructure deployment and end user enablement across all locations
- Development and implementation of bespoke and COTS applications
- Deployment of IT support staff and handholding for a sustained period of time
- Provisioning of training and supporting the Department in capacity development

In order to effectively deliver the above services a "Managed Services Provider" (MSP) approach to IT procurement is recommended. This will enable creation of a single point of responsibility for the above services and better program management. This model has proven successful in India as well as globally in such long term complex IT programs.

A three-phase implementation plan has been recommended over a 5year timeframe

Keeping in view the complexity of healthcare system in Nagaland and difficult terrain, it is recommended to implement the ICT solutions in a phased manner. The implementation plan strongly ties the IT initiatives with capacity development and Information, Education &Communication ("IEC") initiatives to accelerate the ground level changes. The entire Program Plan has been divided into three phases:

- **Phase 1 - Foundation Phase**: In this phase, the foundational aspects such as establishing connectivity, end user computerization and deployment of mobile devices is planned. This phase will also see the deployment of the Core Administrative Solutions at DOH HQ in Kohima and Dimapur. This will include the ERP solutions for HR, Finance and Supply Chain Management.
- **Phase 2 – Accelerated deployment phase**: This phase will see accelerated solution deployments across all the nine districts and strong IEC and capacity development programs to support the change. This phase will see the deployment of Program Management Information System and mobile based solutions for IEC along with Emergency Management System & Helpline.
- **Phase 3 – Sustained Results phase**: This phase will involve realizing and sustaining the results of IT implementation. This phase will involve showcasing the early results of the program and conduct of impact assessment studies to fine-tune various program aspects.

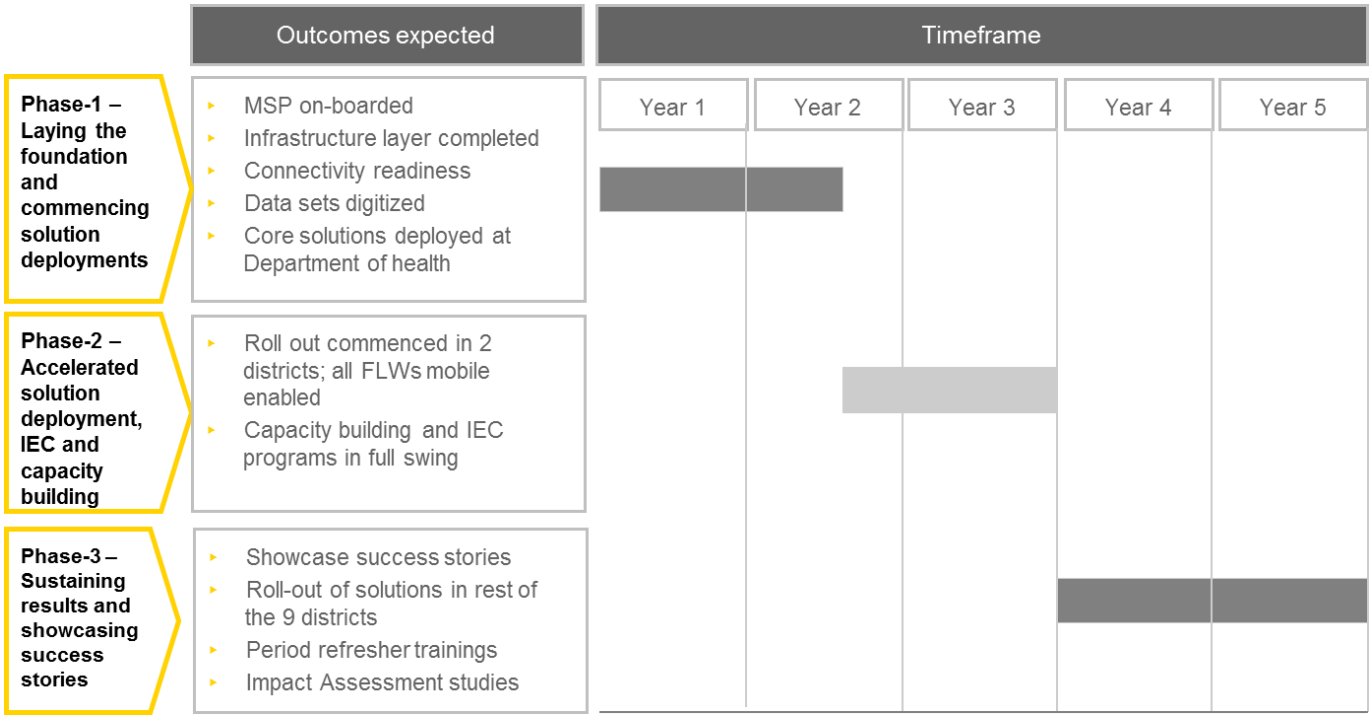


Figure 8: High level implementation roadmap

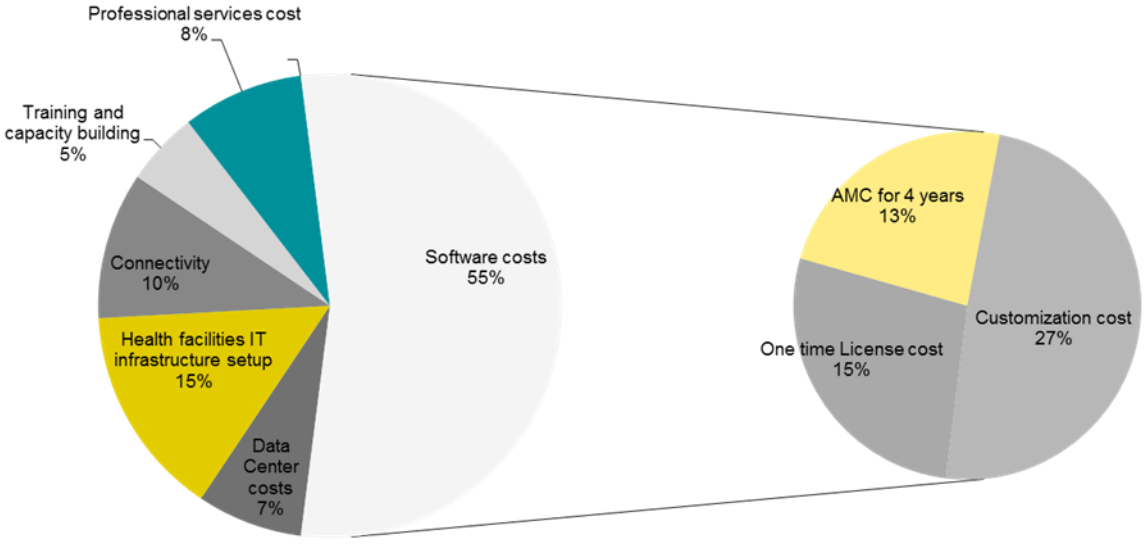


Figure 9: High level cost break-up

Way forward

As immediate next steps, it is expected that this ICT strategy will be communicated to a wider audience in Nagaland that includes all staff of Nagaland's healthcare service delivery ecosystem and the public in general. The program requires strong Program Governance and Technical Assistance to be initiated and sustained over the 5-year timeframe. It is expected that these will be in place within 180 days of acceptance of this ICT strategy report by the Government of Nagaland.

In conclusion, it is hoped that the recommended interventions will have strong and positive impact throughout the healthcare delivery system. The initiatives identified have the potential to address several inefficiencies in the healthcare value chain and deliver better access and quality of healthcare services to citizens without significantly increasing healthcare costs.

1 Introduction

The Government of Nagaland seeks to improve healthcare delivery system for the state's residents and accelerate progress towards achieving quality healthcare. The government wants an "***Integrated Healthcare Service Delivery Model***" that will provide better access to healthcare services and programs to care seekers. The Service Delivery Model should enable sustained and targeted demand generation and behavioral change to facilitate increased uptake of health care services by community members. Simultaneous capacity building and training of health care providers should help improve the quality of services available to the patients/ beneficiaries. EY has been engaged to develop a five year ICT roadmap for the Department of Health to improve healthcare service delivery.

1.1 Objectives of the ICT in Healthcare Program of Nagaland

The ICT in Healthcare Program of Nagaland has four broad health outcomes:

- Better access to healthcare services
- Improvement in quality of healthcare services
- Enhancement of healthcare awareness
- Increase in operational efficiencies

The health outcomes are defined as:

Health outcome	Description of the outcome
Better **access** to healthcare service	• Health as a right for all citizens • Availability of the adequate medical and paramedical staff at healthcare facilities • Ability of patient to afford treatment and obtain coverage under public health insurance scheme(s) • Convenience of reaching the public healthcare facility
Improvement in**quality** of health services	• Improved competency level of healthcare workers • Standardized processes and procedures in healthcare facilities to ensure consistent quality of service • Governance, transparency, and accountability in the delivery of health services
Enhancement of health **awareness**	• Creating resident awareness on preventive public health measures and promotion of healthy lifestyles • Prevention and control of communicable and non-communicable diseases including endemic diseases
Increase in **operational efficiency**	• Delivery process standardization and automation at provider-patient touch-points to improve overall efficiency of the Department of Health • Reduce/remove paperwork and e-enable officers and Field Level Workers for faster data capture. • Empower the Department with better Information Management and IT solutions to support the healthcare outcomes.

1.2 Engagement approach

The approach for the engagement is divided in three phases. The first phase is to gather insights on the current state functioning of the public healthcare system. The second phase is to develop a five-year ICT roadmap for addressing the challenges in the state and improving the public healthcare system. The last phase is to finalize the ICT roadmap after stakeholder consultation. The detailed activities for each phase are listed below:

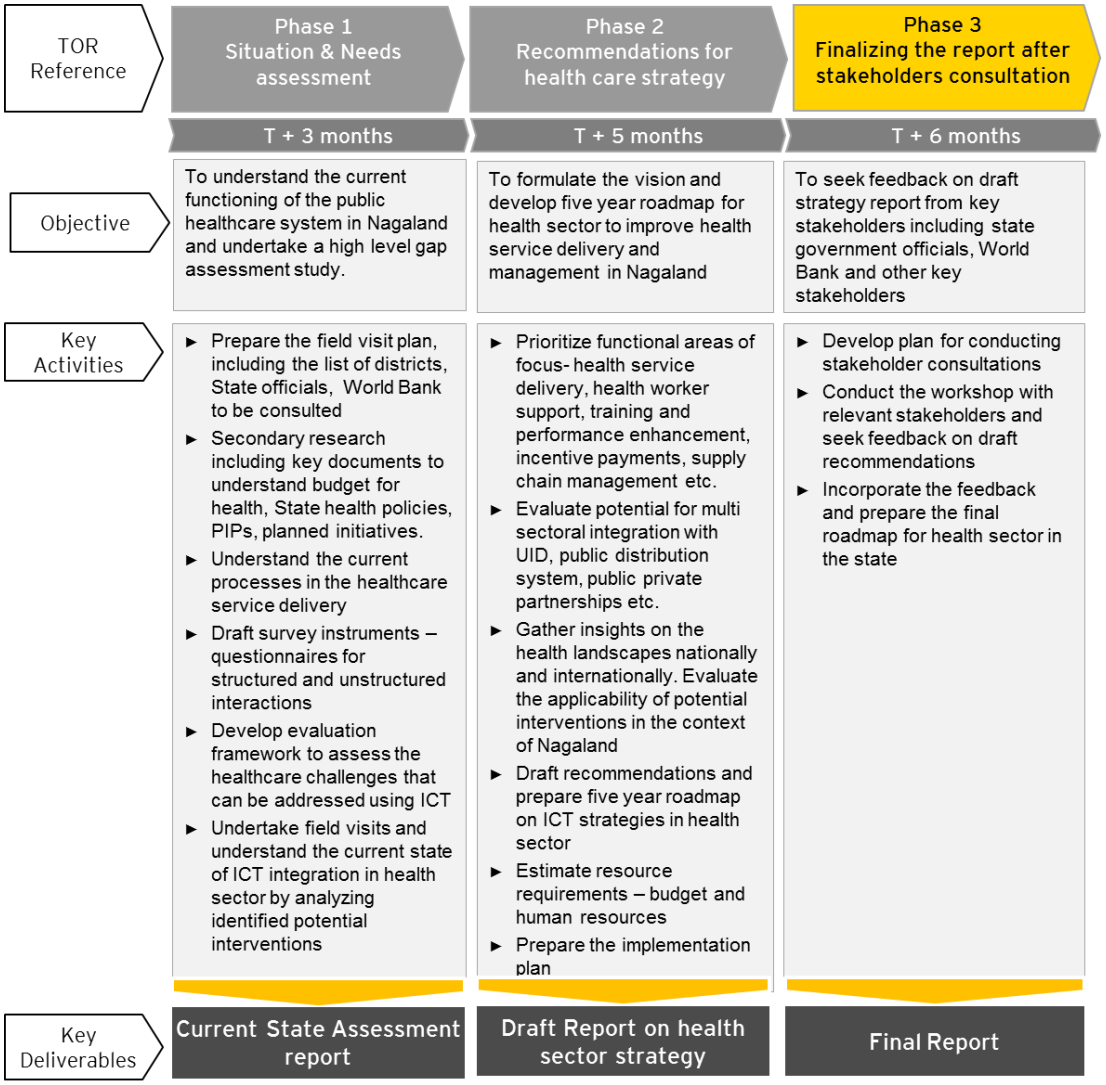


Figure 10: Engagement Approach

Based on the above approach, field analysis was conducted in the month of November 2013 from 5th Nov to 16th Nov, 2013 and 18th March to 25th March, 2014. The outcomes of field analysis were mapped to four health outcomes - access to healthcare services, enhancement of healthcare awareness, quality of healthcare services and improvement in operational efficiency. A brief about the field study is listed below:

- EY Team met 150+ stakeholders across 3 districts (Kohima, Mokokchung, Tuensang) and 21 healthcare facilities in Nagaland;
- Consulted stakeholders across all levels of healthcare ecosystem– facility, block, district and state level;

- Obtained in-depth understanding of state public healthcare system functioning and state IT infrastructure; and
- Conducted on-ground assessment of healthcare service delivery and challenges.

The following facilities were visited by the team.

<table>
<tr><th colspan="6">Facilities visited</th></tr>
<tr><th>District Hospitals</th><th>CHC</th><th>PHC</th><th>SC</th><th colspan="2">CMO office</th></tr>
<tr><td rowspan="2">Mokukchung</td><td>Longkim</td><td>Chuchuyimlang</td><td>Mopungchuket</td><td colspan="2" rowspan="2">Tuensang</td></tr>
<tr><td>Vishwema</td><td>Angangba</td><td>Sungratsu</td></tr>
<tr><td rowspan="2">Tuensang</td><td rowspan="2">Noklak</td><td>Chare</td><td rowspan="2">Meriema</td><td colspan="2" rowspan="2">Kohima</td></tr>
<tr><td>Longpnang</td></tr>
<tr><td rowspan="2">Kohima</td><td rowspan="2">Changtongya</td><td>Jakhama</td><td rowspan="2">Helipong</td></tr>
<tr><td>Kuthur</td></tr>
<tr><th colspan="6">Stakeholder consultation</th></tr>
<tr><th>State health department</th><th>State IT department</th><th>State census department</th><th>NeGP department</th><th>State labour department</th><th>NIC department</th></tr>
</table>

Based on the above field study, the key challenges faced by citizens and various stakeholders were identified and mapped to the health outcomes as shown below.

Figure 11: Snapshot of the key challenges

Based on the list of indicators (short-listed from the indicators provided by Ministry of Health & Family Welfare, World Health Organization and World Bank), field visits surveys and discussion and workshop with the stakeholders, prioritization of the key challenges is done which is shown below.

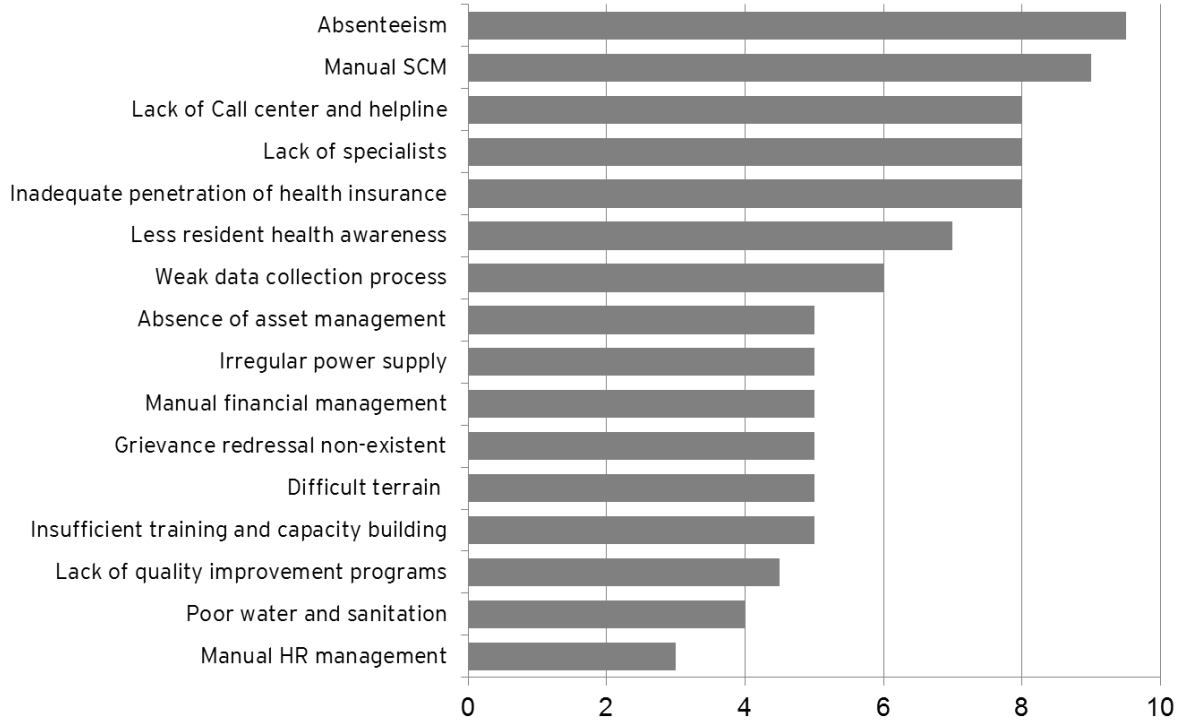


Figure 12: Prioritizing the key challenges

1.3 About this report

This report enlists the leading practices in Healthcare ICT nationally and internationally. An approach is defined for shortlisting the leading practices which have more applicability and suitability in the context of Nagaland. The shortlisted leading practices are discussed in detail in the next section. The exhaustive list of leading practices in provided in Annexure 1.

The report also elaborates on the ICT strategy framework used to formulate the ICT roadmap for Nagaland healthcare system. ICT roadmap was developed following The Open Group Architecture Framework (TOGAF) and starts with listing down the architecture principles and compliance to the industry standards required to be adhered to while developing the ICT solution. The high-level Business Architecture landscape was prepared based on the requirement from the stakeholders. Business Architecture helped in designing the Information Systems Architecture and Technology Architecture. Based on these architectures, the five year implementation plan was developed and a risk management plan was prepared for the envisaged risks. An approach is presented in the Program Governance section for successfully implementing the solution.

2 Background and context for the ICT Roadmap

This chapter establishes the background and context for the ICT roadmap developed for Nagaland covering the national and state level service delivery mechanisms and the challenges that need to be addressed through the ICT roadmap.

2.1 Public Healthcare Structure in India

The 'Ministry of Health and Family Welfare' is the apex national body responsible for formulation of health policies, regulations and framework for National Health Programmes in the areas of family welfare, public health, disease control and promotion of traditional medicine. It is also responsible for providing funds to State Health Departments for implementation of various National Health Programmes.

As per the Constitution of India, Health is a state subject. This implies that State Health Departments play a key role in implementation of National and State-Level health programmes, ensuring better access and quality of healthcare service; ensuring affordability through financing; development/ maintenance of public health infrastructure; and training of public health personnel. The states utilize the funds provided by the central ministry and also allocate additional funds from the State coffers for the implementation of National & State-Level health programmes.

Government of India has introduced important structural reforms in the last decade through National Health Mission Programme[1] (NHM) and has re-emphasized on creation of minimum set of healthcare services for all. Recently, as a next step, the government has envisioned 'Universal Health Coverage' (UHC) as the key driver in order to meet its long-term vision in achieving desirable health outcomes. UHC aims at developing a framework for providing easily accessible and affordable health care to all Indians. The National Health Mission Programme and UHC cover major component of Public Healthcare services in India.

2.2 Public Healthcare in India: Need Assessment

For the purpose of this report, we look at health as a complex interaction between medical diagnostic, socio-economical, environmental and political determinants. The political will to implement better healthcare delivery for the masses and vulnerable sections of society in particular is reflected through NHM and UHC initiatives. The delivery of better healthcare services depends on the following components:

- Better access to healthcare services
- Enhancement in health awareness
- Improvement in quality of healthcare services
- Increase in operational efficiency

The bottlenecks in the current functioning of the healthcare service delivery are below:

1 National Health Mission Programme has two sub-mission components, National Rural Health Mission & National Urban Health Mission.www.nrhm.gov.in

2.2.1 Healthcare Expenditure by Government of India

Financing of health is the most critical of all determinants of health system. Government of India has recognized financing in health as a major challenge in delivery of healthcare services, from 2004-05 to 2011-12 a four-fold increase in public health expenditure. Current public health expenditure is 1.2% of the GDP[2]. The total expenditure in health sector in India (including public and private) spending amounts to 4.5% of the GDP[3], which is below the global average of 5.7% of GDP[4] in similar low and middle income countries (LMIC)[5].

The breakup of total health expenditure, in terms of source of financing, is ~78% from private entities with households accounting for the major share (71%). ~20% financed by the Central Government, State Government and local bodies[6]. Direction provided by UHC intends to increase share of government financing from 1.2% to 2.5% by 2017 and to 3% of GDP by 2022[7].

Despite national focus on increasing spending in public health sector, central and state government face challenges in identifying and prioritizing key financing areas in healthcare service delivery. Government of India has a robust macro-level annual planning mechanism for financing interventions under National Rural health Mission Programme for each state; however, capturing the healthcare service demand at micro-level (i.e. health facility level view) has been a challenge. Financial allocation through evidence-based planning for health resources at micro-level has been a key hindrance in ensuring access and quality of healthcare services.

As public health expenditure is determined by previous year spending and forecasted demand for healthcare service (workforce, infrastructure and drugs) in the next year, it is critical that demand for each year is captured based on actual need so that appropriate funds can be allocated by Central/ State government for improving access and quality of healthcare.

2.2.2 Affordability of Healthcare Services

As per National Health Accounts, the Out Of Pocket (OOP) expenditure in India is more than two-thirds of total health expenditure[8], which is high compared to 37%[9] expenditure in similar low and middle income countries (LMIC). Rural households account for 62% of the total OOP expenditure by households for availing different health care services.

Every year 39 million Indians are pushed below poverty line because of indebtedness due to healthcare needs. Healthcare is inaccessible to 30% patients in rural India as they forego medical treatment because of financial constraints. Around 47% and 31% of hospital admissions are financed by loans and sale of assets in rural and urban India (WHO, 2012). UHC has identified the need to reduce OOP expenditure as it aggravates inequities by impoverishing the poor further. Central/ State

2 High Level Expert Group Report on Universal Health Coverage for India, Government of India

3 High Level Expert Group Report on Universal Health Coverage for India, Government of India

4 India Healthcare, CII National Committee on Healthcare

5 Low and middle income countries (LMIC). This is part of the income based classification of countries by World Bank. Income is accepted as important determinant of health outcomes. India falls within the LMIC category.

6 Annual Report to the People on Health, 2011

7 High Level Expert Group Report on Universal Health Coverage for India, Government of India

8 Annual Report to the People on Health, 2011

9 India Healthcare, CII National Committee on Healthcare

governments have introduced health insurance schemes like Rashtriya Swathya Bima Yojna (RSBY), Arogyashri, Chiranjeevi scheme etc. to address this problem.

Implementation of health insurance scheme will require co-ordination amongst multiple stakeholders - patients, hospitals, insurance companies, TPAs, enrolment agencies, central and state government. The focus of public health insurance schemes is on 'Cashless Service Delivery' so that accessible and affordable healthcare services can be provided to impoverished sections of the society by easing financial burden of up-front payment.

2.2.3 Impact on Healthcare Intervention Programmes

The National Rural Health Mission (NRHM) framework provides for various interventions/ schemes to improve health indices for related to the public healthcare services with a strong focus on the following Millennium Development Goals (MDGs),

- MDG 4: Reduce Child Mortality
- MDG 5: Improve Maternal Health
- MDG 6: Combat HIV/AIDS, malaria and other diseases

Health indices for MDG related interventions and other focus areas as defined by Ministry of health and Family Welfare. While the progress on health indicators can be monitored through a robust monitoring and evaluation framework at state level in all states. Certain operational hindrances such as, awareness of public health initiatives, adequate training of healthcare workforce at community level, availability of public health infrastructure etc. which directly impact the progress of health indices needs to be addressed in a more collaborative, equitable and targeted manner.

It is interesting to note that NRHM framework only facilitates vertical interventions in each sub-sector such as reproductive and child healthcare, communicable and non-communicable diseases, family planning etc. Horizontal integration across schemes is needed under the current framework. For example, if a health beneficiary is registered under maternal health scheme and has two children, she should simultaneously be counselled on family planning interventions and scheme provisions; or a tuberculosis patient should simultaneously be registered under nutritional supplements scheme to improve health . Horizontal integration across various public health interventions can provide better care management for health beneficiaries.

2.3 Healthcare in Nagaland

Nagaland State Government has identified health as high priority area. Based only on health indicators, Nagaland healthcare status fares better than the national average on the same. However, in terms of the rate of improvement in these health indices, Nagaland lags behind the national rate for the same.

For example, Infant Mortality Rate (IMR) health indicator, after the launch of NRHM in 2005, has been on steady decline at national level. However, in Nagaland, IMR remains constant over the period 2005-2012. From this data, it may be inferred that various reproductive and child health (RCH) interventions introduced under NRHM have not had a major impact on child mortality in Nagaland.

Overall, the challenges faced by Nagaland can be categorized in the following four categories:

2.3.1 Access to healthcare services and affordability

Nagaland faces challenges due to inadequate access to health care, poor infrastructure, a shortage of specialists and medical staff at several levels. Approximately 90% of the population is economically

weak. Affordability of healthcare is a major concern since very limited number health facilities are empanelled under the health insurance plan for the residents.

Public Health Infrastructure (number of District Hospitals (DH), Community Health Centres (CHC), Primary Health Centres (PHC) and Health Sub-Centres (SC)) in Nagaland is better than the national average and in the case of PHCs and CHCs the numbers are in excess of the sanctioned strength[10]. However, demographic constraints, patient mobility, and setting-up well-quipped 24x7 facilities or referral units in easily accessible local geographies are key challenges in terms of access to healthcare services. In order to ensure access to health services Nagaland state government is paying-out reimbursement bills for patients who are seeking medical treatment outside Nagaland.

Major sections of Nagaland's population are economically weak and are beneficiaries under schemes for Below Poverty Line (BPL) families and Mahatma Gandhi National Rural Employment Guarantee (MNREGA) scheme. Due to their weak economic status some patients, however, choose to forego diagnostic and medical treatments in order to avoid additional financial burden. Another challenge is non-availability of essential drugs/ vaccines at public health facilities. This leads to increased burden on patients who procure these from private vendors at higher costs.

2.3.2 Awareness about health issues and healthcare services

The awareness about communicable and non-communicable diseases as well as about healthcare services in Nagaland are limited by the difficult terrain and the number of dialects spoken in different areas of Nagaland. Moreover, the budget allocated in the health plan for communication and awareness has been on a lower side - dipping to as low as INR 1.2 per resident. The communication medium has generally been focused group discussions in *health-melas* and radio which is not very effective.

In order to facilitate better utilization of services offered under the NRHM framework, there is a need to create awareness on NRHM health interventions amongst health workers and the general population. Creation of awareness amongst the general population will help address psychographic challenges such as expectant mother's preference to opt for home delivery by relatives over institutional delivery or by skilled attendants etc.

2.3.3 Quality of healthcare service

The quality of healthcare services provided to patients is affected by factors such as lack adequately trained resources, non-availability of medical/ diagnostics equipment and services, limited ability to provide total care management for in-patients etc.

At the national-level health interventions are planned for all seven North-east states[11] as a single unit. Nagaland has no medical or nursing college which leads to a supply-side gap in terms of specialists, doctors, nurses etc. shortage of specialist doctors and medical officers at health facilities affects the quality of care services provided by public health facilities. For, example, only one Super-Specialty Hospital is being planned in Assam for all north-east states; only one State Institute of Health Family Welfare (SIHFW) in Assam is responsible for providing training to healthcare workers across all seven north-east states. This creates inequitable distribution of healthcare resources, infrastructure and

10 Sanctioned Strength is the minimum number of Health Facilities that should be operational based on the population as decided by the State Health Department.

11 Based on geographical location, the seven north-eastern states in India are Assam, Nagaland, Meghalaya, Tripura, Sikkim, Mizoram and Arunachal Pradesh

services across the north-east states (including Nagaland).This also limits the ability of Nagaland state health department in providing adequate trainings to the healthcare workforce.

2.3.4 Operational efficiency in delivery of healthcare services

In order to meet the requirement for adequate trained health workforce, drugs/vaccination, procurement and maintenance of medical equipment there is a need for evidence-based planning of public health expenditure in Nagaland. Internal operational efficiency within the State Health Department and across facilities needs to be improved in terms of drug supply chain management, grievance handling mechanism, financial and contract monitoring and HR management.

2.4 Leveraging ICT in Healthcare – inputs from NeGP, leading practices and as-is scenario in Nagaland

Information and Communication Technologies (ICTs) have been leveraged across the globe as building block for providing equitable, accessible, affordable and sustainable healthcare systems. For the purpose of this report Information and Communication Technologies (ICTs) are defined as tools that facilitate communication, transmission and processing of information by electronic means. Government of India aims at leveraging Information and Communication Technologies (ICTs) for implementing finer points of Governance, such as citizen centricity, service orientation and transparency under the National e-Governance Plan (NeGP).

In order to promote e-Governance in a holistic manner, various policy initiatives and projects have been undertaken to develop core and support ICT infrastructure. Core components such as State Data Centres (SDCs), State Wide Area Networks (SWAN), Common Services Centres (CSCs) and middleware gateways (National e-Governance Service Delivery Gateway (NSDG), State e-Governance Service Delivery Gateway (SSDG) and Mobile e-Governance Service Delivery Gateway (MSDG)) have been implemented or are under implementation in each state. Support components include policies and guidelines on Information Security, HR, Citizen Engagement, Social Media as well as Standards related to Metadata, Interoperability and Enterprise Architecture, New initiatives include a framework for authentication, viz.e-Pramaan and G-I cloud, an initiative which will ensure benefits of cloud computing for e-Governance projects.

At the national level, Health has been identified as a Mission Mode Programme under the National e-Governance Plan (NeGP).The foundation provided by National e-Governance Plan components can be leveraged to provide e-health solutions in Nagaland. ICT as tool can assist the public health care system through e-health solution for:

- Improved dissemination of information on public health interventions and services creating awareness to empower citizens
- Enable remote public health data collection at micro-level by ground-level functionaries to ensure evidence-based planning health policies, reforms, regulations and budget
- Improve healthcare access in remote areas through tele-medicine (remote consultation, diagnosis and treatment)
- Capacity building and collaboration among health workers, including sharing of learning and training approaches
- Strengthened the ability to monitor incidences related to public health threats and epidemics and to respond in an effective and time bound manner
- Remote monitoring patients with chronic conditions for improving survival rates
- Improved the efficiency of internal administrative systems in health care facilities.

Based on our field-study, some of the common themes across which the needs for ICT-enabled healthcare solution were required are:

- **Improve alignment of expenditure allocation based on public healthcare infrastructure requirements:** Lack of availability of high quality and reliable healthcare data for evidence-based planning, budget allocation and prioritization of areas for improvement in Public Health Infrastructure across all health facilities.
- **Creating internal operational efficiency:** Improve resource allocation for health workers and improve HR management processes such a training and development, attendance etc. Improve financial and contract management to ensure that funds as available and utilisation certificates are provided along with contract management to ensure proper maintenance of current health infrastructure. Improve supply chain management for essential drugs and vaccinations under NRHM to ensure availability of basic healthcare drugs at facility-level.
- **Need for remote healthcare management:** Due to difficult terrains and lack of specialized healthcare facilities provide remote healthcare support for diagnosis consultations. Improve access to healthcare facilities through centralized ambulance tracking and management services through GPS based systems to provide immediate response to any patient incidence.
- **Need for single point for healthcare information dissemination:** Centralized call-centres for information dissemination for awareness creation on self-health, government health interventions such as Janani Suraksha Yojna (JSY), Rashtriya Swasthya BimaYojna (RSBY); complaints/ grievance redressal registrations, emergency health services and ambulance services.
- **More affordable healthcare:** Creating health insurance systems for deployment across hospitals to provide 'Cashless Health Service Delivery' for under privileged sections of the society.

Taking into account the challenges faced in Nagaland, EY evaluated healthcare related ICT solutions across the globe and in India. Healthcare ICT solutions deployed in developing countries were found to be more suitable and replicable in the context of Nagaland as they face similar challenges, viz.,:

- Need for better access and quality of Healthcare system
- Creating affordable and sustainable healthcare system
- Relatively lower ICT maturity in terms of ICT infrastructure, user-adoption rate etc.
- Need to increase public expenditure in providing healthcare services

The common ICT solution themes that emerge from the leading practice assessment based on suitability and applicability of these solutions in Nagaland are:

- Supply chain management solution
- Mobile health solutions
- Tele-medicine solutions
- Enterprise Resource Planning solutions for state health department and health facilities
- Healthcare helplines
- GPS tracking for mobile medical units and ambulances and
- Health insurance solutions

For developing the Health ICT strategy for Nagaland the approach adopted in this report is to prioritize ICT solutions which can resolve 80% of the challenges in health sector in Nagaland with 20% effort (i.e., high impact with relatively lower effort and cost). Some of the key considerations formulating the ICT strategy for Nagaland were:

- Mobile Penetration: Public health facilities (CHCs, PHCs, SCs) have very limited internet access in Nagaland through State Wide Area Network or private vendors. Since mobile usage and penetration is high in Nagaland, it is highly recommended that mobile-based ICT solutions are more suitable in the context of Nagaland. Mobile based ICT solutions can be deployed for health awareness, remote data collection, remote monitoring, communication and training for healthcare workers, disease and epidemic outbreak tracking, diagnostics and treatment support.
- ICT infrastructure: Optimizing the performance and utilization of the existing ICT infrastructure in the healthcare facilities.
- ICT initiatives: Dovetailing with the current and proposed ICT initiatives so as to optimize the cost and address a larger set of stakeholders
- Multi-sectoral approach: Lots of departments are working in the areas which directly impact the healthcare service delivery such as Department of Labour, Department of IT, Department of Rural development and Department of Census. ICT roadmap is aligned to make the most of the initiatives which are currently being executed or are proposed.

More detailed discussion on the above factors is provided in the architecture chapters later in this report.

3 Leading practices in Healthcare ICT

Over the last decade, ICT has helped in bridging distances and providing access to clinical knowledge, specialized expertise and health services and thus saving lives and costs. The need for reform of health sector and the need for investment in information technology has been part of agenda for all developing economies. It is observed that nature of challenges faced by developing nations in healthcare sector is similar in nature. Most of the problem areas revolve around health awareness, health quality measures, operational excellence and access to healthcare services. Due to existing similarities, EY has studied the practices followed by developing countries to tackle the challenges faced.

ICT implementations in developing countries have provided an alternative tool to answer the questions of access, quality, awareness and operational efficiency in healthcare sector. In the area of creating health awareness, Health Net is one of the most widely implemented computer-based telecommunications systems in sub-Saharan Africa. It currently is being used in over 30 countries by around 10,000 healthcare workers to exchange ideas and provide medical solutions to various problems. Mozambique a sub-Saharan Africa country launched its first Telemedicine project in 1998 which is yet another example of how ICT can help in creating awareness. This telemedicine project was mainly a link connecting two central hospitals was built based on existing terrestrial and satellite communications system using low cost equipment for transmission, exchange and visualization of images and radiographs. [12]

ICT implementations have also helped in improving the quality of healthcare services. In South Africa, the use of mobile phones has enabled tuberculosis patients to receive timely reminders to take their medication. In Uganda, use of ICTs has covered two health Millennium Development Goals (MDG) improving maternal health and combating HIV and AIDS, malaria. Project used handheld computers to provide nurses records, information on deliveries for the day and how many people have visited the health centre. It has also enabled nurses in connecting with the district on the need for Nevirapine (the drug that stops mother to child infection of HIV) which is registered minutes before child birth. [12]

In the area of operational efficiency, computerized Health Management System (HMS) in Bangladesh has helped in raising immunization rates. Tracking under a manual system was leading to poor immunization rates with up to 40% of children failing to complete their course. A simple computerized system was developed that created a register card for each child, and a daily schedule for health workers. As a result, immunization rates improved and it also lead to a sound data foundation for more strategic decision-making.[12]

Besides above cases, in Cambodia, Rwanda, South Africa, and Nicaragua, multimedia communication programs have been increasing awareness on how community responses to HIV and AIDS can be strengthened.[12]

Despite the fact that the role played by Information Communication Technologies (ICTs) in healthcare service delivery as mentioned in above case scenarios, developing countries still lag behind developed countries in advances in information technologies. This is evident from the fact that the developed countries have embraced the use of information communications technologies (ICT) within the hospitals and health clinics since 19th century. It was around that time first application of ICT in

12 Source: http://ijedict.dec.uwi.edu/include/getdoc.php?id=4613&article=465&mode=pdf

healthcare was realized in the form of Hospital Information Systems (HIS). Developed countries realized that ICT allow varied information sources to be monitored or combined in ways that provide better, more seamless, care while freeing up staff time and resources. In fact, developed countries have gone a step ahead as big data coming into picture in improving healthcare services.[13]

Keeping in mind the state of Nagaland, with vast landscape of ICT solutions in healthcare implemented across continents, it is pertinent to first come up with a robust approach that could identify key problem areas and then suggest solutions for the same learning from leading practices followed in other places.

3.1 Approach for undertaking leading practices study

Leading practices in healthcare ICT define best possible solution to problems observed in present healthcare infrastructure and functioning. Various state governments of India have opted for ICT solutions specific to the problems. EY from its vast experience of working with national and state governments has come up with a list of leading practices in healthcare sector in Annexure 1. Also the field analysis conducted in the month of November 2013 in Nagaland has helped in mapping various challenges in healthcare sector to four health outcomes.

- Better access to healthcare services
- Enhancement in healthcare awareness
- Improvement in quality of healthcare services
- Increase in operational efficiency

Field analysis, extensive secondary research conducted and active discussions with key stakeholders of the state has helped in designing the approach for undertaking leading practices that can be replicated in Nagaland keeping in mind the inherent nature of challenges observed.

13 Source: http://www.ctisinc.com/assets/files/publications/CEO_Article_96-102-RajShah.pdf

3.2 Summary of short-listed leading practices

Analysis done below clearly shows how various leading practices cover one or more health parameters. As discussed earlier, each region has its own characteristic problems. Field analysis helped us to find out challenges faced in the state of Nagaland. Table below discusses how various leading practices can help in achieving relevant health outcomes in context of Nagaland. Study below can therefore help in assessing suitability and applicability of each leading practice.

Leading Practices	Location	Applicability to Program Objectives			
		Better access to healthcare service	Enhancement in health awareness	Improvement in quality of health services	Increase in Operational Efficiency
Development of Drug Logistics & Information Mgmt. System	Gujarat	✓			✓
Establishment of Tamil Nadu Medical Services Corp. Ltd	Tamil Nadu	✓			✓
Establishment of Kerala Medical Services Corporation Limited	Kerala	✓			✓
Presence of NHS Supply Chain	United Kingdom	✓			✓
Arogyshree	Andhra Pradesh	✓			
Chief Ministers' Comprehensive Health Insurance Scheme	Tamil Nadu	✓			
Chief Minister's Relief Fund	Madhya Pradesh	✓			
Presence of Healthcare.Gov	USA	✓			
Swasthya Chetna Yatra	Rajasthan		✓		

Leading Practices	Location	Applicability to Program Objectives			
		Better access to healthcare service	Enhancement in health awareness	Improvement in quality of health services	Increase in Operational Efficiency
Kishori Shakti Yojna	Gujarat		✓		
Calendar of Health Promotion Days	Canada		✓		
Mobile Academy	Bihar		✓		
Mobile Kunji	Bihar		✓		
Kilkari	Bihar		✓		
E-Mamta: Mother & Child Tracking System	Gujarat		✓	✓	
E-City (Ahmedabad Municipal Corporation)	Gujarat			✓	
Birth and Death Data Entry Application & Reporting System	Gujarat			✓	
Agency for Healthcare Research and Quality (AHRQ)	Canada			✓	
Establishment of Odisha telemedicine network	Odisha			✓	
Sanjog Helpline	Odisha	✓			✓
Management of Public Health Information System	Rajasthan				✓

Leading Practices	Location	Applicability to Program Objectives			
		Better access to healthcare service	Enhancement in health awareness	Improvement in quality of health services	Increase in Operational Efficiency
Chief Minister's Grievance Redressal Cell	Kerala	✓			✓
Making a Complaint Portal – Medical Council of New Zealand	New Zealand	✓			✓
E-attendance Odisha Healthcare	Odisha				✓
Employee Attendance Management System	Gujarat				✓
Time and Attendance Solution, Health Canada	Canada				✓
Tamil Nadu Health Management Information System	Tamil Nadu	✓			✓
Gujarat HMIS	Gujarat	✓			✓
Andhra Pradesh HMIS	Andhra Pradesh	✓			✓
Primary Health Care Information program	Canada	✓			✓
108 Ambulance Scheme	Rajasthan	✓			✓
Arogya Kavacha (108 Ambulance Services)	Karnataka	✓			✓
GPS enabled Ambulances, Angels scheme	Kerala	✓			✓

Leading Practices	Location	Applicability to Program Objectives			
		Better access to healthcare service	Enhancement in health awareness	Improvement in quality of health services	Increase in Operational Efficiency
Development of Integrated Finance Management System	Gujarat	✓			✓
Meta-Data Data Standards (MDDS)	India				✓
Open data initiative	USA	✓	✓	✓	✓

3.3 Detailed Case Studies

In the following text, detailed description of prominent ICT solutions is presented in the context of challenges faced by in healthcare sectors of Nagaland.

3.3.1 Rajiv Aarogyasri Community Health Insurance Scheme

Location: Andhra Pradesh, India

Impact: Better access to healthcare services

About the project: In Andhra Pradesh, indebtedness due to unaffordable healthcare had led to financial and physical distress for the underprivileged, which had led to large numbers of suicides. In order to deal with this pressing situation, the Government of Andhra Pradesh under Chief Minister Y.S.R Reddy in 2003 began organising health camps providing healthcare facilities to the poor under the Chief Minister's Relief Fund. However, the reach of the chief minister camp of office was limited and could not garner holistic benefits. Subsequently, the Government of Andhra Pradesh developed an innovative scheme for quality health service delivery to the underprivileged in 2007. The Rajiv Aarogyasri Community Health Insurance Scheme is a state funded health scheme for the 2.03 crore BPL families in Andhra Pradesh. The scheme aims to achieve 'Health for all' by assisting poor families in their struggle out of indebtedness through the provision of free insurance through unique PPP model.[14]

Objective: Rajiv Aarogyasri Community Health Insurance Scheme seeks to improve access of below poverty line (BPL) families to quality medical care and treatment for identified diseases through a network of healthcare providers. By providing complete insurance coverage, the scheme hopes to:

- Provide social protection by addressing the problem of growing indebtedness faced by the poor due to burdensome health care costs.
- Monitor trends in diseases and treatment of ailment to ensure healthcare reaches the grassroots.
- Provide health security to the largest and most disadvantaged segment of population.
- Improve overall health infrastructure for the betterment of citizen well-being.

Lessons learned:

- Targeting specific health sector – Aarogyasri filled the gap in the primary and secondary health service sector by offering health camps, screening, counselling and treatment of common ailments.
- Involvement of Private Sector – By involving private network hospitals and private insurance companies, Aarogyasri has ensured operational efficiency.
- Wide coverage – Aarogysri targeted the entire BPL population of Andhra Pradesh.
- Quality Medical Infrastructure and Expertise – Formulated in consultation with experts and specialists from the medical field, Aarogyasri has provided the poor with quality health services that they otherwise could not access.

3.3.2 Development of Drug Logistics & Information Management System

Location: Gujarat, India

Impact: Better access to healthcare services

14 Source: http://indiagovernance.gov.in/files/gkc_oneworld_rajiv_aarogyasri_health_insurance_scheme.pdf

About the project: An online web-based application named Drug logistics Information and Management System (DLIMS) has been developed by NIC integrating various inter-related activities of the Centre Medical Stores Organization Office. This application is operational since December 2006 at Gandhinagar. It provides some selected features for the 457 Direct Demanding Officers (DDO) spread all over the state. DLIMS has played an important role in monitoring various Govt. sponsored National Programmes such as Anti-Malaria, School Health, Epidemic, Nirmal Gujarat, Anti Rabies, Medical Camps etc. [15]

Objective: DLIMS has following objectives:

- To improve efficiency and effectiveness of drug logistics and warehousing system.
- Using latest information and communication technology to improve various functions like procurement; indenting, placing order, bill payment etc. to serve in a better and effective manner.
- To facilitate continuous online monitoring of all activities.
- To integrate all inter-related activities through common database to avoid redundancy, increase accuracy and enhance transparency.

Lessons learned and benefits envisaged:

- Efficiency, effectiveness & transparency have been increased.
- Online monitoring of various functions is possible.
- All activities indenting, procurement, receipt, dispatch, billing etc. are integrated in a single database so accuracy is maintained throughout the process.
- No duplication of data due to central data base.
- Suppliers are a part of system, which increase the transparency of the process.
- Due to maximum automation of various activities time and cost saved considerably.

3.3.3 Arogya Rath, Mobile Medical Unit

Location: Bihar, India

Impact: Better access to healthcare services

About the project: The Mobile Medical Unit initiative is called 'Arogya Rath' in Bihar. The model runs across all 38 districts in the state. Three private organizations were selected to run the MMUs: Spake Systems3 (in 14 districts), Jagran Solutions (in 12 districts) and Jain Studios (in 12 districts). The state has provided for one mobile van per district, which will travel across the district and provide easy access to primary healthcare facilities. Priority will be given to underserved areas so that those with limited access to healthcare facilities can benefit from this program. The private providers are given a target of serving at least 50 patients each day, and operating for 26 days in a month. [16]

Objective: The objective of the MMU program is toprovide regular, accessible, and quality primary health care services to the farthest areas in the districts of Bihar and to provide a visible face for the mission and the government; also establishing the concept of 'healthy living' among the rural masses.

Lessons learned:

- Given the acute shortage of staff at the primary health care level across the state, the government felt that it would not be feasible to run the scheme on its own and decided instead to involve the private sector and run it as a public-private partnership.

15 Source: www.gujaratinformatics.com/pdf/DLIMS.pdf

16 Source: http://www.accessh.org/CaseStudies_Pdf/MMU%20Comparative%20Case%20Study.pdf

- The Contracting process was centralized with the State Health Society undertaking the responsibility for designing the bid documents, identifying selection criteria, receiving and evaluating the bids, and selecting the providers, though the contract was signed with the District Health Society for each district.

3.3.4 Establishment of Kerala Medical Services Corporation Limited

Location: Kerala, India

Impact: Better access to healthcare services

About the project: Kerala Medical Services Corporation Limited has been constituted by Government of Kerala as a fully Government owned company in order to make available quality medicines, supplies, equipment and diagnostic services to the poorest of poor of the population in the state.[17]

Objective:

- To implement a transparent system for procurement, storage and distribution of quality Drugs, supplies, equipment etc. required for the hospitals at reasonable competitive price.
- To ensure adequate savings in the Drug budget by scientific forecasting system based on the preparation of Essential Drug List and its actual consumption.
- Monitoring the budget and drug consumption pattern by introducing pass book system.

Lessons learned or benefits envisaged:

- Loss is avoided due to expiry of drugs and medical items and accountability is introduced at all levels.
- Constant quality control monitoring of drugs and medical items by establishing adequate quality assurance measures is achieved.
- Procedure for procurement, storage and distribution through IT enabled services like e-tendering & e-procurement is adopted.
- Infrastructure of the existing drug warehouse in district improved.

3.3.5 Efficient use of USSD Technology

Location: Worldwide

Impact: Better access to healthcare services

About the project:

Unstructured Supplementary Service Data (USSD) is a protocol used by GSM cellular telephones to communicate with the service provider's computers. USSD can be used for WAP browsing, prepaid callback service, mobile-money services, location-based content services, menu-based information services, and as part of configuring the phone on the network.[18]

Objective:

Implement a technology that can be quickly deployed in any country, be cost effective and can be easily used both by advanced mobile phone users and those who use it for the first time.

[17] Source: http://arogyakeralam.gov.in/index.php/stateintiatives/kmscl

[18] Source: http://en.wikipedia.org/wiki/Unstructured_Supplementary_Service_Data

Lessons learned or benefits envisaged:

- It contains all the necessary instruments for building any type of mobile service and mHealth services in particular.
- Interactive interface of USSD and its ability to immediately show delivered message on a mobile screen perfectly fits the concept of mHealth service.[19]

3.3.6 Ananya Program, Bihar, India

Location: Bihar

Impact: Enhancement in health awareness

About the project: The Ananya Program is a multiplatform program designed to reduce maternal and infant mortality in Bihar, India. Targeting providers and consumers, the program uses m-health to increase knowledge of health providers and mass media to educate consumers in an effort to generate demand for, and utilization of, maternal and infant health services.[20]

Objective: The three main objectives of the program are to:

- Empower CHWs and reach families through mobile applications - This included Mobile Academy as a training course to expand and refresh CHWs' knowledge of 10 life-saving behaviours and enhance their communication skills. Launched in May 2012, Mobile Academy used Interactive Voice Response (IVR) technology that can be accessed from any mobile phone handset (no special software is required). To access Mobile Academy, CHWs make a call that costs less than US $0.01 – about 90% less than standard IVR rates – however health workers must cover that cost themselves. Once on the phone, workers can either complete the training course all at once or at their own pace. Another initiative was Mobile Kunji, which means "guide" or "key" in Hindi, as a job aid that combines IVR-based mobile service and an illustrated deck of cards supporting key maternal and child health messages. When visiting a family, a CHW used to dial the individual short-code printed on each card and a health message played for the family.
- Deliver critical messages through mass media (TV and radio) – This included mobile service called Kilkari to which families with pregnant women and mothers of children under the age of one could subscribe. The service focused on prompting healthy behaviours and generating demand for health services.
- Engage and mobilize the community through street theatre performance and women's listener clubs: In addition to the mHealth components, Ananya Program also utilizes mass media and community-based interventions to improve maternal, infant, and child health in Bihar.

Lessons learned or benefits envisaged:

- Better access to health information can increase demand for health services. Mobile phones provide a means to that access for millions of people, even those living in the most remote areas. However, mobile phones and mHealth applications are not necessarily a cure-all; financing, scaling-up, and sustaining mobile health programs can be challenging.
- Program developers should consider an integrated strategy, one in which mobile applications are complemented by other communication channels such as interpersonal communication, community-based activities, and mass media. One of the strengths of the Ananya Program is its

[19] Source: http://eyeline.mobi/blog/mhealth-ussd/

[20] Source: http://www.healthcommcapacity.org/sites/hc3/files/hc3casestudy_providerconsumersupport_ananya_10_10_13.pdf

‘360-degree approach’ to improve maternal, infant, and child health. In addition to mobile applications targeted at health workers and consumers, the program includes community mobilization and mass media activities.

3.3.7 Swasthya Chetna Yatra

Location: Rajasthan, India

Impact: Enhancement in health awareness

About the project: Health Awareness Rallies or Swasthya Chetna Yatra and free medical camps were organized at the Gram Panchayat headquarters of the districts of Rajasthan from December 1st to 30th December. This campaign was organized through coordination between various departments like Health, Department of Women and Child Development, Department of Ayurveda, Panchayati Raj Department and Education Department.[21]

Objective:

- It was a campaign to spread awareness on health and hygiene among rural people and to benefit the far flung people by free medical camps.

Lessons learned or benefits envisaged:

- Under this campaign, mobile health units fabricated as Raths were taken around the district.
- Free Health Checkup Camps were organized.
- 17548 Health Camps have been organized so far.
- 53.09 lakh patients have been treated.
- Free Medicines have been distributed to 30.02 lakh patients.

3.3.8 E-Mamta: Mother and Child Tracking System

Location: Gujarat, India

Impact: Improvement in quality of health services

About the project: An IT based management tool to plan, deliver and monitor quality MCH services, track drop outs and ensure complete service delivery through Work Plans, analysis of performance and message alerts, thereby reducing IMR/MMR.[22]

Objectives:

- Aims at ensuring service delivery to every individual with special focus on mother and children.
- Plans the service delivery through system generated Work Plans on the basis of beneficiary information.
- Service delivery is monitored to generate further work plans and analyze status of service delivery & quality of service.

Lessons learned or benefits envisaged:

[21] Source: http://hsprodindia.nic.in/retopt2.asp?SD=19&SI=26&ROT=1

[22] Source: http://www.gujaratinformatics.com/pdf/E-Mamta.pdf

- Unique ID based online family health data base covering the entire rural, urban slum and slum like population.
- 100% tracking is possible for complete health services, especially maternal & child health services.
- Reduction in the work of field level health workers as they have not to prepare reports and keep various records.

3.3.9 Establishment of Odisha telemedicine network

Location: Odisha, India

Impact: Improvement in quality of health services

About the project: OTTET Telemedicine & Govt. of Odisha, in PPP mode bridges the gap of demand and supply mismatch - Doctor-wise and Facility-wise for OPD & IPD Patients, in all Medical Colleges, District Hospitals, Sub-divisional Hospitals, Area Hospitals, CHCs, PHCs & extended up to sub-centers to cover 51000 villages of Odisha.[23]

Objectives:

- To deliver health care services in places where there is none and improving the quality of health care where some kind of health care service is available.

Benefits realized:

- Currently, all 3 medical colleges of the state along with all DHHs and Rourkela Govt. hospital are interconnected to provide services through telemedicine covering all 30 districts.
- PG trainees also benefit through online teaching facility.

3.3.10 Telemedicine through Common Service Centres (CSC)

Location: Rajasthan, Tripura, Andhra Pradesh

Impact: Improvement in quality of health services

About the project: Telemedicine makes it possible to connect health specialists from one end of the world, to patients in the remotest corners- anywhere and anytime. The Common Service Centres, or CSCs, are using telemedicine to provide expert health services to mi !lions of Indians in the remotest parts of the country. Government of India has embarked upon pilot projects in three blocks covering 58 Gram Panchayats in three different states. These blocks are Arian in Ajmer district (Rajasthan), Paravada in Visakhapatnam (Andhra Pradesh) and Panisagar in North Tripura district (Tripura). Currently 46 Gram Panchayats have CSCs: 30 in Arain - Ajmer, 15 in Parvada- Vishakhapattnam and one in Panisagar- North Tripura. Tele-ophthalmology in primary care appears reliable and is likely to be valuable in rural areas, where the distance to an ophthalmologist can be a significant obstacle to satisfactory diagnosis and treatment.[24]

Objective:

- To provide high quality and cost-effective video, voice and data content and services, in the areas of e-governance, education, health, telemedicine.

[23] Source: http://www.ottettelemedicine.com/

[24] Source: http://csc.gov.in/index.php?option=com_content&view=article&id=226&Itemid=398

Lessons learnt or benefits envisaged:

- Till now 150 patients are consulted in the two Tele-ophthalmology centres in Ajmer and 80 patients are consulted for telemedicine services in NOFN centres of Arain block.

3.3.11 Open Data in Healthcare

Location: USA

Impact: Improvement in quality to healthcare services

About the project:

Health and Human Services provides open access to health information and health datasets generated or held by the U.S. government. This is a one-stop resource for the growing ecosystem of innovators who are turning our data into new applications, services, and insights that can help improve health.

Objective:

Goal is to unleash the power of private-sector innovators and entrepreneurs to utilize Health and Human Services data to create applications, products, services and features that help improve health and health care -- while also helping to create jobs of the future at the same time. By opening up data, the idea is to help catalyze the emergence of a decentralized, self-propelled "ecosystem" of innovators across America who leverages HHS data to help consumers, care providers, employers, journalists and local policymakers.

Lessons learned or benefits envisaged:

- Initiative provides to the public, free of charge and without any intellectual property constraint, Community Health Data harvested from across HHS – a wealth of easily accessible, standardized, structured, downloadable data on health care, health, and determinants of health performance at the national, state, and county levels, as well as by age, gender, race/ethnicity, and income (where available).
- The Initiative has pioneered new approaches with respect to sharing data and working with innovators outside the government.[25]

3.3.12 Sanjog Helpline

Location: Odisha, India

Impact: Increase in operational efficiency

About the project: Sanjog Helpline (www.sanjoghelpline.in) is the Orissa State Call Center for the citizens accessed through a Toll Free Number 155335 for any complaint related to Orissa Government operated schemes.[26]

Objective:

- Provide a single window service for citizen to register grievances.
- Escalation of citizen grievances to respective departments in a shorter time frame.
- Enable instant information transfer to respective office heads about any grievances in form of SMS, Fax & Mail.

[25] Source: http://www.hhs.gov/open/plan/opengovernmentplan/initiatives/initiative.html

[26] Source: http://sanjoghelpline.in/website/home.html

- Enable 2-way information sharing for tracking down information as well solving grievances.

Lessons learnt or benefits envisaged:

- Providing support with the help of a "Toll Free Number" will definitely increase the efficiency through time and cost savings for people in their dealings with various government authorities for obtaining the required support.
- Automatic escalation of grievance to its higher level if not solved by the ATA.
- In order to legalize the process at the end of each day daily report (number of queries asked, number of complaints registered, number of solved issues etc) will be sent via FAX & Email to the concerned officers.
- The information in portal can be accessed both by citizens, Action Taking Authority and Govt. officials to get information required by them.
- District & Block wise report can be seen on the viewed on the portal.
- Easier for citizen to know the status of registered grievance.

3.3.13 Tamil Nadu Health Management Information System (HMIS)

Location: Tamil Nadu, India

Impact: Increase in operational efficiency

About the project: HMIS project was envisaged by the Health & Family welfare department of Government of Tamil Nadu through Tamil Nadu Health Systems Project as part of the ongoing initiatives for IT enablement of health sector.[27]

Objectives:

- Conceptualized to provide critical health data across the health chain for quick and timely intervention by the health directorates.

Lessons learned or benefits envisaged:

- It is possible to obtain Patient identification number (PIN) which patient can use on next visit to approach the consultant directly.
- Doctors can view the previous clinical history ports on line.
- Handing over and taking over of charges, patient's census is made accountable and transparent.
- The pharmacist can monitor the expiry dates and the batch number of each drug.
- It provides critical health data across the health value chain for quick and timely intervention by health directorates.

3.3.14 Gujarat Health Management Information System (HMIS)

Location: Gujarat, India

Impact: Increase in operational efficiency

About the project: The GHMIS has been envisaged to help the administrators to have better monitoring and control of the functioning of hospitals across the state using decision support indicators and assist the doctors and medical staff to improve health services with readily reference patient data, work flow enabled less-paper process and parameterized alarms and triggers during patient treatment cycle.[28]

[27] Source: www.tnhmis.org/hmis/

28Source: http://indiagovernance.gov.in/files/hospital_management_information_system_gkc.pdf

Objectives:

- Streamline the operations and improve efficiency in government hospitals.
- Improve patient care.
- Effective administration and control.
- Pro-active monitoring of quality health service indicators.
- Integrated state-level holistic view of the resource utilization.

Lessons learned or benefits envisaged:

- HMIS enables monitoring pre-defined health indicators and the embedded exception reporting facilitates decision making by the management and administrators for policy and strategic decisions.
- It leads to efficient health services at hospitals due to digitized history of records.
- It also leads to longer life of patient records.

3.3.15 Andhra Pradesh Health Management Information System (HMIS)

Location: Andhra Pradesh, India

Impact: Increase in operational efficiency

About the project: Department of Health, Medical & Family Welfare, Government of Andhra Pradesh (DoHM&FW, GoAP) intended to deploy IT enabled robust Health Management Information System to provide decision support (Operating, Managerial & Strategic), enhance evidence based policy making and undertake effective monitoring leading to improve accountability and effectiveness at all levels of the health system. Accordingly, DoHM&FW, GoAP has engaged NISG as primary consultant to support them in design & development of appropriate IT enabled Health Management Information system.[29]

Objectives:

- To design and implement Health Information applications that result in significant improvement in efficiency & effectiveness in delivering Health care services.
- To adopt technology which result in significant improvement in the administrative efficiency of the Health Directorates
- To introduce systems that simplifies/optimizes reporting processes across all the services/functions under health system and improves their effectiveness.
- To establish interfaces among key directorates/sub departments for sharing data/information.

Lessons learned or benefits envisaged:

- Provide information related to financial management such as Item wise budget planning and expenditure tracking with a provision of approvals/workflow.
- Provide help on HR Management by providing information on sanctioned strength, staff in position and vacancies, personal details of staff, promotions, transfers, deputations, trainings and pay related details of different categories of permanent & contractual staff.
- Organize information pertaining to birth &death registrations.

3.3.16 Procurement Management Information System (ProMIS)

Location: India

29 Source: http://nisg.org/files/documents/B02040008.pdf

Impact: Increase in operational efficiency

About the project: The Procurement Management Information System (ProMIS) is a centralized procurement, distribution, and management information system. ProMIS seeks to automate and overcome the challenges of the current procurement system; reduce duplication of efforts, and accumulation and wastage of stock; and increase the efficiency of the entire supply chain process, which is initiated by the Ministry of Health and Family Welfare (MoHFW) and percolates right down to the districts. The key features of ProMIS are:

- A web-based solution, which can be accessed from anywhere, anytime.
- Password protected and secure.
- Provides users with customized views; while data is entered by specific and authorised people.
- Easy-to-use with a user friendly interface.
- Provides an expandable, replicable, adaptive, sustainable, and technically versatile model.
- Provides a platform for standardizing procedures and documents.[30]

Objective: ProMIS has been introduced with the following objectives:

- To streamline the procurement systems and develop capacities for effective functioning.
- To address all the key components of international best practices in procurement and logistics.
- To facilitate informed decision making at all levels.
- To reduce time lines.
- To support cost containment strategies in inventory management and administration.
- Monitoring advances, tender and supply status by PSA (Procurement Support Agent).
- Warehouse information system.
- Management information system that is comprised of various kinds of reports.
- Complaint management system.

Lessons learned or benefits envisaged:

ProMIS is currently a post-transactional system and provides the following modules to handle the procurement-distribution-management process:

- Forecasting
- Planning and finalizing procurements
- Processing tenders/bids with a financial evaluation tool
- Downloading and uploading encrypted tender facility
- Feeding technical evaluation results
- Evaluating financial results through the system
- Awarding contracts by centre
- Processing supply orders and distributing the delivery schedule
- Entering data as and when supply orders are issued and updated by the centre
- Issuing release orders
- Analysing quality (pre- and post-dispatch inspection for sampling and testing)
- Invoicing and payment processing.

3.3.17 Metadata and Data Standards Initiative (MDDS)

Location: India

Impact: Increase in operational efficiency

30Source: http://promis-mohfw.gov.in/UserManuals/UserManuals.aspx

About the project:

The Health Domain MDDS Committee is one such initiative, constituted on Sept 2012, under the chairmanship of Joint Secretary (Policy) with the senior technical officer of NIC as its member secretary. The secretariat is located in the National Health System Resource Centre (NHSRC), entrusted with the task of extensive stakeholder consultations and recruiting appropriate technical agencies to support this work. The process included a study of existing systems and their interoperability issues and a study of global data and interoperability standards.

Objective:

The "Metadata and Data Standards" initiative taken by the Ministry of Communication and Technologies under National e-Governance

Plan (NeGP), aims to promote the growth of e-Governance within the country by establishing interoperability across e-Governance applications for seamless sharing of data and services. Under the MDDS initiative domain specific committees have been constituted in priority areas.

Lessons learned or benefits envisaged:

- MDDS would help in conceptualizing Health Information Exchange model. 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.
- Integration with other domain applications would be quite easy.
- The semantic interoperability in different applications can be ensured using a centralized metadata registry using HIE based intelligent gateways having functions to register, discover, transform, notify, query and retrieve concepts and their meta data from centralized metadata registry. This model has already been successfully implemented in Canada Infoway.

3.4 Health data USA & Open Government Data Platform India

Open data is defined as "the idea that certain data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control."[31] The United States Health and Human Services "HHS")is the US Government's principal agency for protecting health of all Americans and providing essential human services. Over the last few years, it has begun "liberating" health data through the Health Data Initiative -- making more and more data from HHS easily available and accessible to the public and to innovators across the country. This information includes clinical care provider quality information, nationwide health service provider directories, databases of the latest medical and scientific knowledge, consumer product data, community health performance information, government spending data and much more.

In addition to publishing data, Health data has focused on making existing data much easier for developers to use, i.e., by making it machine-readable, downloadable and accessible via application programming interfaces while rigorously protecting privacy and confidentiality. This growing inventory of publicly available data resources is easily findable and accessible at a central location through the HealthData.gov website. This helps in promoting the availability of our data to innovators across the country through grassroots "meetups," public competitions, "code-a-thons" and more.

Similarly, the Open Government Data Platform India is a platform for supporting Open Data initiative of Government of India. The portal is intended to be used by Government of India Ministries/

[31] Source: Wikipedia

Departments their organizations to publish datasets, documents, services, tools and applications collected by them for public use. It intends to increase transparency in the functioning of Government and also open avenues for many more innovative uses of Government Data to give different perspective.

On the same lines, Ministry of Health and Welfare of India has released numerous datasets in the field of healthcare. The concept of open data is new and has been well received by innovators in USA. It has lot of potential in India as well in terms of increasing health awareness and improving the quality of healthcare services. The Open Government Data Platform India is a joint initiative of Government of India and US Government. Open Government Data Platform India is also packaged as a product and made available in open source for implementation by countries globally. The entire product is available for download at the Open Source Code Sharing Platform "GitHub".

Benefits of Open Health Data in USA

It has unleashed the power of private-sector innovators and entrepreneurs to utilize HHS data to create applications, products, services and features that help improve health and health care -- while also helping to create jobs of the future at the same time. By opening up data, it has catalyzed the emergence of a decentralized, self-propelled "ecosystem" of innovators across America who could leverage HHS data to help consumers, care providers, employers, journalists and local policymakers.

Open Data in the Indian context

It is expected that the Open data paradigm encourages transparent behavior within bureaucratic institutions. It will allow innovator to use health datasets in building mobile applications that could increase health awareness and quality of healthcare services. It can also increase public participation in improving healthcare services. However, the key challenges in the Indian context would be the following:

- Open Government Data Platform India is not yet well known yet in India.
- Lack of political will in terms of greater transparency within bureaucratic institutions.
- Lack of required computer skills to use data effectively.

The above challenges notwithstanding, it is expected that Open Health Data would be a path breaking initiative in India and hence has been included as one of the leading practices in this report. The following chapter builds upon the current state assessment in Nagaland as well as lessons learnt from leading practices and puts forth the framework used for ICT strategy development.

4 Framework for ICT strategy development

The Open Group for Architecture Framework (TOGAF)[32]has been used as the Reference Framework for developing the ICT roadmap for Nagaland's healthcare system. TOGAF is a structured methodology for development of Enterprise Architecture- which is typically modelled at four levels: Business, Application, Data, and Technology – and for its implementation and governance. TOGAF is based on four interrelated areas of architecture domains:

- Business architecture which defines the business strategy, governance, organization, and key business processes of the organization
- Applications architecture which provides a blueprint for the individual application systems to be deployed, the interactions between the application systems, and their relationships to the core business processes of the organization with the frameworks for services to be exposed as business functions for integration
- Data architecture which describes the structure of an organization's logical and physical data assets and the associated data management resources
- Technology architecture, which describes the hardware, software, and network infrastructure needed to support the deployment of core, mission-critical applications

Application architecture and Data architecture together are termed as Information System architecture and in this report the term "Information System" is used instead of separately referring to application and data architecture as recommended in the TOGAF "Architecture Development Methodology" ("ADM").A modified approach to basic TOGAF is used for developing the ICT roadmap. The phases which are not required have been eliminated and only select artefacts have been created keeping in mind the purpose and scope of the engagement.

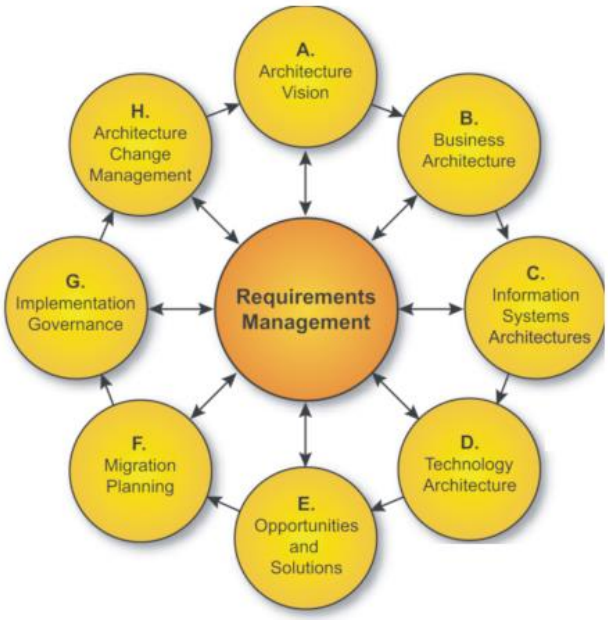


Figure 13: ICT strategy framework

[32] - www.opengroup.org/togaf/

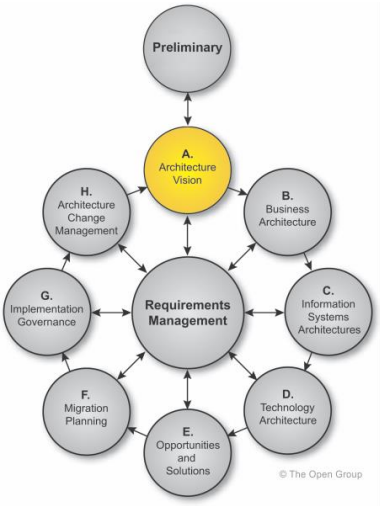
Phases of ADM	Activity performed as part of this engagement
Requirements Management	Every phase has to validate business requirements. Requirements are identified, stored, and fed into and out of the relevant phases, which dispose of, address, and prioritize requirements.
Phase A: Architecture Vision	Set the scope, constraints, and expectations for a engagement. Create the Architecture Vision. Define stakeholders. Validate the business context.
Phase B: Business Architecture Phase C: Information Systems Architectures (Application & Data) Phase D: Technology Architecture	Develop architectures at three levels: 1. Business 2. Information Systems 3. Technology In each case, develop the Baseline and Target Architecture and analyze gaps.
Phase E: Opportunities & Solutions	Perform initial implementation planning and the identification of delivery vehicles for the building blocks identified in the previous phases. Identify major implementation projects, and group them into Transition Architectures.
Phase F: Migration Planning	Analyze cost benefits and risk. Develop detailed Implementation and Migration Plan
Phase G: Implementation Governance	Provide architectural oversight for the implementation. Prepare implementation governance plan. Ensure that the implementation project conforms to the architecture.
Phase H: Architecture Change Management	Provide continual monitoring and a change management process to ensure that the architecture responds to the needs of the enterprise and maximizes the value of the architecture to the business

The following sections describe the outcomes of the various phases described above and the important arte facts developed as part of each of the above ADM phases.

5 ICT architecture and implementation roadmap

5.1 Architecture vision, architecture principles and reference standards

The Architecture Vision is created in the engagement lifecycle to provide a high-level, aspirational view of the end state. The purpose of the vision is to agree at the outset what the desired outcome should be for the architecture, so that architects can then focus on the critical areas to validate feasibility. Architecture vision is prepared after the consultation from the stakeholders and the architecture vision for this engagement is listed below.



The Architecture Vision of the ICT in Health Program is to "***Create an integrated, multi-sectoral healthcare service delivery system for all residents of Nagaland to address the challenges of accessibility, affordability, awareness, quality and operational efficiency"***.

The Architecture Vision has been articulated keeping in view the key stakeholders of the program who will be involved with and benefited from the program. The key stakeholders at various levels are:

- Residents of Nagaland
- Department of Health – Nagaland
- Ministry of Health and Family Welfare, Government of India
- Health facility administrators
- Health Department employees
- Funding Agencies
- Project Management Unit
- Managed Service Provider(s) and
- Other departments of Government of Nagaland whose services are utilized by the health department.

Architecture principles define the underlying general rules and guidelines for the use and deployment of all IT resources and assets across the enterprise. They reflect a level of consensus among the various elements of the enterprise, and form the basis for making future IT decisions. The key architecture principles developed for the ICT program for Nagaland are:

- Availability
- Ease of use
- Performance
- Security
- Manageability
- Scalability
- Inter-operability
- Data accessibility and sharing

The above principles evidence themselves in the form of certain high level architecture requirements which are detailed in the table below.

S. No.	High level architecture requirements
1	**Performance** - The system should provide fast and steady response. The speed and efficiency of the system should not be affected with growing volumes, especially during search operations, reporting, MIS, online processes and batch processes. The system should be operational with good response time using low band width in the hospital of about 32Kb per user, especially for LAN and internet users. The system should support high variance in frequency as the volumes are not expected to be constant.
2	**High Availability** – All the components of the system must provide adequate redundancy to ensure high availability of the applications. The systems shall be designed for 24x7 operations. Designing for availability assumes that the systems will fail, and therefore the systems must be configured to recover from component or server failures with minimum application outage.
3	**Security** – The implementation of the system for each of the project locations should comply with the standard guidelines of Information Security Management System (ISMS). The IA is expected to implement ISO 27001 for the project and should formulate standard security policy and procedures applicable for each of the entities separately. The Data Center Services should be as per ISO 27001 standards.
4	**Manageability (Version Control and Management)** – The proposed system must have versioning features to track and document and process revisions made. A tool may be used for version control.
5	**Scalability** – All components of the system must support scalability to provide continuous growth to meet the requirements and demand. A scalable system is one that can handle increasing number of requests without adversely affecting the response time and throughput of the system. The system should support vertical scalability (the growth within one operating environment) and horizontal scalability (leveraging multiple systems to work together in parallel) by the use of load balancers and other high availability mechanisms.
6	**Inter-operability** - The entire system with all subsystems should be interoperable and must seamlessly integrate with other legacy applications and the applications being developed / already developed by Government of India as well as Government of Nagaland for similar purposes. Operating systems and storage technologies from several suppliers must interact well with each other. These systems should support the open architecture solutions such as XML, LDAP, SOAP, etc. where information/ data can be ported to any system, whenever desired.

7	**Ease-of–use -** Applications developed should be easy to use. The underlying technology is transparent to users, so they can concentrate on tasks at hand. The more a user has to understand the underlying technology, the less productive that user is. Ease-of-use is a positive incentive for use of applications. It encourages users to work within the integrated information environment instead of developing isolated systems to accomplish the task outside of the enterprise's integrated information environment. Most of the knowledge required to operate one system will be similar to others. Training is kept to a minimum, and the risk of using a system improperly is low.
8	**Data is shared and accessible -** Data is accessible for users to perform their functions. Wide access to data leads to efficiency and effectiveness in decision-making, and affords timely response to information requests and service delivery. Using information must be considered from an enterprise perspective to allow access by a wide variety of users. Staff time is saved and consistency of data is improved. Timely access to accurate data is essential to improving the quality and efficiency of enterprise decision-making. It is less costly to maintain timely, accurate data in a single application, and then share it, than it is to maintain duplicative data in multiple applications.
10	**Limited Server Based Computing** – Certain parts of the computing architecture shallbe server based and operate in a client-server design. The applications will reside in the servers and will be accessed through web browsers.
11	**Browser based application Client**– The clients should be supported on latest versions of popular browsers - Chrome, Mozilla Firefox and Internet Explorer. It should also be multi-channel compatible to allow web based as well as mobile based access. The system should be web 3.0 compliant to ensure the applications work on various platforms, browsers and resolution.

5.1.1 Application standards relevant to the program

This section details the various Information Technology (IT) related standards that are to be considered while developing the ICT in health system. The below mentioned components need to be taken care of while developing the technology components on the system:

- Platform Flexibility
  - Web-centric, multi-tier architecture shall be used.
  - Open Standards and Interoperability shall be considered.
  - XML based standards shall be used wherever applicable.
  - Compliance to SOA and Web-services.

- Interoperability
  - Usage of standard APIs.
  - Service-oriented architecture (SOA) based.
  - Support for multiple channels
  - Support for multiple industry standard databases with ODBC, JDBC and Unicode compliance.

- User Experience
  - Applications should have intuitive user experience and the user experience should

remain coherent on all the service delivery channels.

5.1.2 Compliance with Industry Standards

The system shall be based on or compliant with industry standards wherever applicable. This applies to all the aspects of system including but not limited to design, development, security, installation, and testing. Following are some relevant standards that should be considered during implementation.

S.No	Areas	Specifications
1	IT Infrastructure management	ITIL / EITM specifications
2	Service Management	ISO 20000specifications
3	Project Documentation	IEEE/ISO specifications for documentation
4	Portal Development	W3C specifications
5	Internet Protocol	IPv6 ready equipment
6	UHID	Unique Health Identifier (UHID), as a unique (primary or secondary) patient identifier. The UID should be used to identify a particular patient across all organizations (and their EMR systems); Aadhaar number is recommended for use in EMR as either the primary or secondary, where the primary is an internal unique health identifier used by the healthcare provider organisation.
7	Medical standards	Healthcare Information Technology Standards Panel develops a widely accepted and useful set of standards specifically to enable and support widespread interoperability among healthcare software applications. Standards that can be adopted are: HITSP/C 19: Entity Identity Assertion HITSP/T20: Access Control DICOM 3.0 Compliant
8	Imaging	Picture Archiving & Communications System (PACS) standards
9	Healthcare Information technology Standards - HL7 Clinical Document Architecture - Interoperability standard for exchange of electronic health information	Likely to be used for exchanging the clinical documentation between two Electronic Health Record solutions both within an organization and outside

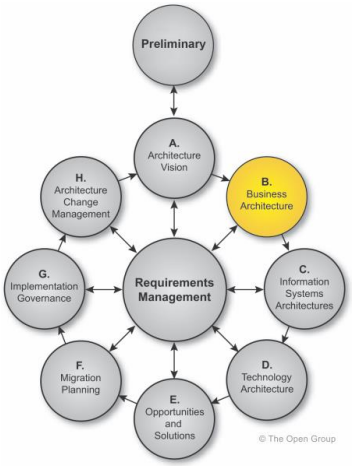
S.No	Areas	Specifications
10	Healthcare Information technology Standards - HL 7 V2.x	Seamless handling of inbound and outbound HL7messages from any system that has similar capabilities
11	Healthcare Information technology Standards - HL 7 V3.0 RIM	Reference Information Model: Intermediate recommendation; to be replaced with HL7 FHIR when it is accepted by BIS/HL7-India
12	e-Health Applications	Web enabled application, Web 2.0
13	Universal standard for identifying medical laboratory observations	LOINC Coding, is Logical Observation Identifiers Names and Codes
14	WHO ICD 10 for Disease Classification	ICD-10 coding, is the international standard diagnostic classification for all general epidemiological, many health management purposes and clinical use
15	Clinical Healthcare Terminology	SNOMED-CT Coding (when available), is a Systematized Nomenclature of Medicine –Clinical Terms, Provide comprehensive clinical granularity, used to capture problem list, allergies, diagnosis, procedures etc. – will immensely aid in clinical analytics, clinical decision support systems, automated clinical care path way management systems, support evidence based practice, etc.
16	ISO 18308	Reference EHR Requirements Specification, the latest version
17	CEN / TC 251 EN 13606	Reference Model & Archetypes
18	ATC Pharmacologic-Therapeutic Classification Indian Drugs – MIMS/CIMS from CMP medica	Needs to be researched as there is no universal drug reference database. The WHO Drug Dictionary ATC – anatomic therapeutic classification – may be a good choice to begin with
19	International Classification of Traditional Medicine (ICTM)	Ayurveda, Yoga, Unani, Siddha, Homeopathy systems of medicine as distinct from the allopathic(Western) system of medicine.
20	Investigations	Investigations coding, Results coding
21	Equipment compatibility	All equipment will be used with international bench-marks that are

S.No	Areas	Specifications
		workable in India
22	Operational integrity and security management	System to be ISO 17799 complaint
23	Disaster recovery	ISO/IEC24762

The system shall adhere to all the IT standards published by the Department of Electronics & Information Technology, Government of India (www.deity.gov.in) and other applicable medical standards listed in the table above as approved by the Ministry of Health & Family Welfare, Government of India.

5.2 Business Architecture

As per Open Group's definition, the Business Architecture describes the product and/or service strategy, and the organizational, functional, process, information, and geographic aspects of the business environment.



The Business Architecture of the **Healthcare Service Delivery Model** in Nagaland is described in detail in this section. The IT needs have been derived based on detailed interactions with various stakeholders in the service delivery value chain.

The Healthcare Service Delivery Model in Nagaland comprises of:

- The Directorate of Health, Nagaland
- The District level set up under the Chief Medical Officer and Nursing Superintendent respectively
- Health Units that include
    - 11 District Hospitals
    - 2 TB Hospitals
    - 1 Mental Hospital and
    - District Health Units that include 21 Community Health Centers, 126 Primary Health Centers, 1 Subsidiary Health Center, 3 Dispensaries and 396 Sub-centers

The key roles and responsibilities of the various organizational stakeholders are described below.

- **Department of Health, Government of Nagaland**: The DoH is the primary stakeholder and nodal agency for delivering improvements in Nagaland's Healthcare Service Delivery Model ("HSDM"). The Vision of Department of Health is to[33]:
    - Prioritize the fulfillment of health needs of women & children in all areas possible
    - Address the health needs of the adolescent and youth.
    - Focus on prevention, stigma & discrimination, care and support in addressing the issue of HIV/AIDS.
    - Deliver basic quality health care to the grassroots level.
    - Develop ownership & participation by Communities in strengthening health services.
    - Develop an efficient Health Management Information System (HMIS) for evidence based planning.
- **Department of Labour, Nagaland**: The RSBY scheme of Government of India is a major initiative for improving affordability of health care services and is administered by the Department of Labor, Nagaland. This makes the Department of Labour an important stakeholder in the ICT program for Health.
- **Ministry of Health and Family Welfare, Govt. of India** –The MHFW is a key link to the HSDM in Nagaland. A variety of schemes and programs have been created by MHFW which are being administered by the Department of Health. The key ones are:
    - Communitization – All the health facilities in Nagaland except the District Hopsitals have been communitized. Under this scheme all health centers are owned by local communities and they plan for and execute the health needs.
    - National Cancer Control Program (NCCP)
    - Oral Health Programme (Dental)
    - National Tobacco Control Programme (NTCP)
    - Health Intelligence Bureau (HIB)
    - National Mental Health Programme (NMHP)
    - Ayurveda Yoga Unani Siddha Homeopathy (AYUSH)
    - Food Safety & Standard Act (FSSA)
    - Nagaland State AIDS Control Society (NSACS)
- **The National Rural Health Mission**: NRMH has its own Directorate in Nagaland and is playing the role of enabler to a variety of health initiatives in Nagaland. It is playing a complementary role to the Department of Health's various initiatives.

The other key stakeholders include Doctors, Health Facility Administrators, Employees of Department of Health, Lab technicians, Nurses and Frontline Workers. Based on our needs assessment, the below Business Architecture diagram represents the key stakeholders of the ICT program and the Information Systems that are required by each of them.

[33] Source: http://nagahealth.nic.in/vision%20statement.htm

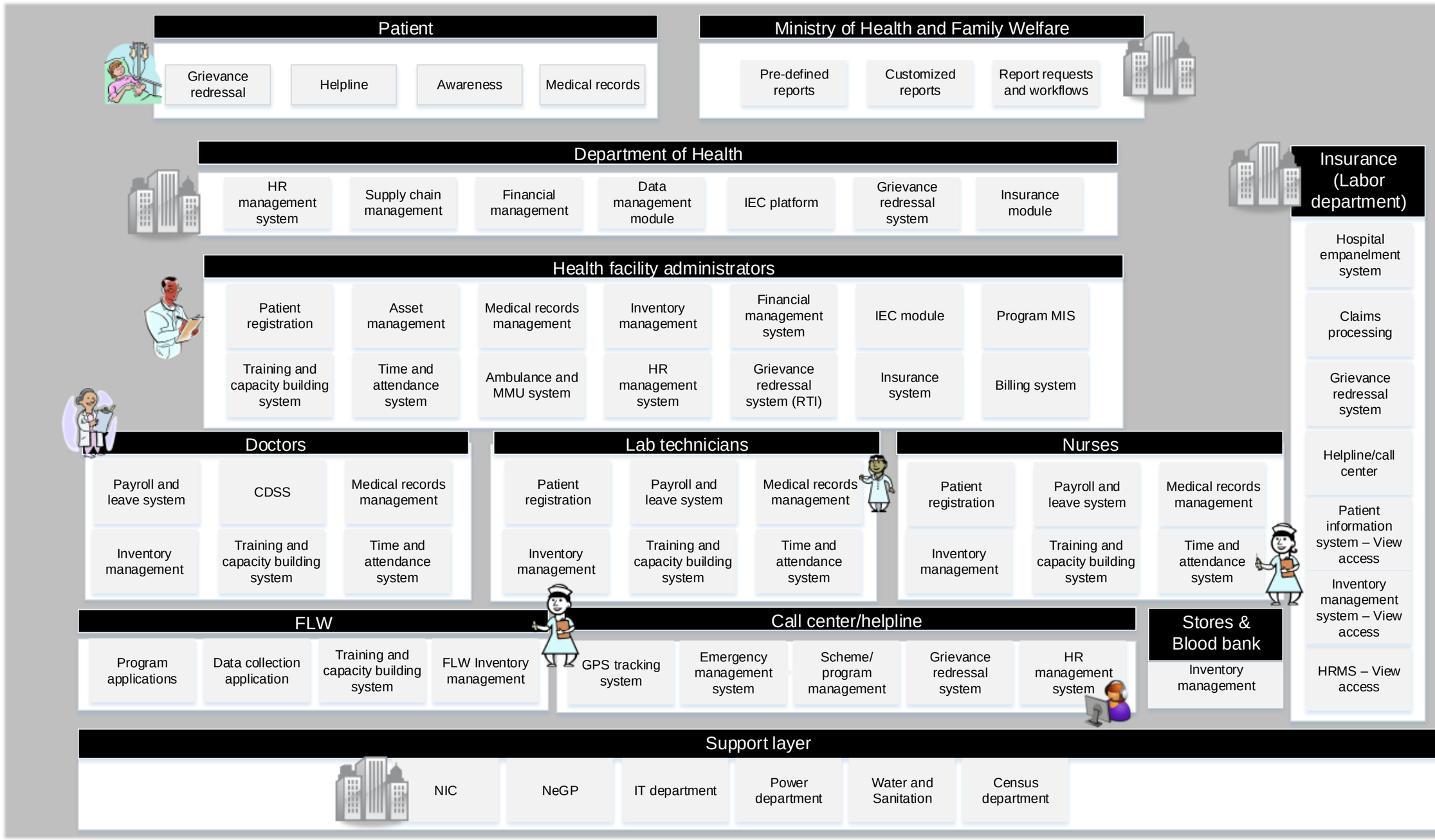
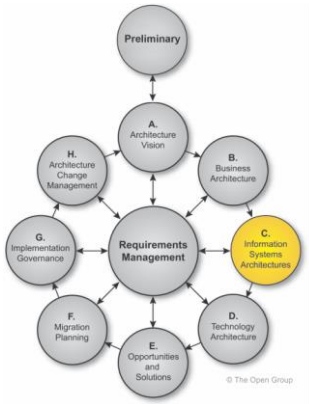


Figure 14: High level Business Architecture and Information System Needs

5.3 Information Systems architecture

The Information System Architecture comprises of two sets of architectures – **Application Architecture** and **Data Architecture**. This section describes the application and data architecture required to support the business architecture described above.



5.3.1 Application Architecture

The objective of the application architecture is to define the major kinds of application system necessary to process the data and support the business. Based on the detailed assessment of IT needs of various stakeholders, the following applications have been identified.

S. No.	Application	Brief description & benefits to the ICT program
1	Supply Chain Management	The Supply Chain Management (SCM) solution will help in optimization of inventory and supply chain processes with respect to medical supplies. This will cover the entire process of indenting, approval, dispatch and record keeping. At present, the health department follows a manual centralized procurement process for procuring and distributing the drugs which is creating major inventory management challenges in Nagaland. The key objectives of SCM solution are: • To streamline the procurement systems and develop capacities for effective functioning • To address all the key components of international best practices in procurement and logistics • To facilitate informed decision making at all levels • To reduce lead times • To support cost containment strategies in inventory management and administration
2	Finance Management System	Financial management system provides an integrated suite of accounting and financial management modules for managing health facility's operations and personnel. The Financial Management system will deliver the following benefits : • Consolidates and reports on financial position of healthcare facilities

S. No.	Application	Brief description & benefits to the ICT program
		○ Capital expenditures & asset acquisition ○ Funding receipts ○ Utilization of funds • Integrate with Insurance Management System and help manage cashless hospitalization claims • Manage cash receipts for treatments and lab facility usage • Efficiently manage vendor invoices and tracks payment transactions • Vendor contract management • Automate payroll processing and reporting
3	HR Management System	The HRMS system will be vital for the Department of Health for effective workforce management. The HRMS is expected to enable: • Manage all activities in the Departments Hire-to-Retire lifecycle • Create and maintain a central Employee Database • Manage recruitment, training programs and performance of employees • Enable employee self-service to improve management of leave, payroll and benefits views and training
4	Time & Attendance Management	A specific solution requested for by the Department of Health to manage issues around non-attendance of healthcare staff is the Time & Attendance Management System. This would integrate with the HRMS and may have additional components like 'access cards' to enable better tracking of time & attendance.
5	e-Learning	The E-learning solution is expected to enable capacity development with the Department and reduce costs of training. Given the highly dynamic nature of the healthcare industry, the e-Learning solution is aimed at delivering trainings at multiple levels. Some of the key objectives include:

S. No.	Application	Brief description & benefits to the ICT program
		• Better Program and Project Management by Managerial staff in DoH • Skills upgrade of Doctors, Nurses and FLWs • Better dissemination of key policies and healthcare program related details
6	Program Management Information System	The DoH of Nagaland is required to design and manage a wide variety of Centrally Funded and State Funded healthcare programs. A host of metrics are required to be collected regarding the programs to report 'Physical' and 'Financial' progress of the Program/Scheme implementation and its benefits to the state. The PMIS is expected to have three key features: • A Central Management Dashboard to enable consolidation of program information and its reporting to various stakeholders • Interfaces with the HMIS and various mobile apps to collate healthcare data both at the facility level and a more granular field level data
7	Insurance Management System	Insurance (esp. the RSBY) scheme is the vital link to improve affordability of healthcare in Nagaland. The Insurance Management System is expected to help automate the full work flow for: • Enrollment of facilities for cashless hospitalization • Application and approval of claims and • For preventing fraudulent claims and leakages in insurance administration
8	Hospital Management System	The Hospital Management System is expected to have light-weight and full-feature variants to support the functioning of smaller facilities like PHCs as well as larger facilities like the CHC or the District Hospitals. The various modules are detailed in the solution charter. Keeping in view the specific issues of terrain and connectivity in Nagaland, this report has also proposed a distributed architecture based deployment of the solution.

S. No.	Application	Brief description & benefits to the ICT program
9	Health Facility Asset Management System	The Health Facility Asset Management system is expected to help in procurement, allocation and tracking various fixed and movable assets deployed at the various healthcare facilities and to ensure their better utilization.
10	Electronic Medical Records	Electronic Medical Records Management is expected to be a key element of Hospital Management in this ICT program. This initiative will involve a software application to support creation and maintenance of UHID linked EMR and also a program to enable field level data collection. The Nagaland Healthcare - Open Data Initiative (detailed later in the data architecture section) is also expected to leverage anonymized data derived from the EMR.
11	Clinical Decision Support System	The Clinical Decision Support System is expected to help in providing doctors with advanced information modules on diseases, treatment options, reference cases and various tools for analysis of health data for improved clinical decision making.
12	m-Training	Mobile based training is expected to help improve capacities of field level workers and support the IEC campaigns. In this report, an IVRS based training model is proposed. In addition, this strategy report also factors in provisioning of mobile devices to FLWs which can be used for delivering rich media training content over the network.
13	RTI & Grievance Redressal System	This is a standard application to enable management of RTI queries and grievances from the time of their logging to their closure. This is expected to be a workflow management system.
14	Mobile Apps for Program Management	This IT strategy envisages two types of mobile apps. One category of apps will be Program Specific Apps that help in disseminating and gathering data regarding the reach and impact of various healthcare schemes and programs.
15	Mobile Apps – Information, Education & Communication	This is the second category of apps which will focus on delivery of information, education and communication with citizens, FLWs and healthcare staff. These apps will feature rich content and could

S. No.	Application	Brief description & benefits to the ICT program
		use various channels such as SMS, USSD and Data networks to deliver content.
16	Telemedicine	This is a standard telemedicine suite to help people in remote areas of Nagaland obtain expert/specialist consultation without having to incur major costs in travel and also to expedite treatment in critical cases.
17	Healthcare Helpline	The Healthcare Helpline will feature a Contact Center (CRM) module to support information queries and grievances/issues/requests and provide timely and prompt assistance to citizens.
18	Emergency Healthcare Management System	The Emergency Healthcare Management System will be an extension of the helpline that will interface with mobile units and/ambulances to deliver emergency healthcare rapidly.

The detailed description of each of the applications is provided in Annexure 2 – Solution Charter. The application and capabilities are defined without reference to any specific technologies and products. The application features are considered to be stable and relatively unchanging overtime, whereas the technology used to implement them may change over a period of time.

5.3.2 Data Architecture and Open Healthcare Data

The objective of the data architecture is to create data sets necessary to support the business and it is not concerned with database creation. The goal is to define the data entities relevant to the business, not to design the logical and physical storage systems. Data is shared; accessible and trusted are the key architecture principles which lay the foundation for data architecture.

Key considerations of for data architecture are:

- **Data Management**: A clear definition of which application components in the application landscape will serve as the system of record or reference for master data. Clear understanding of how data entities will be utilized by business functions, processes and services.
- **Data Migration**: When an application is upgraded or replaced by a new application. A clear understanding of the data to be transformed, weeded and cleansed for the target application
- **Data Governance**: Business to have a structure to manage data entities for transformation, management system to manage the governance aspects of data entities throughout the lifecycle and people to have skills to effectively manage the data entities.

It is expected that during the course of the ICT program, various data sets of value will be created for the following entities. These data sets may be created as a result of a one-time Data Entry/Migration project and ongoing use of various software applications for managing the Healthcare Service

Delivery System. The key data sets will include data about the following. More data sets may be created by the Department of Health and published over a period of time.

S. No.	Data Set	Description
1	Healthcare facilities	This data set will comprise of data about hospitals, health facilities at district, block and village levels, labs, pharmacies and various fixed and movable assets forming part of the service delivery model.
2	Human Resources	This will comprise of data regarding the Employees of Department of Health, Doctors, Nurses, frontline workers, and various auxiliary support staff such as lab technicians, specialists and the skill profiles of these personnel.
3	Population Statistics	This will comprise of various population health statistics including birth, death, mortality rates, sex ratio, and variety of factors specific to Nagaland and factors that help in assessing healthcare demographics.
4	Public Health & Community Health Status Indicators	
5	Mother & Child Health	This will comprise of specific metrics relating to pregnancy, pre-natal and post-natal care, infant and child health, and nutrition related statistics.
6	Immunization & Diseases	This will comprise of data regarding immunization programs, coverage of population, impact of immunization on control of various diseases.
7	Electronic Medical Records	Electronic Medical Records is a major healthcare intervention planned in Nagaland. It is expected that this will result in availability of UHID linked electronic medical records of a vast majority of the population. This will also help in collecting significant amount of statistics about general status of health in Nagaland's population.
8	Emergency Healthcare, Injuries & Accidents data	This data will be compiled from emergency management system to draw data to support provisioning of emergency handling system and for statistics about common injuries and accidents.
9	Healthcare finance, Medical Insurance Coverage and Statistical Information	The will include edata on health expenditures for the entire population, characteristics of the covered populations, use of services, and expenditures under various programs. In addition, it will also comprise of RSBY data on access to healthcare, coverage in insurance schemes and various statistical information regarding public health expenditure.
10	District-wise health data	This data set will provide district-wise statistics of healthcare including key health metrics, coverage in

S. No.	Data Set	Description
		immunization programs, status of healthcare service delivery, healthcare spend/finance and impact of healthcare programs.
11	Performance of Healthcare facilities	This data set will comprise of facility-wise statistics on resources available in the facility, usage of the facility by citizens and impact on the local health demographics.
12	Clinical Decision Support (CDS) Inventory	The Clinical Decision Support (CDS) Inventory modelled along the lines of US Open Health initiative shall contain descriptions of past and present CDS projects, clinical conditions, delivery settings, patient populations and technical environments.
13	Frontline Worker Data	This will comprise of statistics about FLW enrollments, staffing, training, activities supported, technology enablement and impact delivered.

5.3.3 Data Application Programming Interfaces (API) and formats

To support the above data architecture and to make it available to various stakeholders, it would be essential to publish the data in various formats and provision various APIs that can enable the data to be interfaced with various government applications. The APIs enable applications to search and query the data sets programmatically. It also publishes 'metadata' and 'data summaries' for use in reporting applications. These could be used by Ministry of Health and Family Welfare for rapid compilation of various program performance data. In addition, the data sets would need to be made available in various formats through public portals. The key formats to be supported include

- CSV
- JSON
- XML
- RDF
- XLS
- Plain Text
- Map and
- ATOM/RSS feeds

To realize the above information systems architecture, various underlying technologies will be required. The following section describes the technology architecture required to support the above Information Systems Architecture.

5.4 Technology Architecture

The High Level Technology Architecture described in this chapter is derived based on the Business and Information Systems Architectures detailed in the previous chapters. In arriving at the high level technology architecture, the team has factored in various emerging technologies and how they can be 'appropriately' deployed in a state like Nagaland given its unique terrain, power availability and network penetration challenges. Following were the key considerations taken into account while arriving at the high level technology architecture and choice of technologies for Nagaland.

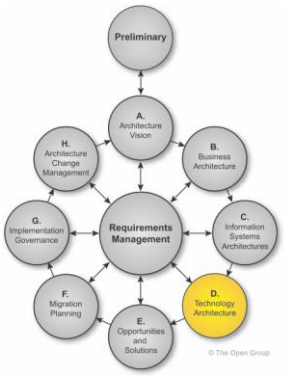


Table 1: Key considerations for technology architecture

Consideration	Technology implication(s)
Poor network and telecom connectivity: Though Nagaland is implementing State Wide Area Network, it is expected that the current network and telecom availability and Quality of Service (QoS) challenges will continue in the near to medium term future.	• **For business applications**: Software solutions must be capable of working in a 'disconnected' mode without the need for access to any central servers for data, identity management or workflow processes. • **For application and data management**: There should be mechanisms to serve, update, patch applications and replicate data using "low bandwidth". This also requires that the applications should be capable of storing data locally for extended periods of time in case of continued network non-availability. • **For mobile applications**: Mobile applications should be capable of working in disconnected more and alternative solutions which can work on basic telecom connectivity (without data) also need to be provisioned for. • **For connectivity**: Given the difficult terrain in Nagaland, network technologies that rely on line-of-sight may not be useful. There is a need to use 2G/3G/4G telecom technologies for providing last mile data connectivity. For office connectivity in major cities the state's Broadband backbone would need to be used. However, these may be hampered by poor power availability all the same and network availability could be low.
Poor power availability: Interior parts of Nagaland have very poor power availability.	• **For devices**: Devices that are used in Nagaland should ideally have low power footprint and be capable of running on batteries. This makes Mobiles, Tablets and Laptops more preferable in comparison to PCs. • **For offices;** Offices would require power backup mechanisms
English is commonly used and understood by a large portion of Nagaland's population	• From a localization perspective, it appears that Nagaland's Health ICT systems can be built using English as the preferred language and no language localization requirements need to be factored in.
Improving penetration of mobile devices and 2G/3G mobile networks	• For frontline health workers and ASHA workers this opens us numerous opportunities to enable them with mobile applications for data gathering, for IEC campaigns.

Consideration	Technology implication(s)
SWAN, State Data Center, State Portal and State Service Delivery Gateway initiatives under NeGP are currently under implementation in Nagaland	• Reuse and integrate with these foundational elements to accelerate technology deployment for ICT programs in Nagaland • SWAN allows extension of broadband connectivity upto Block level health centers. This creates possibilities for making use of Telemedicine technologies at the block level. • Availability of the State Data Center will help accelerate deployment of ICT applications without the need to create data center infrastructure specifically for the ICT program. • The State Portal can be used to publish various services and enable open data initiatives and accelerate various public interfaces for the ICT program. • The SSDG (Service Delivery Gateway) initiative is expected to create a middleware backbone to allow interoperability between various State Government applications. This will, for example, help the ICT program interface easily with payment gateways, applications of treasury, power, water and labour Departments.

Keeping in view the above considerations, the following technology landscape is recommended for Nagaland. The Reference Architecture is depicted in the diagram below.

5.4.1 Reference Architecture for ICT in Healthcare in Nagaland

Since this report is an IT roadmap report for the next 5 years, the purpose of this reference is to highlight the key technologies that are expected to be made use of in ICT for Health in Nagaland. The technology specifics might emerge only at the time of implementation. However, it is expected that the reference architecture captures all relevant technology components of the landscape. The Reference Architecture has been detailed in 4 layers following the TOGAF approach of separation of Information Systems Architecture from the Technology Architecture. The layers being:

- **Service Delivery Channels or Access Channels** which describe how the various Information Systems will be accessed.
- **Information Systems Layer comprising of Applications Layer and Data Layer** which describes the software applications that would be supported by the technology architecture and the data that will be hosted. [These have been covered in the earlier chapter on Information Systems with their respective Solution Charters.]
- **Middleware Layer** which describes the key middleware components that will be used to support the Information Systems Layer.
- **IT Infrastructure Layer** which defines the underlying IT infrastructure components to support the above layers.

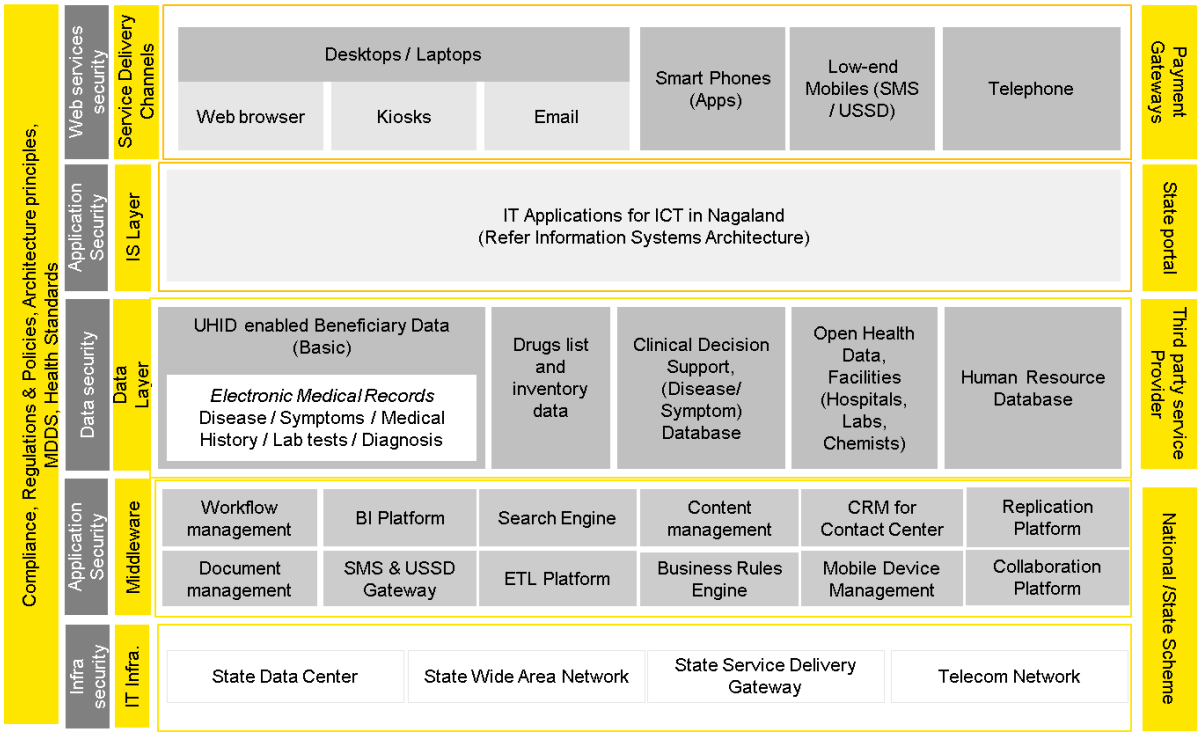


Figure 15: Reference Architecture for ICT in Health

5.4.2 Service Delivery / Access Channels

Three service delivery channels have been considered in the Reference Architecture.

- **Desktops/Laptops**: As stated above, laptops are the preferred choice for Nagaland over desktops given the battery backup facility though PCs may also be used for office computing purposes.
    - For business applications, it is expected that Web Browsers would be the primary access mechanism. To support multiple end-user operating systems, typical Windows/OS-bound applications are not preferred given the challenges in installation and delivering application updates. It is expected that laptops/desktops will have local data stores supported by replication mechanisms to enable automated application data backup to central servers upon network availability. (Note: The architecture approach proposed here is similar to that of anti-virus applications that have local data stores and allow standalone applications to replicate based on network availability.)
    - Kiosks shall be set up at Primary, Block and District Healthcare facilities to promote Citizen Self-Services and also for IEC purposes. This has been derived as a leading practice input following success of various similar facilities in e-Governance.
    - For the general public as well as for health officials, Email will be an important access channel. In the middleware layer, the CRM backbone has been provisioned to enable automated processing of email based enquiries and service requests.
- **Mobile based service delivery:** Mobiles (phones and tablets) are expected to be the most important service delivery channel in Nagaland. India has already successfully launched USSD based banking services. It is expected that USSD will be a game changer in Nagaland in increasing access to services. In addition, various mobile applications could be created for

Field Level Workers and for the citizen that can run on smart phones to enable access to numerous Data Collation and IEC services.

- The traditional telephonic access channel will help in enabling universal access to healthcare related information and will also act as the main Emergency Services access channel.

5.4.3 Information Systems Layer

The information systems and data bound to the applications are discussed in the detail in the earlier chapter on Information Systems Architecture.

5.4.4 Middleware Layer

Following are the key middleware components that are proposed in the reference architecture.

- **Workflow management and business rules engine**: While the ERP and Hospital Management System are expected to address majority of the business workflow requirements of the Department of Health as well as the health centers, a workflow management platform would be required to create custom workflows and enable various ad-hoc business processes. This will help administrative officials track various pending tasks and take appropriate action for their closure. The specific choice between workflow management and the need for a business rules middleware is to be evaluated during implementation.
- **ETL Platform**: To support the standard MIS requirements of the Department of Health as well as the requirements to enable an Open Data initiative in Nagaland's healthcare, a ETL platform would be required to help extract, transform and load raw data into various data models suitable for MIS and BI requirements.
- **BI Platform**: The BI platform will enable rapid data analytics and faster decision making for the Department. It will also help consolidate standard healthcare metrics as well as Program performance related data for Department of Health as well as various Program Reporting purposes.
- **Search Engine:** The search engine feature is required as a plug-in for various applications proposed in the Information Systems layer. It is expected to enable:
    - Search for content and documents
    - Search through databases and open data sets
- **Content Management:** The IEC program of Nagaland will depend extensively on new rich content being developed and delivered through various platforms that include website, mobile apps and kiosks. To effectively manage this content and its publication through various channels a content management system is required. In the absence of this rapid enablement of IEC campaigns will be difficult and would require repeated involvement of programming teams to update websites, apps and kiosks.
- **Document and Records Management:** Document management systems are vital for any enterprise to manage documents and records over time. This is a standard component of all e-Governance programs globally and is highly recommended for Department of Health as well as for the Health Centers as well. In addition, this is expected to be one of the solution building blocks of the Patient Records Management System as well.
- **CRM for Contact Center:** The Contact Center is a key element of CRM suite for Contact Center is expected to support the following features.
    - Email, IVR, Fax, Post and Voice based contact process
    - Call Center Agent support system
    - History/Log of contact with the contact center
    - Service Request status tracking mechanism

- Automated Call Distribution System
- Interactive Voice Response System

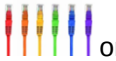
- **SMS and USSD Gateway:** SMS and USSD based services will be a very important technology tool in Nagaland. While SMS-es will support IEC campaigns, especially for mass communication purposes and for updating citizens about the status of their service requests.

  USSD (Unstructured Supplementary Service Data) is a mechanism to enable mobile based service delivery which can be made operational even in low end mobile phones. It is also beneficial due to the need to have very limited literary to use the facility. Unlike Short Message Service (SMS) messages, USSD messages create a real-time connection during a USSD session. The connection remains open, allowing a two-way exchange of a sequence of data. This makes USSD more responsive than services that use SMS. USSD Gateways enable the routing of USSD messages between the telecom network and the application that will actually respond to the request and back.

- **Replication platform**: Replication solutions will play a very important role in Nagaland's ICT program. The expectation here is that this could be managed with replication features available in off-the-shelf RDBMS solutions and with well written SQL scripts. It is being specifically highlighted as it will be vital to enabling Nagaland's IT applications to work in offline/disconnected modes.
- **Mobile Device Management**: The ICT program will rely extensively on the provisioning of tablets to FLWs for IEC programs and to enable them with a variety of program apps. Mobile Device Management will be an important technology element to enable the following:
  - Centralized management and tracking of Tablets
  - Issue resolution, application updates and device security
  - Enable data management and synchronization with central applications
  - Enable data protection and identity & access control in the devices
  - Remote application updates and upgrades

5.4.5 IT infrastructure layer

The IT infrastructure layer will comprise of the following key elements – State Data Center and State Wide Area Network. The details of these elements can be found here. http://www.nic.in/state/Nagaland. In addition, for network connectivity the following technology matrix is recommended for end to end connectivity to support the ICT program. The below matrix has been arrived at considering the appropriateness and ease of deployment of the various technologies at different levels of Nagaland's ICT Service Delivery Model. The key considerations as outlined in the introductory part of this section have been factored in to arrive at these recommendations.

S.No	Facility	Primary mode of connectivity	Secondary mode of connectivity
1	Department of Health		
2	Chief Medical Officer		 or 
3	District Hospital		 or 
4	Community Health Centre		
5	Primary Health Centre		
6	Sub Centre		
7	Field Level Worker		

Legend

	SWAN		VSAT		Data Card		GPRS		Leased Line

Table 2: Network Connectivity - Technology Options for Nagaland

In addition to the above, the Nagaland State Portal (https://nagaland.gov.in/portal) and Service Delivery Gateway projects (as and when they are implemented in the state) will support the ICT initiatives in terms of public outreach, transparency and interfacing with other Departments of the state. The following sections detail the implementation plan, capacity building plans and cost estimates based on the above technology architecture recommendations.

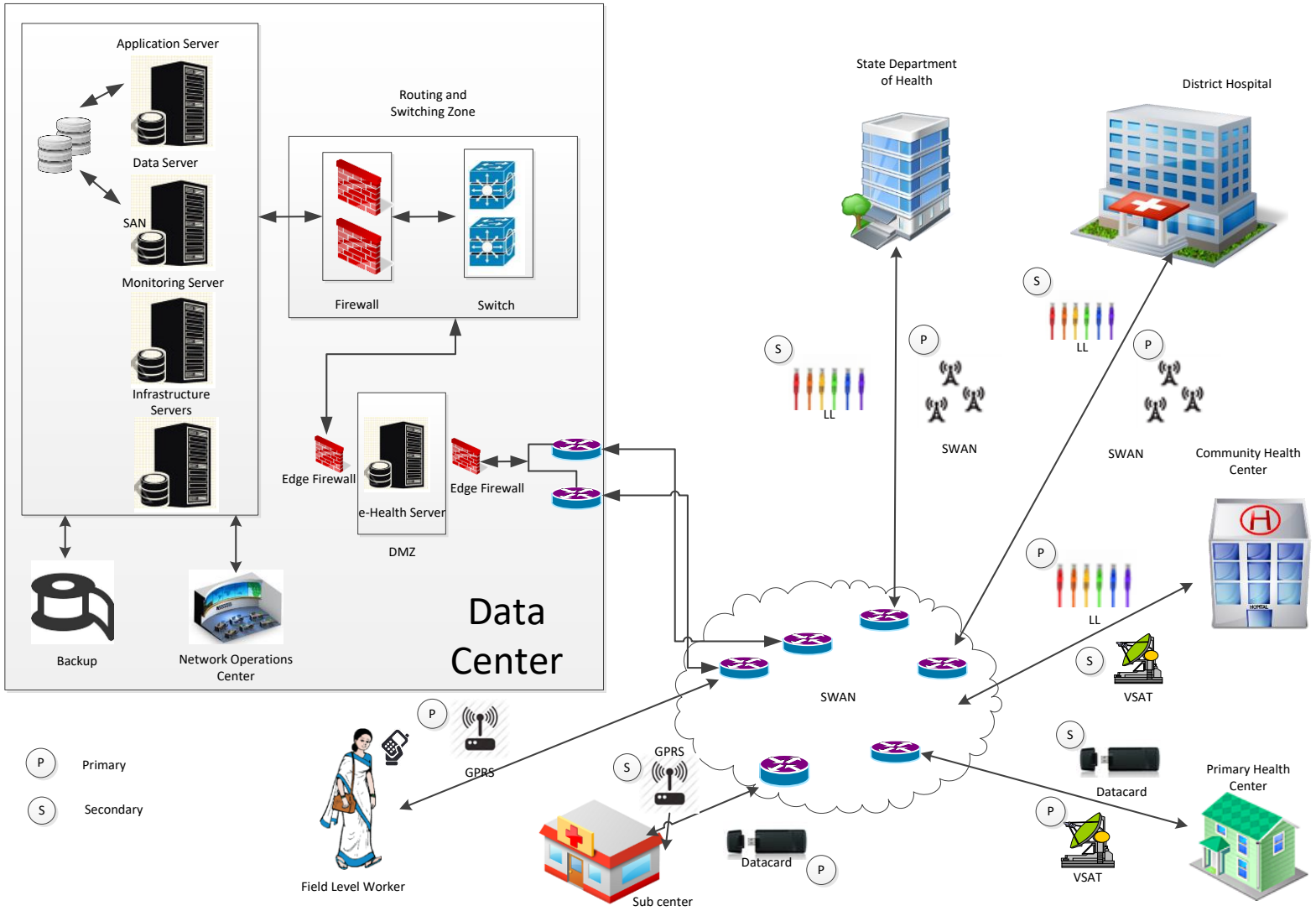
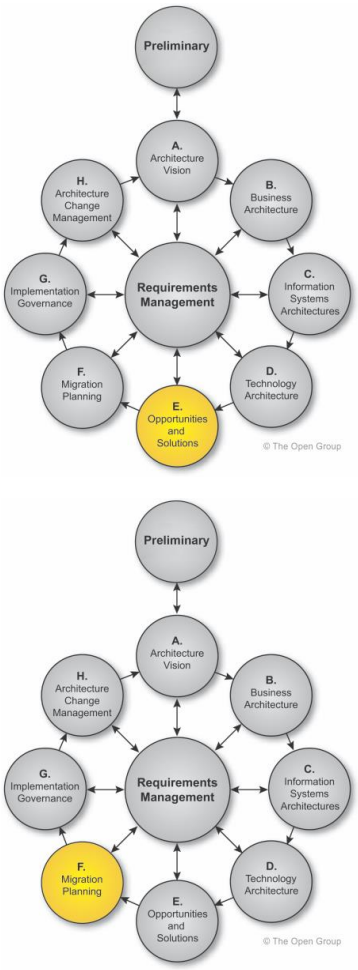


Figure 16: High level technology architecture

5.5 Implementation plan and prioritization

To arrive at the implementation plan, the various IT initiatives identified have been prioritized using a Prioritization Framework that considers the Business Impact of the initiatives and the Implementation Complexity. The following sub-factors were considered in each of these two dimensions.

- **Business Impact**: Business Requirements which has three sub-factors:
  - Criticality and Priority assigned by stakeholders
  - Number of stakeholders directly impacted by the proposed ICT solution
  - Impact on the improvement in healthcare delivery
  - It also captures EY's assessment of the business scenario and guidance from leading practices.
- **Implementation complexity**: The ICT solutions proposed are evaluated on the set of the parameters mentioned below for preparing the implementation plan for deployment.
  - Time to deploy
  - Development efforts to create the solution
  - Resource training and capacity building including change management
  - Ability to leverage existing ICT infrastructure
  - Need to procure new ICT infrastructure



Based on the above dimensions, the IT initiatives were grouped into four categories as depicted in the diagram below.

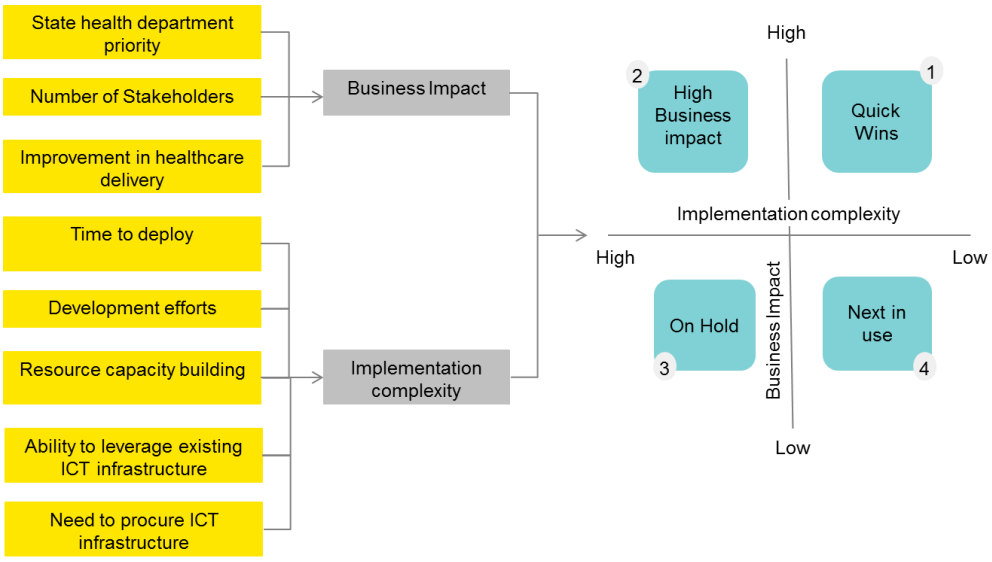


Figure 17: Key factors for implementation

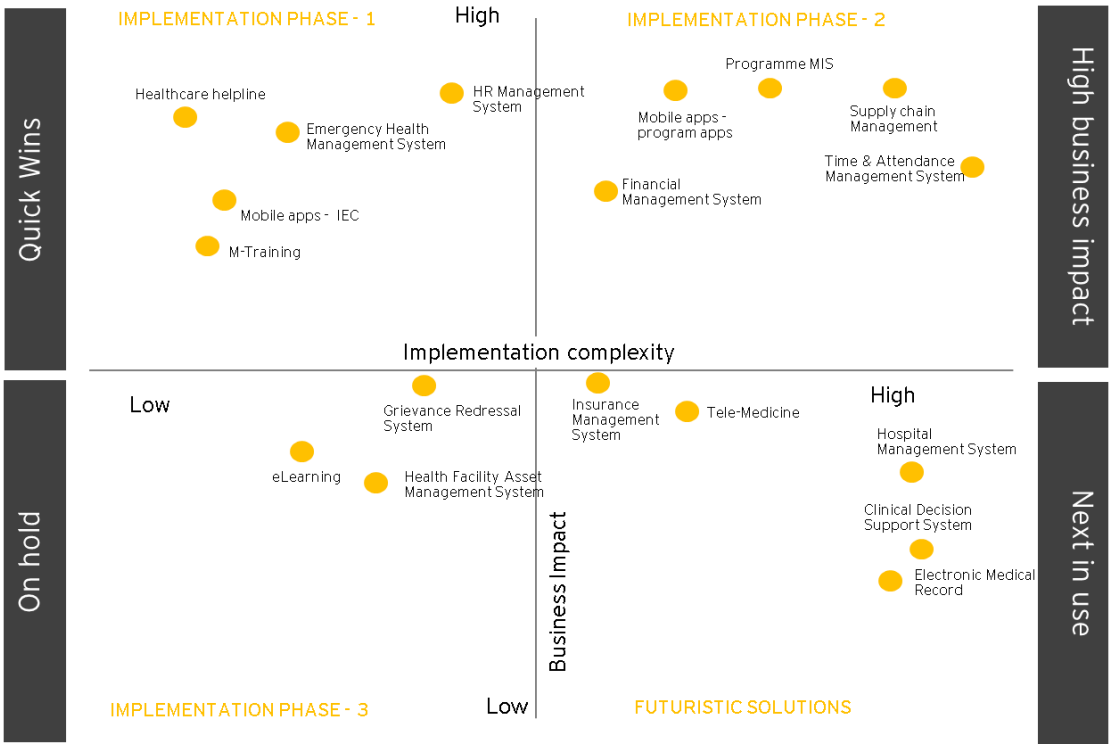


Figure 18: Implementation Priority Matrix

Detailed working is attached in the Annexure-3. The following initiatives are shortlisted for implementation under six themes.

Initiative	Theme and Key outcomes supported
Supply Chain Management	• Strengthen Medical Supply Chain management in Nagaland • Enable better quality of healthcare through timely availability of medical supplies • Improve operational efficiency in healthcare system
Finance Management System	• Strengthen Financial Management to enable faster approvals, streamline budgetary allocations and track expenditures against outcomes
HR Management System	• Strengthen HR management functions of the Department for streamlined payroll processing, better leave management and enable stronger career management processes • This is expected to improve operational efficiencies, address problems around absenteeism and contribute to better quality of healthcare services
Program Management Information System	• Streamline administration of Schemes and programs • Improve data gathering about scheme/program impact by enabling supporting mobile apps for program data gathering
M-Training and Mobile Apps for Information, Education & Communication	• Mobile based solutions to enhance reach of IEC initiatives • This is expected to enhance healthcare awareness and help in better control of communicable diseases and address age/gender group specific health issues
Healthcare Helpline and Emergency Health Care Management System	• Support Emergency Management and improve access to healthcare

The implementation plan is shown below.

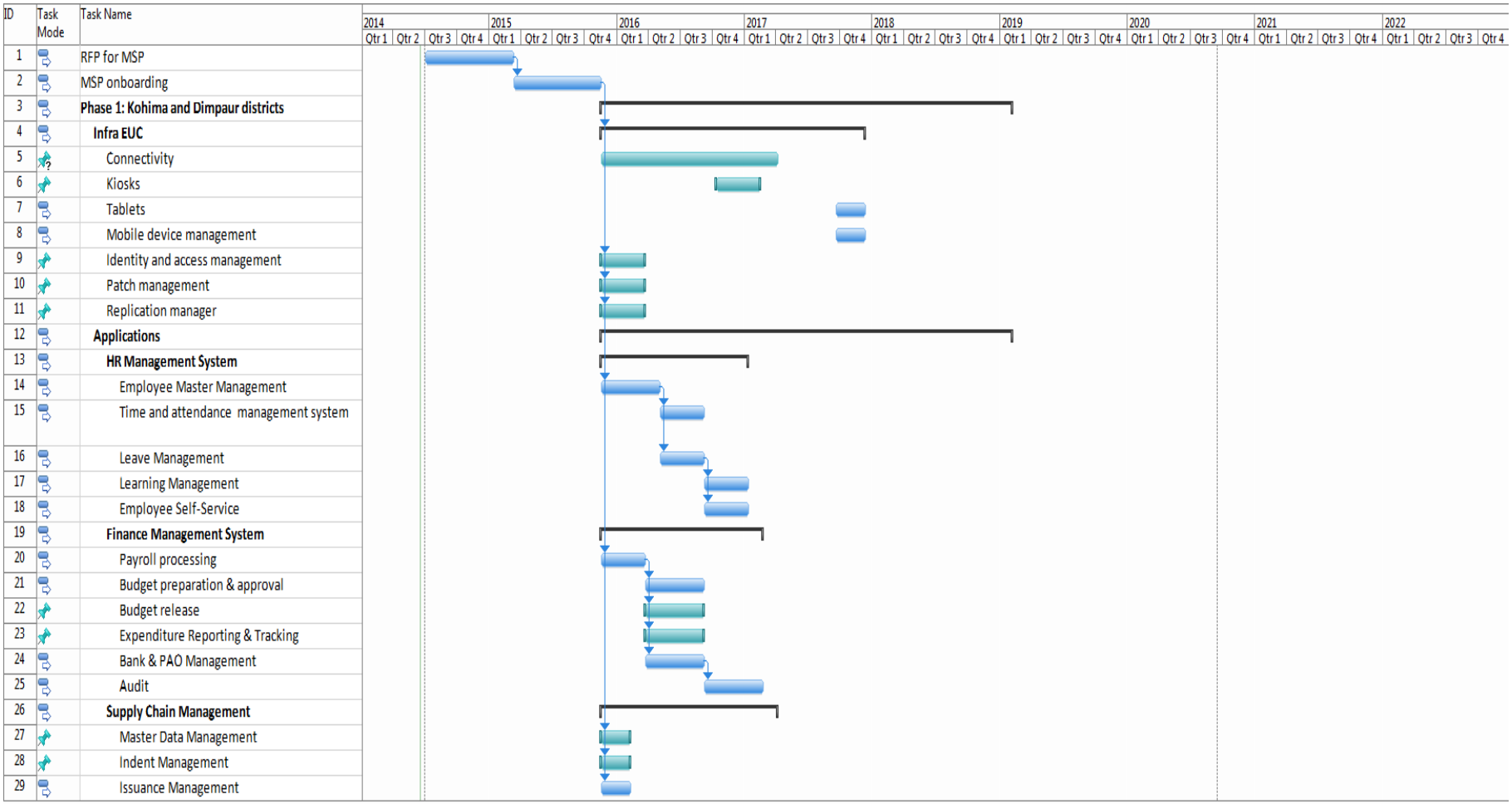


Figure 19: High Level Implementation Plan - Part 1

ID	Task Mode	Task Name
30		Invoice & Payment processing
31		Forecasting
32		e-Procurement & Tendering
33		**Programme Management Information System**
34		Program Management (Scheme Management)
35		Data management module [ETL Tool]
36		Reports Generation & BI
37		**Mobile apps**
38		IEC Apps
39		**Program Apps**
40		MCTS
41		HMIS
42		Learning Apps for FLWs
43		Vehicle tracking system
44		Information, Education & Communication System
45		Helpline/call center
46		Emergency Healthcare Management system
47		Phase 2: Roll-out in the next 9 districts
48		**End User Training**
49		End User Training 1
50		End User Training 2
51		End User Training 3
52		End User Training 4
53		End User Training 5
54		End User Training 6
55		End User Training 7
56		End User Training 8

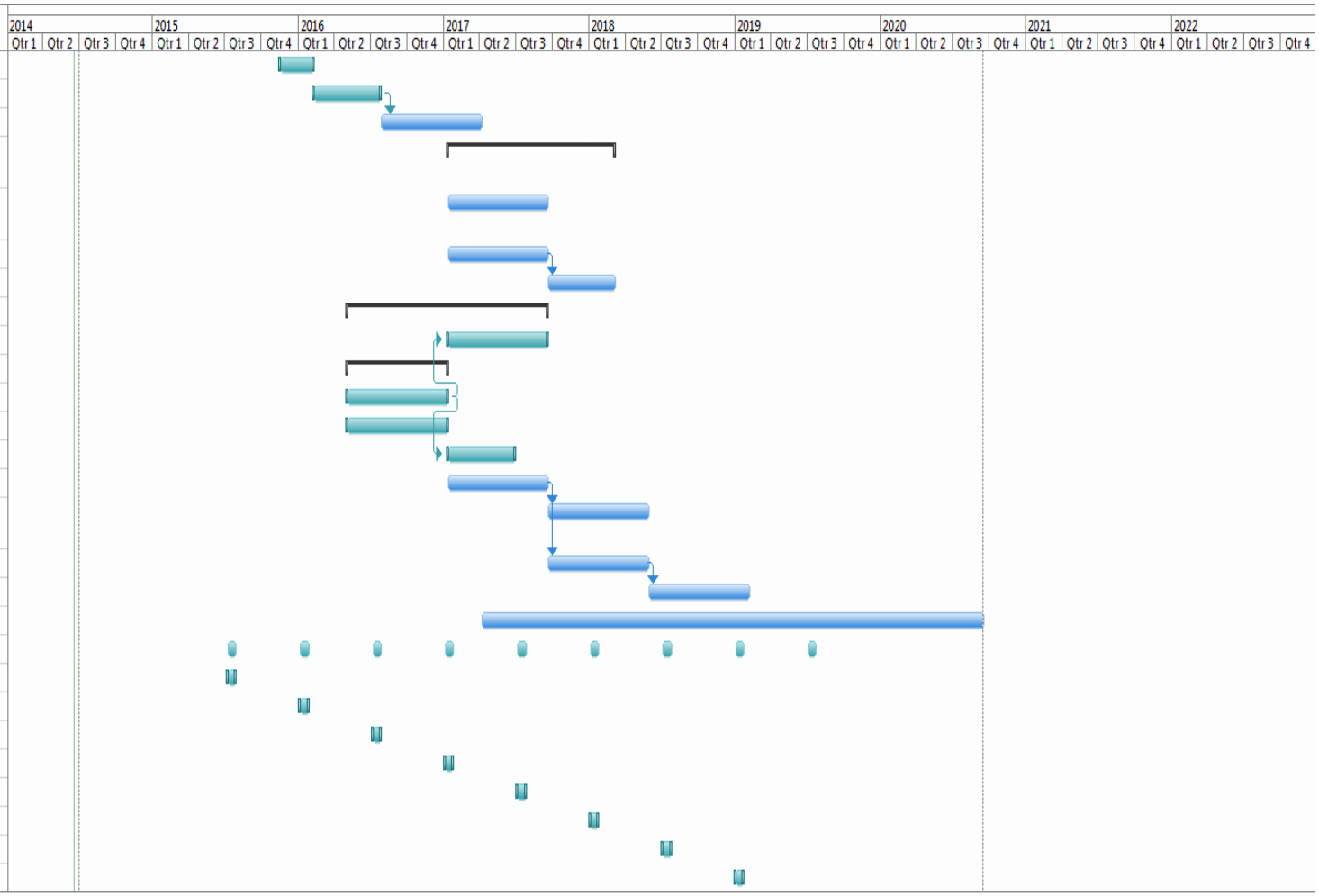


Figure 20: High Level Implementation Plan - Part 2

5.5.1 Key risks and Mitigation measures

Specific mitigation plans for each of the identified risks are suggested in addition to recommending a governance framework for monitoring these risks. The following table summarizes the key risks identified for the implementation of the ICT Strategy, and the estimated probability and impact of these risks on the implementation progress. Key mitigation actions for mitigating these risks have also been enumerated.

A	Risk Type	Technology Risk			
	Implications	**Probability**	**Impact**	**Risk level**	**Risk Mitigation Strategy**
A1	▶ Inadequate / ineffective IT program implementation. ▶ The Programme Management Committee program could miss opportunities in delivering IT infrastructure facilities.	M	H	H	▶ Setup a program IT Board to draw a blueprint that comprehensively identifies IT linkages and integration points across stakeholders and all levels of the program. ▶ Setup of an IT Strategy & Execution Office as recommended in the IT Strategy to oversee the implementation of IT initiatives, as per the implementation plan ▶ Periodic review and reporting of the proposed IT initiative implementation progress to be done to the ICT Steering Committee as recommended in the IT Strategy.
A2	▶ Lack of an architecture led approach.	M	H	H	▶ Setup of an IT Healthcare Data Standards Authority, as proposed under the IT Governance structure. ▶ Development of enterprise Architecture design capabilities within the IT team. ▶ Training of IT staff in the area of enterprise architecture. ▶ Review of the effectiveness of critical IT systems to check their alignment with the overall IT architecture.
A3	▶ Complexity of the architecture	M	H	H	▶ Clear definition of the entire ecosystem and broad level functions. ▶ Inclusion of all

					stakeholders in the development process.
A4	▶ Data Loss	L	H	M	▶ Formulate well defined policies for prevention of data loss in the system.
A5	▶ Data Privacy	L	H	M	▶ Formulate well defined policies for role based access and access to data on need-to-know basis. ▶ Communicate the controls and policies to all concerned stakeholders and strict implementation of the same.
B	**Risk Type**	**Business Risk**			
	Implications	**Probability**	**Impact**	**Risk level**	**Risk Mitigation Strategy**
B1	▶ Non availability of Business Continuity Plan	M	H	H	▶ Prepare a Business Continuity Plan. ▶ Setup Disaster Recovery team with clear roles and responsibilities of each stakeholder during the disaster. ▶ Conduct necessary trainings to all concerned stakeholders. ▶ Setup necessary infrastructure for the disaster recovery and conduct periodic DR drills.
B2	▶ Delay in periodic project status reviews/ decision cycles.	M	H	H	▶ Timely approvals from Programme Management Committee. ▶ Fixing a pre-defined time limit with mutual discussions during which the approvals & decisions need to be given for various tasks.
B3	▶ Failure in obtaining anticipated results.	M	H	H	▶ Establish feedback mechanisms to take corrective measures. ▶ Conduct regular workshops on services delivery concept and create awareness regarding the benefits of the system
B4	▶ Lack of quality services to citizens due to non-transparent system.	L	M	H	▶ Prepare a citizen charter for all the services offered. ▶ Define escalation mechanisms and make it available to public. ▶ Implement the grievance

					redressal in the first phase of the system.
C	**Risk Type**	**Program Management Risk**			
	Implications	**Probability**	**Impact**	**Risk level**	**Risk Mitigation Strategy**
C1	▶ Incomplete definition of functional scope of ICT in health Application	M	H	H	▶ Defining processes in detail and documenting the same. ▶ Process documents to be reviewed and updated regularly at pre-defined intervals. ▶ Post implementation, process audits to be conducted to fine tune the processes
C2	▶ Stakeholder involvement & commitment	M	H	H	▶ The roles and responsibilities of every individual stakeholder would be clearly outlined leading to transparency and accountability of every stakeholder in the project. ▶ Regular status reviews to check the readiness of Stakeholders.
D	**Risk Type**	**People Risk**			
	Implications	**Probability**	**Impact**	**Risk level**	**Risk Mitigation Strategy**
D1	▶ Resistance to change in process and technology from the employees of various stakeholders.	M	H	H	▶ Communicate the changes and envisaged benefits to the entire user community in advance ▶ Create awareness and provide necessary trainings. ▶ Handholding support for 3 months at each Health Unit for smooth transition.

D2	▶ Lack of skilled IT resources	M	H	M	▶ Outsourcing of the IT support function to a vendor. ▶ Choose technologies which have a wide resource base. ▶ Define the SLAs in the contract to ensure availability of skilled resources.
E	**Risk Type**	**Legal Risk**			
	Implications	**Probability**	**Impact**	**Risk level**	**Risk Mitigation Strategy**
E1	▶ Delays in necessary amendments and Issuance of Government orders.	M	H	H	▶ Formation of a legal committee to identify necessary legal changes. ▶ Preparation of Government Orders well in advance.
E2	▶ Delays in formation of ICT steering committee.	L	H	M	▶ Setup of relevant committee in timely manner. ▶ Continuance of existing committees/ additional powers till the setup of relevant committees through necessary Government Orders
F	**Risk Type**	**Network and Power Risks**			
	Implications	**Probability**	**Impact**	**Risk level**	**Risk Mitigation Strategy**
F1	▶ Unreliable power and network facilities.	H	H	H	▶ De-centralized servers at each Healthcare facility. ▶ Hybrid Architecture ▶ Offline Systems for Data Capture. ▶ Speed up the installation of VSATs. ▶ A thorough feasibility study for each location. ▶ Speed up the process of set up of solar power for each Health Unit

					▶ Existing DGs for power backup ▶ Individual UPS for each PC/ Switches

5.6 High Level Cost Estimates

The cost estimates are based on a portfolio of assumptions and actual costs incurred may vary during implementation. These estimates are intended to be a high level guidance only to assist in execution of the IT Strategy. These estimates are for duration of five years and account for the following:

- Software license costs for initiatives that need additional software to be procured.
- System implementation effort and the related costs to the initiatives
- Expert hours required to carry out specialized system architectures and strategies
- High level IT infrastructure costs
- The personnel and operating costs of IT division are not budgeted for in this estimate.
- **Software license costs:** Software license costs have been taken at list prices as available from EY's internal databases and/or external publicly available sources for a variety of products that may meet the solution requirements. It is to be noted that these are indicative rates and OEMs/vendors may offer higher or lower prices in the actual implementation.
- **System implementation costs:** The implementation costs have been arrived at based on assumptions on effort required and blended cost rates for system implementation resources as prevalent in the region. It does not provide for cost escalations, discounts and development environments.
- Out of pocket expenses are not included
- No taxes are included

Please find below a cost heads:

Cost heads
Data Center costs
Health facilities IT infrastructure setup
Connectivity
Training and capacity building
Professional services cost
Software Costs
One time License cost
AMC for 4 years
Customization cost

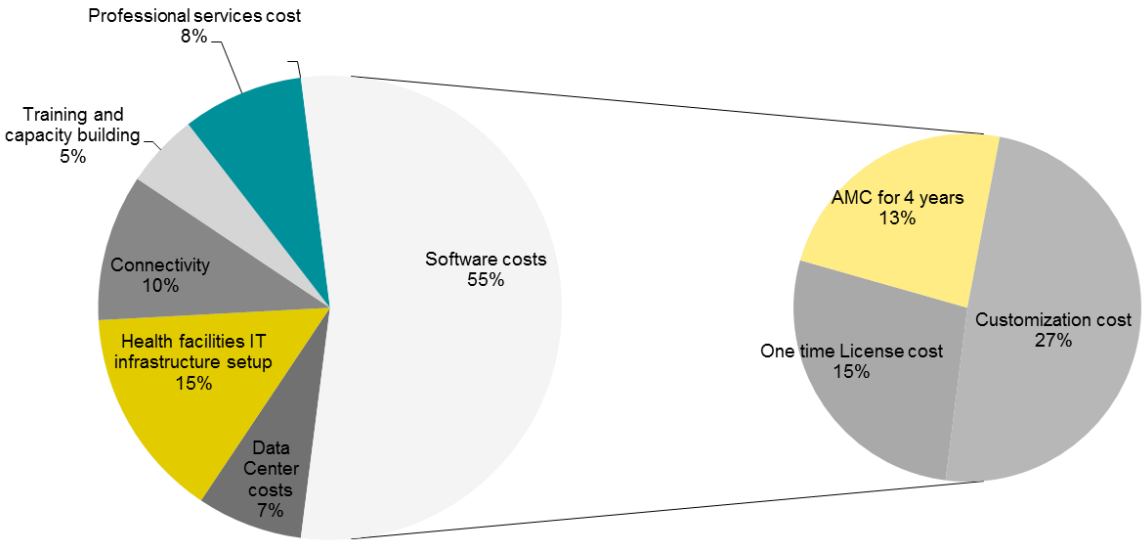


Figure 21: Break-up of cost heads

The breakup of the software cost is shown below in the table spread across five years:

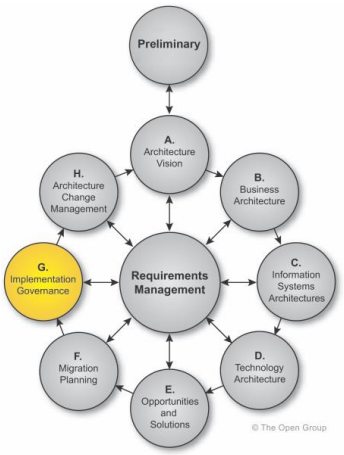
Initiative
BI Platform for Health Service Analytics
Mobile Device Management
CRM for Contact Center
Mobile apps
Customization of the COTS product
PMIS
IEC Content Development
m-Training
ETL platform

The breakup of the connectivity cost is shown below in the table spread across five years. This includes network setup cost at the facilities as well as the recurring data charges.

Connectivity cost heads	Connectivity type	Number
Department of Health	Wi-Max/Broadband	1
District Hospital	Wi-Max/Broadband	11
Block Level	VSAT	74
CHC	Broadband/GPRS	21
PHC	Broadband/GPRS	126
Sub center	GPRS	396
Ambulances and MMU	GPRS	100

5.7 Program Governance

"Governance is defined as the process of developing, communicating, implementing, monitoring, and assuring the policies, procedures, organization structures, and practices associated with a given program" – the Project Management Institute (PMI) standard for Program Management



The ICT in Health program proposed for Nagaland spans over a term of five years. The Program envisages a large group of ICT and non-ICT projects to be executed in a coordinated manner to derive the benefits. In such long term programs, the program governance model is of vital importance. Experience of several large scale programs suggest that "Benefits delivery" of a long term program is strongly correlated to continuity in Program Management and consequently, the importance of a strong Program Management Office.

5.7.1 Role of Program Governance in the ICT in Health Program

Governance spans the entire program life cycle and assists in managing ***risks***, ***stakeholders***, ***benefits***, ***resources***, and ***quality***. The governance structure is expected to ensure that the Program's goals and objectives are aligned with the strategic goals and objectives of the Department of Health of Nagaland for which the ICT in Health program is being developed.

The ICT in Health program overlaps a number of organizations, with one or more being customers, performing organizations, suppliers, or stakeholders. The key ones include:

- Citizens of Nagaland
- Front-line Workers / ASHA workers
- Department of Health, Government of Nagaland
- Department of Labor, Government of Nagaland
- Various Program Directorates, e.g., NRHM, ICDS, RSBY etc. set up in Nagaland under various National and State level schemes
- Ministry of Health and Family Welfare, Government of India
- The World Bank in its role as the Technical Assistance provider
- NIC, Department of IT – Nagaland & NeGP as providers of various technology services

The governance framework is required to ensure that important interfaces between these stakeholders are managed carefully to minimize program and inter-component conflicts. The interaction between Program and Project Management Processes is depicted below. The key activities of Program Governance, as per PMI, include:

- Identification, monitoring, and control of the interdependencies between projects
- Dealing with escalated issues among the projects and
- Tracking the progress of each project in the context of the master program schedule

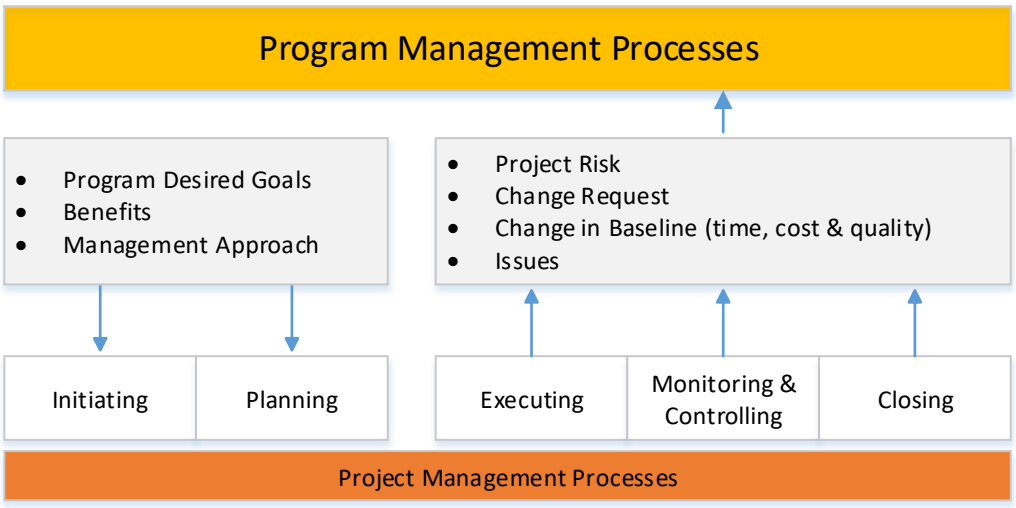


Figure 22: Role of Program Governance – Interaction between Program &Project Management

In addition, to the above, a major activity in Public Sector programs is Tracking of Benefits and Communication of Benefits to the various stakeholders. The following functional structure is proposed keeping in view the above activities and responsibilities of Program Governance.

5.7.2 Proposed Functional Structure for the Governance Team

A 3-tier Program Governance Model is proposed for the ICT in Health program in Nagaland. It envisages

- A Program Steering Committee chaired by Principal Secretary – Health, Govt. of Nagaland and comprising of:
  - Representatives from the Directorate of Health
  - Representatives from Partner Departments/Directorates such as NRHM, Labour, Power, Electricity, NIC, NeGP, Department of IT and various Program Officers
  - Elected Representatives such as the MP, MLA as well as key Panchayat officers may also be invited to the Steering Committee for key meetings
  - Representative from the World Bank and/or the Technical Assistance Office in its role as Technical Assistance provider
- A Program Management Office headed by a Program Director supported by Project Directors for the five key tracks of the program which are:
  - ERP implementation
  - Hospital Management System
  - Program Apps
  - IT infrastructure &
  - Information, Education & Communication
- A Technical Assistance Office staffed by Independent Program Consultants & Experts headed by a Technical Director and supported by Project Managers and a Panel of Experts.

A high level structure of the Program Governance organization is depicted below. The detailed functional structure may be created by the Department of Health, Nagaland in alignment with the above recommendation.

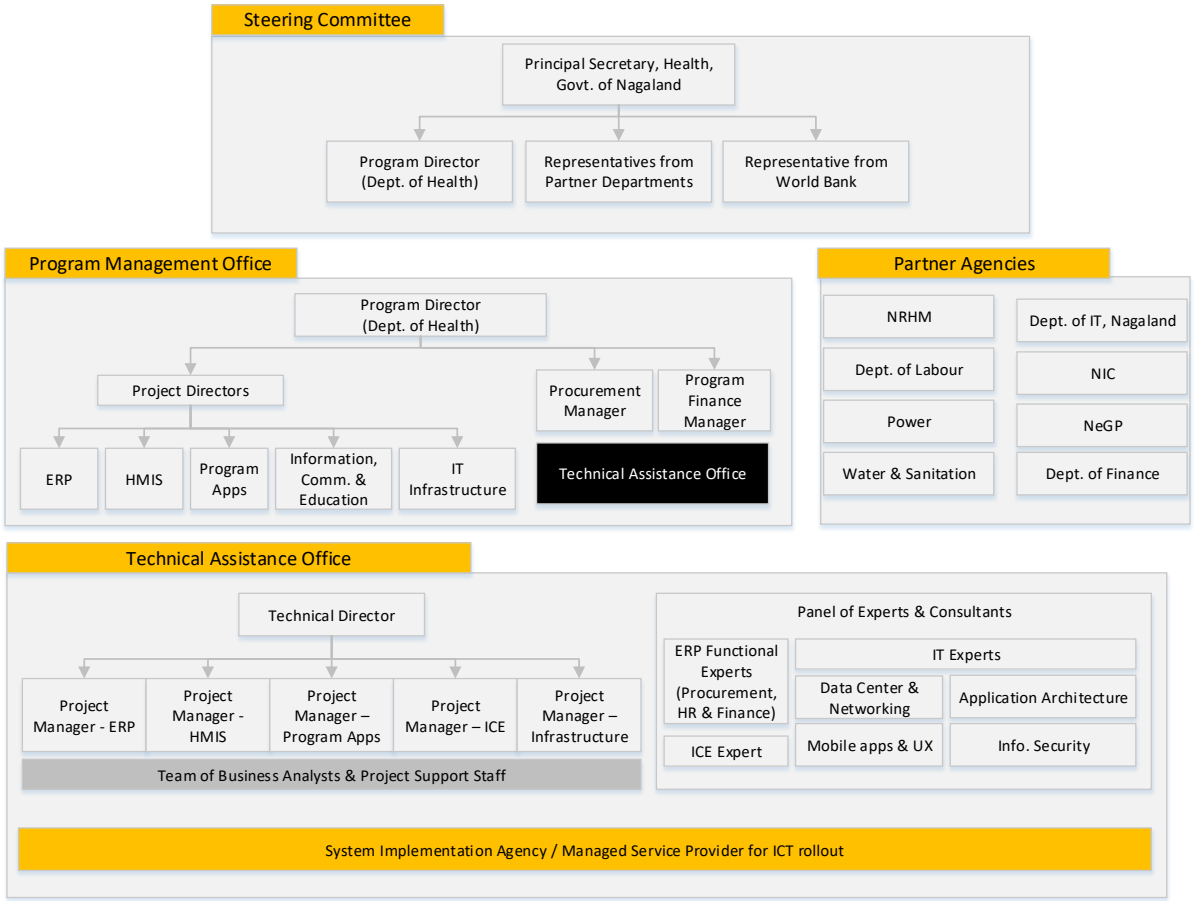


Figure 23: Recommended Program Governance Structure

5.7.3 Key roles and responsibilities of Steering Committee

The Executive Steering Committee shall be responsible for:

- Oversight of progress on State strategic goals and any strategy modifications
- Reviewing Executive level project status updates including project issues and risks with state-wide impact
- Monitoring achievement of major program milestones
- Directing State resources to accomplish strategic goals
- Participating in the selection and approval of the Program Director
- Reviewing and making decisions regarding issues and risks which are escalated to the Committee.
- Assigning authority to the Program Director and Program Management Office
- Providing state-wide leadership and support for the program
- Supporting the program and component projects by communicating the vision and working to reduce barriers and mitigating risk
- Facilitating the interdepartmental collaboration of a state wide system
- Providing issue resolution across agencies
- Review and approve the overall program procurement strategy
- Evaluate state wide policy changes

- Receiving periodic briefings from the Program Director regarding program and project progress, resource needs, issues, risks, funding and expenditures

5.7.4 Roles of Program Management Office and Technical Assistance Office

The state Program Director and management team are responsible for the management of the program and are therefore responsible for the development and approval of all program management plans, processes and procedures. The following subsections briefly describe program governance processes and activities within knowledge areas identified by the PMI Standard for Program Management.

Note that while the overall responsibility for performing the below activities and processes lies with the PMO, it will draw upon the Program Management resources provided by the Technical Assistance Office in performing the below activities as part of Program Governance.

Integration Management

This area includes the processes and activities needed to identify, define, combine, unify and coordinate multiple projects and coordinate various program management processes and activities. Some of the integrative activities performed by the project management team include:

- Transform the program's strategic directives and business case into a program management plan and an initial program roadmap;
- Identify, define, and document critical success factors;
- Develop and manage the governance structure;
- Monitor, correct, forecast, and report program progress, issues, and risks, and;
- Analyze earned value management reports;
- Analyze project performance reports;
- Make Go/No Go decisions associated with key program and project milestones.

As part of governance, a critical overarching process is issue management and a formal escalation process to achieve issue resolution. The program is responsible for overseeing and managing program-wide or cross-project issues identified by the projects or other program stakeholders. The purpose of the issue process is to ensure unanticipated issues, action items and tasks are assigned to a specific person for action and are tracked to resolution.

Deliverables Management (for Program Governance)

The following tables summarize who is responsible for the review and approval of program governance deliverables throughout the entire program lifecycle. While these governance deliverables will be owned by the PMO, they will be assisted in the below activities by the Technical Assistance Office staffed by independent consultants.

WORK PRODUCT	REVIEW	APPROVE
Program Charter	• Program Management Team • Program Director • Program Sponsors • Partner Departments	✓ Steering Committee
Memoranda of Understanding between Program and Sponsors/Partners	• Program Director • Project Sponsors • Partner Departments • Project Directors	✓ Program Director
Project Plans	• Program Management Team • Independent Consultant • User Community Representatives	✓ Program Director
IT Procurement Plans	• Project Managers • Program Procurement Manager & Team	✓ Program Director
Program-wide Procurements	• Program Management / Technical Assistance Team • Program Procurement Manager • Program Finance Manager	✓ Program Director
Program Cost Baseline	• Program Director • Program Finance Manager • Program Management Team	✓ Steering Committee
Lessons Learned (program)	• Program Management Team • User Community Representatives • Project Sponsor(s) • Partner Departments	✓ Program Director ✓ Project Directors
Program-wide Contract Deliverables	• Program Management Team	✓ Program Director

WORK PRODUCT	REVIEW	APPROVE
User/Project Deliverable Acceptance	• Project Team • Program Management Team • User Community Representatives	✓ Program Director
Program Final Report	• Program Management Team	✓ Program Director

Scope Management

Program Scope Management includes monitoring and guiding project design efforts so they are compliant with overall program architecture standards and fully facilitate all interface and data sharing requirements. An important aspect of scope control is the program (and projects) change management processes. Program change management governs project changes which could affect the overall program's benefit delivery or has cross-project implications. Change requests (or requirements) impacting a project's scope, duration, quality, or costs should be examined to determine whether the change request must be escalated to a program-level **Change Control Board** for consideration.

Time Management

Program Time Management involves processes for scheduling the defined program components and entities necessary to produce the final program deliverables. It includes determining the order in which the individual components are executed, the critical path for the program, and the milestones to be measured to keep the overall program on track and within the defined constraints. Major processes include developing the program schedule and monitoring and controlling the program schedule.

Quality Management

Program Quality Management includes all the activities of determining quality policies, objectives, and responsibilities between the program and the projects to ensure the customer's needs are satisfied. Major processes include developing a program-level Quality Management plan, managing the independent validation and verification effort, managing the independent program oversight provider, and performing quality assurance with respect to program standards, and managing continuous process improvement.

Risk Management

Program Risk Management is another critical program management area. Program risk is an event, or series of event or conditions that, if they occur, may affect the success criteria of the program. Positive risks are often referred to as opportunities and negative risks as threats. These risks arise from the program components and their interactions with each other, from technical complexity, schedule and/or cost constraints, and with the broader environment in which the program is managed.

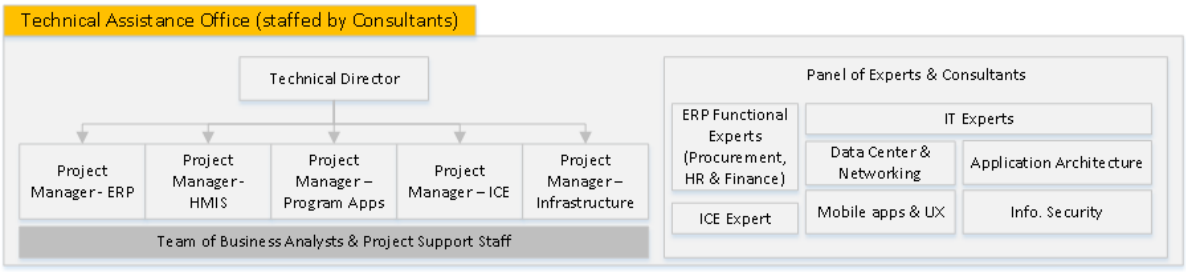
The main processes are developing the risk management plan, identifying risks, analyzing risks, planning risk responses, and monitoring and controlling risks.

Financial Management

Program Financial Management includes all the processes involved in identifying the program's financial sources and resources, integrating the budgets of the individual projects, developing the overall program budget, and controlling costs throughout the life cycle of projects and the program. The main processes include establishing the program financial framework, developing the financial plan, estimating program costs, developing the budget, and monitoring and controlling expenditures.

5.7.5 Composition of Technical Assistance Office and Key competencies required

The Technical Assistance Office is expected to be staffed by Consultants/Experts in various areas. Keeping in view the requirements of the ICT in Health program of Nagaland, the following composition and competencies are recommended for the Technical Assistance Office.



The technical assistance office is expected to be headed by a Technical Director who will be advised by a Panel of Experts and who will be supported by a team of Project Managers, Business Analysts and Project Support Staff.

Considering the Program's requirements, it is recommended to have a team of 5 Project Managers who will coordinate the major projects under the program. The five major projects envisaged are:

- **ERP**: ERP implementation at Directorate of Health with its various lightweight components being installed at various field offices at the District, Block and Gram Panchayat levels. Given that Procurement, Human Resources and Finance modules are required to be implemented, this warrants the full time involvement of a Project Manager. He/She will be assisted by a team of Business Analysts and supported by ERP functional experts in the areas of Procurement, HR and Finance.

- **HMS and Supply Chain**: The implementation of Hospital Management System at the three tiers of Nagaland's Healthcare Service Delivery Model, viz., District, Block and PHC levels is a complex project that requires extensive technology as well as change management interventions. The HMS requires extensive integration with supply chain management systems to help improve availability and quality of medicines and prevent pilferage. It also entails various business process changes, training and communication steps as well as data migration / master data management activities. Hence it is recommended that the HMS rollout be led by a full time Project Manager.

- **Program Apps**: For the ICT in Health program to be effective, a variety of Program Apps are required to be developed and deployed, especially in the mobile/tablet platform. This will be a

vital link to gather field level data and enable FLW/AHSA workers in better gathering of program data.

- **Information, Communication & Education**:For the program to be successful, ICE initiatives will be very important. On one hand, ICE initiatives are required to be created to enable FLW/ASHA workers in promoting awareness about various health related issues and also in their continued education. On the other, ICE initiatives will be needed for mass communication and for addressing various socio-cultural issues that impact adoption and use of Nagaland's healthcare delivery system. Hence it is recommended to have a full-time ICE Project Manager assisted by Expert(s) in Healthcare ICE programs, E-learning & Mass communication.
- **IT Infrastructure**: IT infrastructure will play a key role in delivering the ICT program. While DIT, NIC and NeGP are providing some foundation elements of IT infrastructure in Nagaland in the form of State Data Center and SWAN, innovative IT architectures will be required to overcome the challenges posed by Nagaland's poor power and network availability. Nagaland is also a complex geographical terrain and hence a full time manager's attention is required to proactively identify issues and resolve them through the roll out phase. The IT infrastructure track is expected to be supported by experts in the areas of
  - Data Center, Telecom and Networking
  - Information Security
  - Application architecture (esp. distributed architectures) and
  - Mobile apps and User Experience expert, preferably with Product Development background to help in creating and delivering effective program apps

With the above governance structure in place, it is expected that the ICT in Healthcare program in Nagaland will help the program retain necessary strategic alignment, manage the program's resources, control risks and ensure that benefits are delivered in line with the original business plan.

5.8 Change Management & Capacity Development Plan

Change enablement is a critical success factor for this engagement. The ICT project will bring about a variety of technology enabled changes that would need to be managed effectively. These would include:

- **Business Process Automation** in
  - the areas of HR, Finance and Procurement at the HQ level and
  - hospital management processes at the health facilities and supporting centers such as pharmacy, labs and stores
  - The above business process automation may involve organizational changes as well though this report is not recommending business process changes – rather only process automation has been recommended. However, this is a contingency that would need to be factored in.
- **Training and capacity building** in order to impart:
  - IT skills to officials to transition to electronic workflows for various processes
  - Mobile technology usage skills to FLWs and ASHA workers for better data gathering and effective conduct of IEC initiatives
- **Information Management changes** in
  - The manner of collection and recording of data

- Reporting and analysis of data

Effective management of the above changes requires a high-powered organization with the right skill sets and authority to effect the changes. The Program Governance Structure described in the previous section has been developed keeping these requirements in view and hence the recommendation for a Steering Committee chaired by the Secretary of Health, Govt. of Nagaland. It is expected that this Steering Committee will enable:

- Effective collaboration with health officials: To account for people related changes, risks and impacts as well as establishing clear roles and responsibilities to enable decision making and rapid resolution of issues.
- Work in close conjunction with representatives from Department of Health to define and agree on the desired change maturity level required within each function to deliver on the transformation.
- Design of key tools to meet the desired maturity levels and closing gaps around organizational and HR processes.

Drawing upon the above change requirements, while the earlier sections of the report have addressed the requirements for business process automation and information management, the following section outlines the Training & Capacity Building requirements and a plan to address them.

Training and capacity building plan:

Training and capacity building plan will address the development needs of the stakeholders. This will help in building skills during the process of transformation. The people readiness towards the new technology will require a robust training plan. The following high level training plan is proposed for all the stakeholders of ICT in health system.

Training program	Recipients	Duration	Content	Trainers
ICT in health orientation program	▸ Head of all the Directorates ▸ Chief Medical Officer ▸ Heads of Department (Health, IT, Labour, Census)	1 day	▸ Overview of the proposed ICT system ▸ Vision, objectives and key ICT solutions proposed ▸ Scope of implementation ▸ Roles and responsibilities of the officials in enabling the system implementation ▸ Expectations from the stakeholders ▸ Benefits envisaged from the ICT solution	▸ Program Management Unit
Detailed ICT Orientation	▸ Dy. Directors and Assistant Directors ▸ Level 2 staff reporting to HODs	3 days	▸ Overview of the complete architecture of the ICT solution ▸ Specific functionalities of ICT solution for report generation and decision support system ▸ Features that enable	▸ Program Management Unit and Managed Service provider

Training program	Recipients	Duration	Content	Trainers
			▸ Concerned process officials to be given hands on training on use, working, authenticity and implementation of access control methods and tools	
User Training Sessions on Hospital Management system	▸ SMOs and MOs ▸ Nurses ▸ Data entry operators ▸ Accountants ▸ Pharmacists ▸ Store keepers	3 days	▸ Overview of complete HMS ▸ Functionalities of each module ▸ Hands-on training on the application	▸ Managed Service provider
Module-specific user training sessions ▸ Supply chain management ▸ Financial management system ▸ HR management system ▸ Insurance management system	Employees from the respective groups of the Health department	5 days	▸ Overview of the complete architecture ▸ Details about the respective solutions ▸ Hands-on experience to the users of the respective application ▸ Generation of reports	▸ Managed Service provider
User Training - Program MIS	FLWs	2 days	▸ Overview of the application ▸ Hands-on experience on the application to fill up the data for various programs	▸ Managed Service provider
m-Training and e-Learning	▸ FLWs ▸ Medical staff ▸ Paramedical staff ▸ Nurses	2 days	▸ Overview of the training program ▸ Details about the training modules available ▸ Process to enroll and attend a particular training	▸ Managed Service provider

Training of the stakeholders is critical factor for the success of the engagement and therefore, a total of 15 days of training has been proposed bi-annually in the implementation plan. All the trainings will have a feedback mechanism in the form of Training Effectiveness Surveys to improve and develop a tailor made training solution to cater to the needs of the stakeholders achieve the best results.

6 Next steps

The following steps are recommended to take this ICT strategy forward:

Activity	Expected timeframe (T being date of approval of ICT strategy)
Socializing and Communicating the ICT strategy through • Stakeholder workshops in Nagaland (Kohima & Dimapur) • Publication of ICT strategy summary on Department of Health, Nagaland's website • Press release to local media about the ICT Strategy and its expected benefits • Communication via Email to all DoH staff • Issue of printed posters with summary of ICT strategy to all offices and facilities of DoH	T + 30 days
Appointment of Steering Committee for the ICT program through Government Order	T + 60 days
Publication of RFP for selection of Consultant for Technical Assistance envisaged as part of Program Governance	T + 60 days
Appointment of Consultant for Technical Assistance to the Steering Committee	T + 120 days
Further activities shall be planned and driven by the Steering Committee and Consultant appointed for Technical Assistance	

7 Conclusion

With the inclusion of Health as a Mission Mode Project (MMP), the Government of India has renewed its focus towards ensuring universal access to health services for all, and towards developing an integrated and sustainable healthcare ecosystem. ICT components of Health MMP include hospital management and information systems, drug supply chain management, tools for field health workers, etc. The MMP is expected to usher in a wave of innovative solutions resulting in effective and efficient delivery of health services. Consequent to these interventions, the healthcare sector in India is going through a transformational phase in terms of technological advances.

ICT in health is not just the implementation of the IT systems, it is a management solution assisted by the application of technology. Effective user awareness and capacity building is crucial for the success of the engagement. IT infrastructure is foundation to the ICT program and government should focus on building necessary communication infrastructure of required quality of service. ICT implementation requires new policies and procedures and therefore, a detailed understanding of what ICT in health can do and the risks associated with it should be clearly documented to set the right expectations to the stakeholders.

This ICT strategy proposes phased approach to implementing 18 Strategic Initiatives that have been prioritized at the application level as well as the geographical level and scheduled according to what is realistic at each point of the implementation plan. The recommended interventions will have impact throughout the patient life cycle in the healthcare system. They can address several inefficiencies in the healthcare value chain in Nagaland and provide increased healthcare access to citizens without significantly increasing the spending on the same. While the recommended interventions would help Nagaland “bend the curve” as far as healthcare access is concerned, it would, in the long term, help leverage technology and connectivity to continuously improve the state of its public healthcare system. This would eventually lead to clinical efficacy, better sharing of knowledge and healthcare transformation.

8 Glossary

Abbreviation	Definition
ANC	Ante Natal Care
ANM	Auxiliary Nurse Midwife
APBS	Aadhaar Payment Bridge System
ARSH	Adolescent Reproductive Sexual Health
ASHA	Accredited social health activists
AYUSH	Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy
B2B	Business-to-business
B2C	Business-to-citizen
BAM	Block Account Manager
BHQ	Block Head Quarter
BMO	Block Medical Officer
CHC	Community Health Centre
CMO	Chief Medical Officer
CSC	Common Service Centre
CT Scan	Computed Tomography scan
DEO	Data Entry Operator
DHQ	District Head Quarter
DHS	District Health Society
DMPU	District Program Management Unit
DoHFW	Department of Health and Family Welfare
EMR	Electronic Medical Records
FMG	Financial Management Group
FRU	First Referral Unit
G2C	Government-to-Citizen
GNM	General Nursing & Midwifery
GoI	Government of India
HFMC	Health Facility Management Committee
HMIS	Health Management Information System
ICT	Information and Communications Technology
IDCS	Infectious Disease Clinical Services

Abbreviation	Definition
IDHAP	Integrated District Health Action Plan
IDSP	Integrated Disease Surveillance Programme
IEC	Information, Education and Communication
IMR	Infant Mortality Rate
IPD	In-Patient Department
ISO	International Organization for Standardization
ISRO	Indian Space Research Organisation
IVRS	Interactive Voice Response System
KYC	Know Your Customer
MCTS	Mother and Child Tracking System
MMR	Maternal Mortality Ratio
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MO	Medical Officer
MoU	Memorandum of Understanding
NABH	National Accreditation Board for Hospitals and Healthcare Providers
NABL	National Accreditation Board for Testing and Calibration Laboratories
NeGP	National e-Governance Plan
NHAK	Naga Hospital Authority, Kohima
NIDDCP	National Iodine Deficiency Disorders Control Programme
NLEP	National Leprosy Control Programme
NPCB	National Programme for Control of Blindness
NPPCD	National Programme for Prevention and Control of Deafness
NRHM	National Rural Health Mission
NSACS	Nagaland State AIDS Control Society
NTCP	National Tobacco Control Program
NUHM	National Urban Health Mission
NVBDCP	National Vector Borne Disease Control Programme
O & G	Obstetrics and Gynaecology
OPD	Out-Patient Department
OTP	One Time Password
PHC	Primary Health Centre

Abbreviation	Definition
PIP	Performance Improvement Plan
PNC	Post Natal Care
PPP	Public Private Partnerships
PRI	Panchayati Raj Institutions
RCH	Reproductive and Child Health
RNTCP	Revised National Tuberculosis Control Programme
RSBY	Rashtriya Swasthya Bima Yojna
RTI	Reproductive Tract Infections
SC	Sub Centre
SDC	State Data Centre
SHQ	State Head Quarter
SHS	State Health Society
SMO	Senior Medical Officer
SMS	Short Messaging Service
SN	Staff Nurse
SOP	Standard Operating Protocols
SPIP	State Performance Improvement Plan
SPMU	State Program Management Unit
SRDH	State Resident Data Hub
STI	Sexually Transmitted Infections
SWAN	State Wide Area Network
TB	Tuberculosis
TFR	Total Fertility Rate
TPA	Third party Administrator
UID	Unique Identification
UIDAI	Unique Identification Authority of India
UNICEF	United Nations International Children's Emergency Fund
VHC	Village Management Committee
VHND	Village Health Nutrition Day
VLE	Village Level Entrepreneur
VSAT	Very Small Aperture Terminal

9 Annexure

9.1 Annexure 1 – Leading Health Practices in India

S.No	Programmes	Category
1	Onco Net India	Central Govt. Programmes
2	Telemedicine Project-Chhattisgarh	
3	Nutrition Resource Platform	
4	AIDS Prevention and Control Project	
5	Health Management Information System	
6	Janani Suraksha Yojana (JSY)	
7	Rashtriya Swasthya Bima Yojana (RSBY)	
8	1075 IDSP Call Centre (Integrated Disease Surveillance Project)	
9	Mobile phones to sub center ANMs	
10	Mother Child Tracking System	
11	Hospital Information Management System	
12	Aysuhmathi Scheme	State Specific Initiatives
13	Contracting of clinical lab services	
14	Tripura Vision Centres	
15	Rajiv Aarogyasri Healthcare Insurance Scheme	
16	CEASE-TB	
17	Kalaignar Insurance Scheme	
18	Contracting of radiology services	
19	SMS based Monitoring System	
20	SMS Supervision	
21	Health Management and Research Institute (HMRI)	

S.No	Programmes	Category
22	Centralized Ambulance Trauma Services	
23	Janani Express	
24	102 Ambulance Call Centre	
25	Micro Ensure	IFI Funded Programs
26	D-Tree International	
27	Merrygold Health Network	
28	Aastha	
29	DiMPA Network	
30	ArogyaGhar (kiosk based clinics)	
31	Teledoc Initiative	
32	Business in the bag (Vision Entrepreneurs)	
33	Aravind Eye Care System	
34	India Healthcare Delivery Project Nalgonda project	
35	Sproxil	
36	Sarathi 104 initiative	
37	MOTECH	
38	Beneficiary Verification System	
39	eCompliance	
40	Mobile Money Transfer through ASHA	
41	Sure Start	
42	Smart Card Initiative Project	
43	Ziqitzia - Dial 1298 for Ambulance	
44	SWASTH	
45	Vision Centres	

S.No	Programmes	Category
46	PROJECT Ashwini BYRRAJU Foundation Telemedicine Project	
47	Viva Sehat	
48	Mobile phones for health monitoring	
49	108-Emergency Response Services	
50	Highway Rescue Project	
51	Mobile Data Management Software	
52	Safe Motherhood and Child Survival Project	
53	Distance Healthcare Advancement (DISHA)	
54	Dial 104 for Health-HMRI	
55	Rural Emergency Health Transport Scheme- EMRI (108)	
56	Arunoday 108	
57	Bihar Evaluation of Social Franchising and Telemedicine Project (BEST)	
58	Embrace	Private Sector Initiatives
59	Calcutta Kids	
60	uNotify	
61	Eyeway	
62	Mera Doctor	
63	E health point	
64	mDiabetes	
65	Mobile Cath Lab	
66	Uplift Health Mutual Fund	
67	mDhil	
68	Mobile Medics Healthcare	
69	Electronic Program Management Software	

S.No	Programmes	Category
70	Rural Telemedicine Centre	
71	Maternal Health Reporter	
72	First Care- Rural Health Project	
73	Highway Rescue Project	
74	Srikon Healthcare Services	
75	Name-based Information Tracking System	
76	Nationwide Primary Healthcare Services	
77	Nokia Life Healthcare Service	
78	Piramal E-Swasthya	
79	E Choupal Health	
80	Swasth Health Centre	
81	Distance Healthcare Advancement	
82	Narayana Hrudayalaya	
83	TouchHb	
84	Apollo Telemedicine Network Foundation	
85	Vatsalya Hospitals	
86	SMART pill Box for TB patients	
87	Mobile Care Support and Rx Manager	
88	Hello Doctor (24x7)	
89	Unique Identification Mobile Verification	
90	Wireless Health Incident Monitoring System	
91	Project DISHA	
92	Handhelds for health	
93	Freedom HIV / AIDS	

S.No	Programmes	Category
94	Healthline 24x7	
95	Integrated Rural Health Pilot	
96	CARE Hospitals	
97	Vitagoat	
98	mPedigree	
99	MediAngels	

9.2 Annexure 2 – Solution Charters

The initiative charters are expected to help the ICT Program Managers understand the initiatives and create an actionable roadmap for developing and implementation of the solutions envisaged. Each charter covers the following - Business Needs, Requirements of the Solution envisaged as part of the initiative, high level view of the process, dependencies and delivery channels associated with the solution.

A1	**Theme: Strengthen Medical Supply Chain Management** **Initiative: Supply Chain Management**

Business Needs

One of the major challenges of Nagaland's IT health service delivery system is managing the supply chain of medical supplies for health care centers as well as field level workers. The SCM initiative is expected to streamline and improve the medical supply chain in the state. The end-to-end processes of indenting, approval, dispatch and record keeping will be covered under this intervention. Currently health department follows a manual centralized procurement process for procuring and distributing the drugs. Objectives of SCM solution are:

- To streamline the procurement systems for medical supplies
- To streamline the process of indenting and approval for medical procurement
- To improve the supply logistics and reduce lead times for supply of goods
- To obtain a better view of medical inventory status in the central depots as well as in the various field locations
- To support cost containment strategies in inventory management and administration

Solution Description

The solution is expected to have the following key features:

- Procurement Planning
  - Demand forecasting of drugs and medical accessories
  - Planning and finalizing procurements
- Purchase Automation
  - Publication of Tenders
  - Tender submission / e-Procurement portal
  - Processing tenders/bids with a financial evaluation tool
  - Downloading and uploading encrypted tender
  - Feeding technical evaluation results
  - Bid evaluation workflow management
- Contract & Price Management
  - Contract Lifecycle Management
  - Awarding contracts by centre
  - Processing supply orders and distributing the delivery schedule

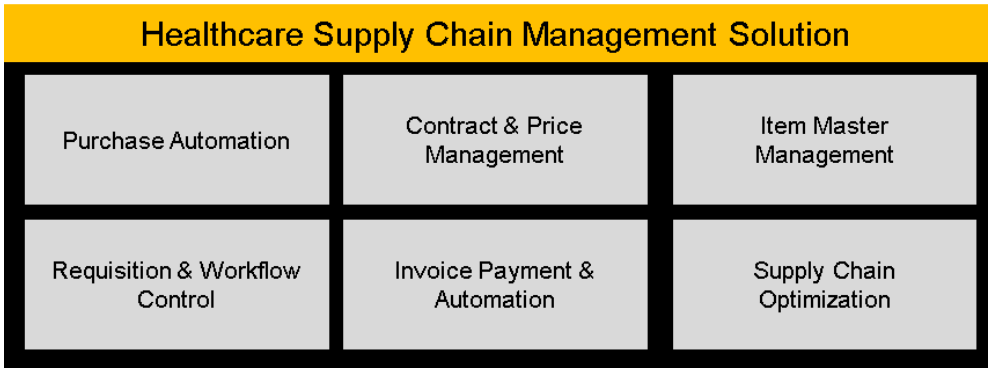
A1	**Theme: Strengthen Medical Supply Chain Management** **Initiative: Supply Chain Management**

- Entering data as and when supply orders are issued and updated
- Issuing release orders

- Item Master Management
- Requisitioning and Workflow Control
- Invoice & Payment Automation
- Warehouse information system

Key modules / high level process description

The below diagram depicts the high level view of modules required in the solution.



Dependencies

Following are the key dependencies for implementation of the SCM system:

1. For effective demand consolidation, it would be essential to have network connectivity to all health facilities and with FLWs who require the medical supplies. It is proposed to do this via the network architecture detailed in this report and through provisioning of mobile enabled applications to FLWs for requesting supplies such as nutrient supplements, ASHA kits, etc.
2. Business process changes would be required to enable e-Procurement processes with respect to procurement and purchase automation.
3. Digitization of existing contract information into the system would be a pre-requisite.
4. Data digitization and use of industry standard item masters would be a pre-requisite.

Delivery Channels

The solution is expected to be accessed via:

- Web Portal
- Mobile Apps
- Intranet application / HMIS

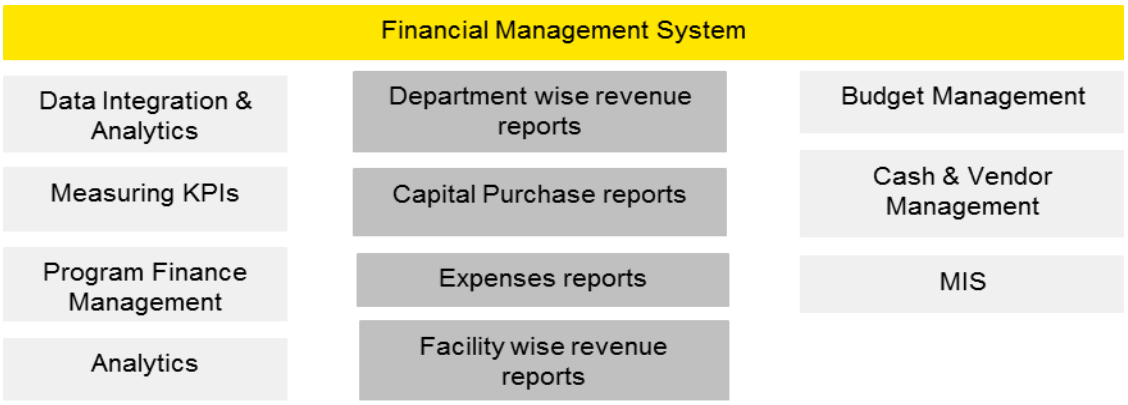
A2	**Theme: Strengthen Financial Management** **Initiative: Financial Management System**

Business Needs

Financial management system provides an integrated suite of accounting and financial modules for managing health facility's financial operations, resources and personnel. Financial Management system will have the following benefits :

- Consolidates, monitors and reports on the financial results of healthcare facility
- Efficiently manages vendor invoices and tracks payment transactions.
- Effectively automates inventory control, materials purchasing and requisitions.
- Provides for multiple vendor contract management.
- Completely automates payroll processing and reporting.
- Provides for the effective management of employees' information, including validation of criminal background checks.

Process:



Solution description

Key features:

- Access accurate, timely data and reporting
- Leverage powerful analytics tools - not just workflow and record keeping tools
- Manage entire fixed asset lifecycles, including acquisitions, transfers and disposal
- Track up-to-date project encumbrance information to control purchases being applied
- Meet growing need for Automated Clearing House (ACH) payments

Dependencies		
▶ Training	▶ Change management	▶ Infrastructure readiness
Delivery Channels		
▶ Mobile	▶ Portal	▶ Standalone applications

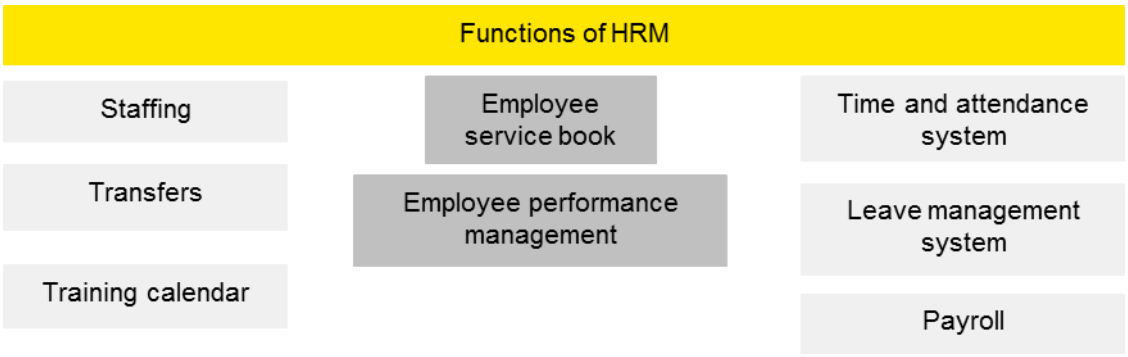
A3	**Theme: Improve Human Resource Management** **Initiative: Human Resource Management System**

Business Needs

Human resource Management in health-care can be used at different levels of clinical and non-clinical staff pertaining to public and individual health intervention. It has following benefits:

- Helps in creating a personal development plan.
- Store additional job-related training.
- Conducting job performance review.
- Conduct regular departmental meetings.
- Promote a leadership style of the manager which is transparent and supportive.

Process:



Solution description

Key features:

- Recruitment and selection of the health workforce
- Helps in improving the skill of the medical and paramedical staff by understanding their requirements
- Distribution of employee benefits
- Better workforce management
- Provides time and attendance system integrated with leave and payroll management system

Dependencies		
▶ Training	▶ Change management	▶ Infrastructure readiness
Delivery Channels		
▶ Mobile	▶ Portal	▶ Standalone applications

A4	Theme: Streamline administration of Schemes and programs Initiative: Programme Management Information System

Business Needs

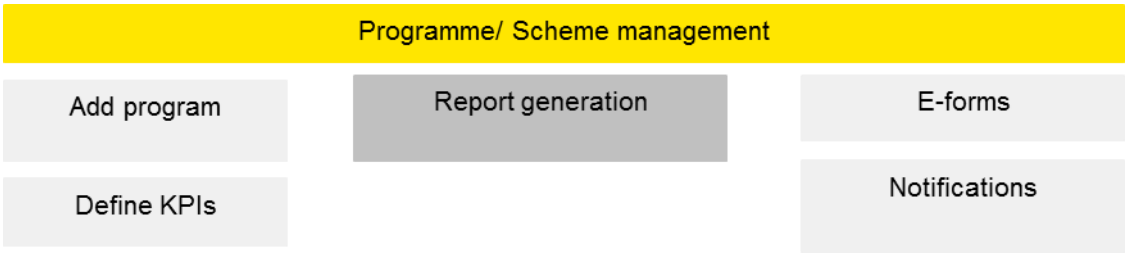
Programme management or scheme management is linked to high value, high impact, high quality, and measurable outcomes. Ensuring efficient programme management information system provides following merits:

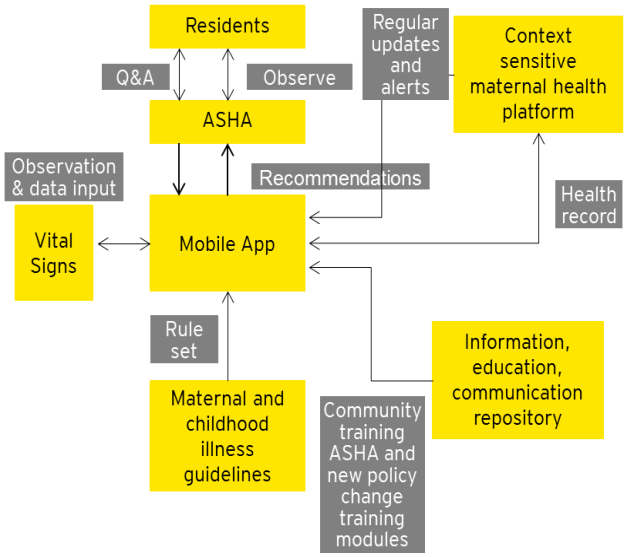
- Experience with the steps involved in the project management process and helps in addressing the nuances within a variety of health care settings.
- Helps in implementing strategies to navigate the interpersonal dynamics that emerge between and among the roles of clinical and administrative leaders/staff.
- Helps in improving overall health care delivery performance.

Given the limitations of providing hard IT infrastructure in remote areas, programmes that involve development using handheld devices can be used in disseminating information easily. Such initiatives have following advantages:

- Increases the process efficiency in hospitals
- Semi-skilled outreach workers can deliver quality healthcare at the point of contact
- Doctors freed up from routine data collection activity, and can focus on diagnosis
- Increase catchment area: due to outreach program run by hospitals (if they so desire)
- Data collected can be used for pro-active follow up and measurements

Process:





Data collection through mobile devices

Solution description Key features: ▶ Benefits by monitoring savings delivered per project or rolled up to a programme or entire organisation. ▶ Budget planned and actual cost incurred in a financial year. ▶ Integrated view of project and financial information. ▶ Operational and transformational change programmes. ▶ Qualitative and quantitative key performance indicators. ▶ Risk and issue management ▶ Hindi, menu-driven with audio option ▶ Seamless integration of guided interactions and recording of data ▶ Synchronized between AWW, ASHA and ANM ▶ All data 'uploaded' when connected – sync with MCTS

Dependencies		
▶ Training	▶ Change management	▶ Infrastructure readiness
Delivery Channels		
▶ Mobile	▶ Portal	▶ Standalone applications

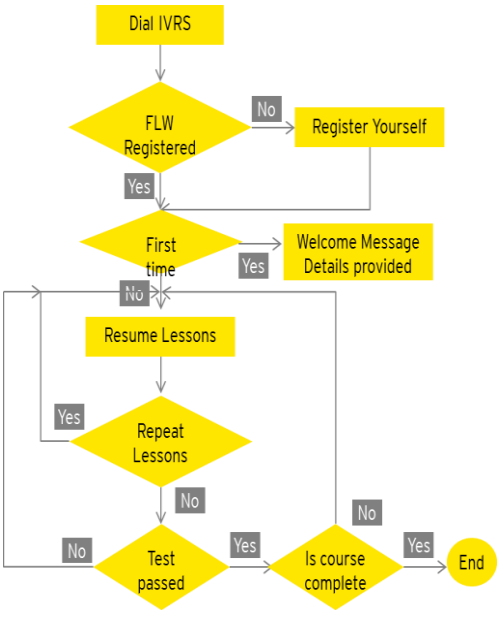
A5	**Theme: Mobile solutions to enhance reach of IEC initiatives & better Data Collection** **Initiative: m-Health**

Business Needs

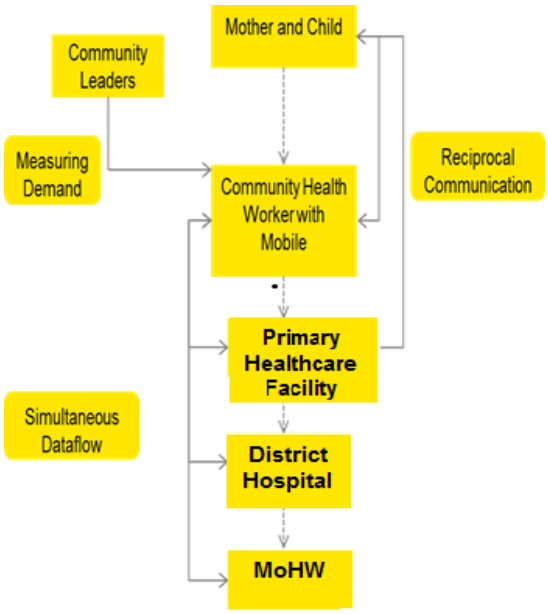
m-Health is used as a technological support initiative involving m-diagnosis, treatment tracking for chronic patients etc. through health promotion messages, preventive check-ups reminders etc.M-health is also being used to transfer data to doctors / hospitals for real time monitoring from a distance. IVRS technology using mobile platforms helps in training field health workers to deliver life-saving information to millions of families via a simple voice call. Most of these m-learning programs work on platforms that also provide offline content delivery and assessment solutions. It has following benefits:

- To expand FLWs' knowledge of life saving preventative health and enhance their communication skills
- To constantly upgrade the knowledge of the FLW
- To build capacity remotely using a centralized system
- To provide Multi-lingual system that can address a larger section
- Cuts the costs of providing healthcare.
- Maintain and improve the quality of care.
- Reach patients in even the most remote locations.
- Reducing inequalities based on gender, income or geography.

Process:



IVRS framework



IEC Workflow

Solution description

Salient features of m-training:

Structure:

- The structure will be divided into chapters, lessons and quizzes
- The course will have chapters
- Each chapter will have lessons
- There is quiz at the end of each chapter
- Accumulative pass/fail score
- Printed certificate for all those who pass

Length:

- Each lesson should be approximately 4-5 minutes long
- Each quiz should be approximately 5 minutes in length
- The whole course will be approximately 200-240 minutes in length, including prompts

Personalization:

- FLWs do not have to complete training on one call
- IVR system will remember the MSISDN of the FLW
- If the FLW disconnects the call, when she calls back, IVRS will remember where she was and return her to that place

Salient features of mobile based IEC:

- Initiative like mobile kunji provides an audio-visual job aid for CHWs to use in their interactions with families, combining an IVR service and a printed deck of cards.
- IVR training courses for CHWs have been designed to expand their knowledge of life saving preventative health and enhance their capacity to communicate and engage effectively with families.
- Most m-health initiatives use PDAs, smartphones, mobile web sites, and web browsing to access health information.
- Bandwidth and handsets are not a prerequisite for access as data can be downloaded onto PDAs.
- M-Health services can also use USSD technology effectively to deliver short messages on GSM mobiles.

Delivery Channels	
▶ IVRS	▶ Mobile

Dependencies		
▶ Training to the field level workers	▶ Awareness creation	▶ Last mile connectivity readiness

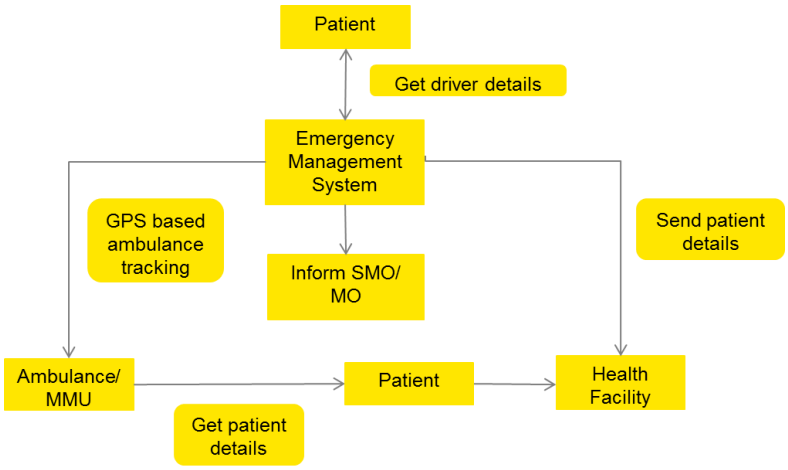
A6	**Theme: Support Emergency Management** **Initiative: Ambulance tracking and Emergency management system**

Business Needs

Health emergency management system is used to plan for and coordinate all personnel and materials required to either mitigate the effects of, or recover from healthcare hazard. It has following benefits:

- To lead and oversee the development and maintenance of emergency plans and procedures for the health sector.
- To provide expert pre-hospital care and being the first on scene when there is medical emergency
- To provide an integrated information system for a shorter lead time to emergency

Process:



Solution description

Key features:

- The ambulance reaches the emergency site in the quickest time possible. The call center maintains time log for each action for later scrutiny. The victim is transferred to the nearest Health Center in an ambulance.
- The EMS provides pre-hospital services to the victim. Several defined parameters like pulse, blood pressure and other vital statistics are measured to determine if the victim requires pre-hospital care.
- Pre- hospital care is provided on the instructions of the Emergency Response Center Physician (ERCP).
- Instructions are provided by the ERCPs after collecting all the vital information about the emergency.

Dependencies

▶ Integration with database	▶ Call center setup	▶ GPS enabled vehicles

Delivery Channels

▶ Mobile/Telephone	▶ Portal

9.3 Annexure 3 –Prioritization of the ICT solutions

The process for calculating the implementation complexity of the proposed ICT solutions is shown below:

S.NO	SOLUTION	Time to deploy	Development efforts	Resource capacity building	Ability to leverage existing ICT infrastructure	Need to procure ICT infrastructure	Score
A1	Supply Chain Management	5	4	4	4	4	**21**
A2	Finance Management System	3	4	3	3	3	**16**
A3	HR Management System	3	3	3	2	2	**13**
A3a	HR Management System-Time & Attendance Management System	4	5	5	5	5	**24**
A3b	HR Management System-eLearning	2	3	2	2	1	**10**
A4	Program Management Information System	4	4	4	4	4	**20**
A5	Insurance Management System	3	5	4	2	2	**16**
A6	Hospital Management System	4	2	5	5	5	**21**
A6a	Hospital Management System-Health Facility Asset Management System	2	3	2	3	1	**11**
A6b	Hospital Management System-Electronic Medical Record	5	4	1	5	5	**20**
A6c	Hospital Management System-Clinical Decision Support System	5	5	5	5	1	**21**
A7	M-Training	2	2	1	1	1	**7**
A8	Grievance Redressal System and RTI	2	4	2	2	2	**12**
A9	Mobile apps - program	3	4	4	4	3	**18**

S.NO	SOLUTION	Time to deploy	Development efforts	Resource capacity building	Ability to leverage existing ICT infrastructure	Need to procure ICT infrastructure	Score
	apps						
A10	Tele-Medicine	3	4	3	4	4	**18**
A11	Mobile apps - IEC	2	2	2	1	1	**8**
A12	Healthcare Helpline	1	1	3	1	1	**7**
A12a	Healthcare Helpline-Emergency Health Care Management System	2	2	4	1	1	**10**

The process for calculating the business impact of the proposed ICT solutions is shown below:

S.NO	SOLUTION	State health department priority	Improvement in healthcare service delivery	No of stakeholders					Total
				MoHW	DOH	HFA	MS	FLW	
A1	Supply Chain Management	5	5	1	1	1	1	1	**15**
A2	Finance Management System	4	3	1	1	1	1	1	**12**
A3	HR Management System	4	3	1	1	1	1		**15**
A3a	HR Management System-Time & Attendance Management System	4	3	1	1	1	1	1	**12**
A3b	HR Management System-eLearning	3	3				1	1	**8**
A4	Program Management Information System	5	5	1	1	1	1	1	**15**
A5	Insurance Management System	4	4	1	1				**10**
A6	Hospital Management System	3	3		1	1			**8**
A6a	Hospital Management System-Health Facility Asset Management System	4	3				1		**8**
A6b	Hospital Management System-Electronic Medical Record	2	3				1		**6**
A6c	Hospital Management System-Clinical Decision Support System	3	2			1	1		**7**
A7	M-Training	4	5			1	1	1	**12**
A8	Grievance Redressal System and RTI	4	4		1			1	**10**

S.NO	SOLUTION	State health department priority	Improvement in healthcare service delivery	No of stakeholders					Total
				MoHW	DOH	HFA	MS	FLW	
A9	Mobile apps - program apps	5	5	1	1	1	1	1	**15**
A10	Tele-Medicine	3	4		1		1		**9**
A11	Mobile apps - IEC	5	4			1	1	1	**12**
A12	Healthcare Helpline	5	5		1	1	1	1	**14**
A12a	Healthcare Helpline-Emergency Health Care Management System	5	5			1	1	1	**13**

Abbreviations used:

MoHW	Ministry of Health and Welfare
DOH	Department of Health
HFA	Health Facility Administrators
MS	Medical Staff
FLW	Field Level Workers