Design of an Emergency Medical System in Philippines

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Introduction

A system that offers emergency medical care is called emergency medical services, or EMS. The primary objective of EMS once it is called in response to an incident that results in serious illness or injury is patient emergency medical care (s). When emergency vehicles or helicopters are observed responding to emergency occurrences, EMS is most immediately identified. Nevertheless, EMS offers much more than a trip to the hospital. It is a system of coordinated emergency medical care and response encompassing many people and organizations. Every day, a complete EMS system is prepared for all possible emergencies. Each element of the complex EMS system plays a crucial function in providing emergency medical care in a coordinated and seamless manner.

EMS relies on three key pillars: "On-time Incident Reporting," "On-time Arrival at the Incident," and "Transfer to the Health Center.“ It is a very useful application for ambulance drivers since it reduces ambulance response time to the patient's location and contributes greatly to the prehospital medical care system's overall performance.

- **Research Question**

  What is the procedure to determine the pain areas and steps to design a customized Emergency Medical Service Information System in the Philippines?

Objective:

This study encompasses on how to investigate current state analysis of a country with regards to its goal and how technology impacts the delivery of prehospital emergency care, with the goal of improving the quality of services and lowering the risk of early patient termination. This is done for:

- To design an integrated emergency medical service information system in Philippines.
- To understand the existing on ground realities of the country with regards to geography, existing facilities, existing transport infrastructure.
- To develop the plan for the system, plan to train the personnel, and plan to implement the system.
- To understand the current health care system of the country.

Research Design:
It was an observational study wherein a comprehensive study of the existing scenario is gauged with respect to:

Health system, Infrastructure (roads, ro-ro jetties for cross island transfer), Existing facilities (hospitals, health professionals, ambulances, health equipment's), Protocols for health emergencies, Legislation governing health, determine the number of health facilities and number of ambulances including number of air ambulances, sea ambulances and land ambulances, understand the types of ambulances available with respect to type of medical emergency and supposed equipment's needed, understand the skill set of the people involved in the healthcare system and develop training material based on system to be developed, understand the system requirements for procuring the same.

The observed pain areas (gaps and deficiencies) found are used to design an EMS information system and a plan is designed on how to put in in motion in stages.

- **Study Setting** : The study was conducted in the 7000+ islands of Philippines with initial study starting in Luzon and Mindanao with study initially being conducted in the capital city of Manila. The existing response system was gauged along with all the resources put in place. The parameters that are checked includes, response times, incident reporting times, on-time arrival. Conservation of golden hour is studied with the existing system and the pain areas (deficiencies) are understood.

Design Methodology for EMS and Results

Current Scenario in Philippines

Overview

- The Republic of the Philippines is a low-lying island nation comprised of close to 7641 islands. Presence of 2000 inhabited island with health centers having multiple access points.

Resources

- No usage of tech intervention aids like walkie-talkies, GPS enabled vehicles, tablets for Emergency Response System
- CAD system to be procured by USAID
- Local telecom in process of installing primary rate interface
- Use of MDPS system to be developed in future by IAED

Existing Facilities

- Ambulances operational currently in the capital are 171, current triaging of COVID - 19 patient done by HEOC medical team, 1065 land ambulances in existence with expansion plans in the number 1900-2000, current ambulances include basic life support facility, 900+ hospitals can be integrated in the EMS framework. Current ambulances include basic life support facility.
- 190 hospitals can be integrated in the EMS framework

Health Framework

Health services in Maldives currently delivered by a four-tier referral system serving to island, atoll / regional and central level services.

Problem Statement

Gap Areas

- Traditional way of Managing Emergency Response Services
- Inadequate staff at National Call Center for handling EMS
- Delayed Response to Emergency Calls during the Pandemic
- Lack of Coordination between health facilities, sea and land ambulances, police departments, fire departments and other stakeholders
- Capacity building and IEC
- Inability to locate and dispatch nearby paramedic team and vehicles

Need for Automated EMS Response System

Challenges	Delay in establishing location of help and additional data	Availability estimation and dispatch of ambulance in the vicinity	Continuum of responses	Understanding patient criticality	Lack of information of ETA	Pre-help patient care	Connecting remote areas
Need	***Computer Telephony Integration***	***Computer Aided Dispatch Function***	***Call Monitoring and Recording***	***Medical Triage***	***Real Time Ambulance Tracking & Monitoring***	***Dissemination of medical advice until paramedics arrive***	***Integrated framework for patient transfer***
Response	Records Management System (RMS) provides data relevant to incident call and caller ID verifies location of caller	GIS provides requisite geospatial data and AVL function pinpoints location of response vehicle	Patient Information System (PIS) provides the telemetry functions for consultation to patients until transfer to facility	Structured questionaries, SOP's for patient evaluation based on MPDS determinants by IEAD and dispatch of most qualified responders appropriate to the criticality	GPS enabled ambulances transmitting data to the incident reporters/ callers through UCAD system	Organized, preempted medical advice until help arrives	Reaching remote areas with protocol for land/air/ sea ambulance and ro-ro ferries for land ambulances
Shifts	Hassle-free, informed and accurate incident establishment	Conservation of the golden hour of the patient	Value based continual patient monitoring	Situation credited response figures	Better traiging of emergency responses	Life saving measures until paramedics arrive	Unhindered patient transfer

Focus area for strengthening of EMS Information system

Governance & Policy

- Comprehensive protocols & guidelines review.
- Implementation of existing policies & standards.
- Initiation of coordination links between public and private hospitals and between the 4 - tier health system for EMS sensitization.
- Monitoring parameters to measure performance across all levels and verticals.

Human Resources

- Capacity building for paramedics and call center personnel for holistic, coordinated response.
- Accountability and ownership from personnel at all levels.
- Perception of personnel and citizens towards digitalization and sensitization for the same.
- Dynamic roles envisaged for the integrated response of the fire and police personnel in the EMS framework.

Technological Intervention

- Implementation of a holistic, integrated system for digitalization of EMS and automation of call centers for a robust healthcare responsiveness.
- Installation and operationalization of GPS, walkie-talkies in ambulances.
- Design, development and procurement of IT hardware-software.

Process

- Testing, piloting of the EMS information system.
- Benchmarking of the response.
- Addressing the bottlenecks and protocols for contingencies.
- User training of the system and workflow with responsibilities.
- Workflow plan to have a coordinated response in the varied geography of Maldives.

Understanding the scope of work through DMAIC tool

Define

Comprehensive review of reports and documents.

- ❖ Overview of the existing Covid-19 emergency response plan
- ❖ Review of National Health Policy and disaster plan review
- ❖ Redefining of guidance documents, SOP's according to WHO and International standards
- ❖ Develop and Review of current process, roles and responsibilities of relevant stakeholders
- ❖ Study of medical priority dispatch system of international academy of Emergency Dispatch

Deliverables

- ❑ **Reviewing and updating of existing SOPs, manuals and guidelines**
- ❑ **Training Content and Capacity Building Sessions**
- ❑ **Improving of real time EMS system based on feedback and issues**
- ❑ **Better Integration of Hardware Components and other Health Systems.**

Measure

Diagnostics and Need Assessment

- Mapping key stakeholders across the verticals
- Integration assessment of CAD , call monitoring and computer telephony integration
- Introduction and testing of beta software
- Collecting the initial response time in the pilot and embedding required changes in the change management process

Control

Actionable insights through reports

- Corrective Action
  - Facility specific corrective action
  - Fortnightly and monthly action plan
  - Track the timeline to ensure its completion
- Trigger /Action generated for any deviation

Analyze

Emergency Medical Service Information System

- Performance Evaluation of Automated EMS System and Integration with other components
- Real time monitoring through the variables of Integrated response structure through various first responses and other components
- Response Time, Coordination bottlenecks, Human resource integration, downtime in person hours due to automation
- Analysis of the operationalized GPS among other components in mobile units and at coordination call centers

Improve

Strengthening of coordinated response

- Continuous Quality Assessment of EMS
- Developing of training material and sensitization programs
- Enhancing the Patient satisfaction by working on feedback
- Capacity building of all stakeholders for usage , automation, coordination across all verticals

Approach and Methodology

	Discovery	Implementation	Technological Intervention	Post Implementation Support
	0-9 weeks	**9-16 weeks**	**16-28 weeks**	**28-52weeks**

Initial Outline	• Review of existing guidelines, SOPs and existing COVID-19 and emergency response system- based on population.
	• Prevalence study and existing response times for various emergencies.
	• Analysis of the current human resource and development of training material.
	• Analysis of the current IT infrastructure.
		• Identifying all the interfaces and integration components for the EMS System.
		• Assessment of current gap in Ems system such as computer aided dispatch , computer telephony integration ,call monitoring.
			• Gap Assessment based on desired functional need of EMS System.
			• Preparing the UAT and Training material for the End Users.
				• Establishing Baseline through KPI of EMS:
				  • On time incident reporting
				  • On-time arrival at the incident
				  • Transfer to the health-center.
				• Identifying Initiatives/ Interventions for better use of the EMS information system.

Execution Strategy	• Detailed strategy and work plan for designing of EMS system . • Review of existing facilities – Total number of ambulances, types available and geographical constraints. • Estimation of Land/sea/air ambulances pathways and interpolation of health institutions for adjusted connectivity. • Assessment of Training and Capacity Building for the EMS.	• Development of EMS system as per workplan. • Pre-requisite hardware and software assessment • Interface build and fitment into central EMS Coordination Mechanism. • Development of Beta version of EMS system.	• IT software and hardware procurement for digitalization and automation of call centers procured and installed. • Installation of GPS devices, walkie talkies and tablets in the ambulances. • Developing, testing and deployment of beta-version of the digital EMS information system and draft final report based in inputs. • Providing end user training.	• Establishing coordination among various health facilities, land and sea ambulances, police departments, fire departments etc. • Operational support for service delivery and training of paramedics. • Assessment and evaluation of the performance of the EMS information system software conducted and remaining gaps addressed through system upgradation.
Deliverables	❖ **Inception Report**	❖ **Interim Report** ❖ **Handover of system design specifications**	❖ **Draft Final Report** ❖ **Handover of training content manual**	❖ **Revised SOPs, manuals, guidelines, and EMS functional document** ❖ **Final Report**

Steps involved in the design of EMS Information System

S. No.	Area of Work	Deliverables	Timeline
1.	**Project Initiation and Discovery Session**	• Discovery Session attended by core project team members, identification of key stakeholders from ADB, MOH, MOF and WHO to develop key insights of the project and facilitate transition • Developing a framework for a robust communication paradigm comprising of rules and procedures for securing and communicating approvals, guidelines for implementation, escalation hierarchy etc.	**5 WEEKS**
2.	**Development of EMS System**	• Designing and Development of EMS System	**4 WEEKS**
3.	**Pre-Requisite Software and Hardware Installation**	• Awarding of contract for procurement • Placement of components in place • Collection of configuration data and installation of base software • Sequential installation and review of satisfactory domain performance	**6 WEEKS**
4.	**Interface Build and Fitment into central EMS Coordination Mechanism**	• Procurement of Hardware and software according to SRS documents • Installation and operationalization of EMS digital system • Procurement of hardware and software for automation of call center	**4 WEEKS**
5.	**Beta testing of the EMS System**	• Smooth roll-out of EMS system with well established and well-connected system module • Assessment and evaluation of the performance of the EMS information system software and identification of the remaining gaps • Performing stress testing of the developed EMS system	**3 WEEKS**

Project Snapshot (contd.)

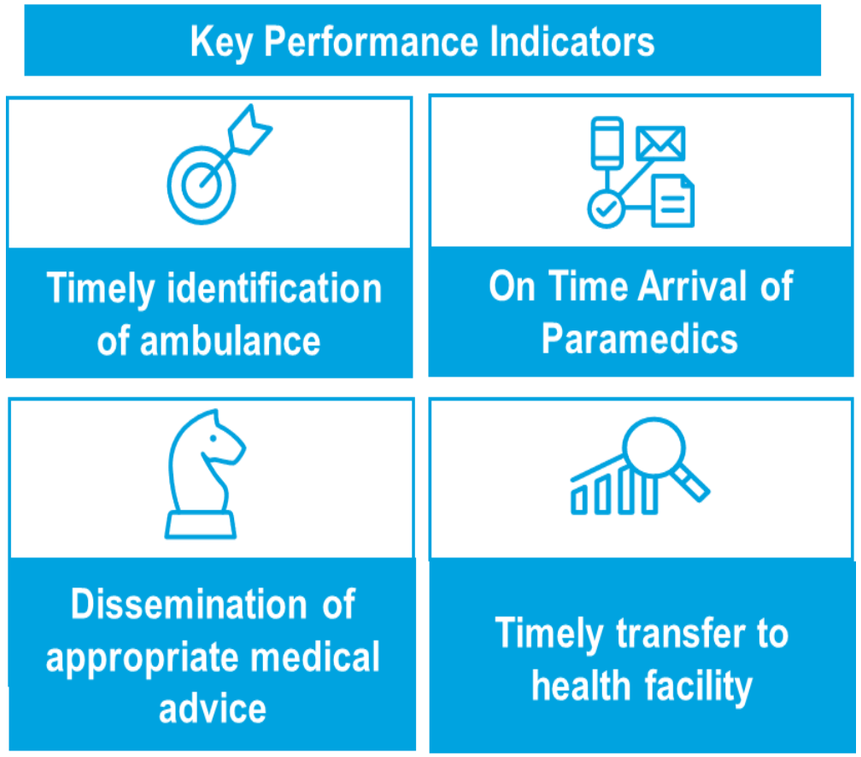
S.No.	Area of Work	Deliverables	Timeline
6.	**Super User Training**	• Training of super user personnel in the configuration and administration aspects of the application • Workflow training of super –users for gap analysis • Compilation of training schedules and course material for future reference	**5 WEEKS**
7.	**User acceptance Testing**	• Testing , piloting and upgradation of EMS as per government request. • Integration of EMS with other HMIS system • Workflow of EMS system is properly established on field	**5 WEEKS**
8.	**Pre-Go Live System & Operational Readiness**	• Review ,Update , support strategy and communication process during Rollout with MOH • Distribute the support resources over required locations • Manage Support calls, logs and issues tracking • Daily system rounds for monitoring users and their feedback • Install fixes as per the EMS system requirement	**6 WEEKS**
9.	**Post Implementation Review and Support**	• Project monitoring and maintenance report • Document handover to MOH and ADB. • Knowledge transfer and successful sign off	**14 WEEKS**

Stage 1: Project Initiation and Discovery Session

Conduct a visionary workshop with all stakeholders	Discovery Session attended by core project team members, identification of key stakeholders from ADB, MOH, MOF and WHO to develop key insights of the project and facilitate transition
Change Protocol Establishment	Developing a framework for a robust communication paradigm comprising of rules and procedures for securing and communicating approvals, guidelines for implementation, escalation hierarchy etc. Communicate change and facilitate transition.
Identification of area specific paramedics and clinical staff to form a repository	A repository consisting area wise database wherein information related to paramedics and clinical staff is stored.
Identification of ambulances and creating a repository	The ambulances will be identified as per the MPDS determinants standards, and a repository will be made for the EMS consisting various ambulances with different intervention capabilities
Integration with other systems facilitation	Integration study for EMS pillars consisting of Records Management Systems (RMS), Geographical Information System (GIS), Automatic Vehicle Location (AVL) and Caller ID for verifying location of incoming call
Prevalence Research	Secondary research conducted to analyze the current health status of the population. Their requirements mapped and most common medical emergencies identified and corelated with the MPDS and questionaries protocol for action established.

Stage 1: Project Initiation and Discovery Session (contd.)

Assessing current state evaluation of FRS documents and defining KPIs



	Functional requirement specification (FRS)					
	Computer telephony integration	Computer-aided dispatch function	Call monitoring and call recording	Real-time ambulance tracking and monitoring.	Digitalization of the EMS	The automation of the call center
Current state analysis for pain areas	✓	✓	✓	✓	✓	✓
Requisite analysis for SRS	✓	✓	✓	✓	✓	✓
Beta- testing for functionality	✓	✓	✓	✓	✓	✓
Super User and User Acceptance Testing	✓	✓	✓	✓	✓	✓
Training and Capacity Building	✓	✓	✓	✓	✓	✓

Illustrative

IQVIA Learnings **Designed and developed FRS document based** on current pain areas, required functionalities, intervention plan, interoperability testing and capacity training

Stage 1: Project Initiation and Discovery Session (contd.)

Design of EMS Workflow System

Occurrence of incidence

Call to the call center being placed

Connecting to the command center

- Caller ID integrated CAD triangulates the location of the caller.
- The computer-telephony integration records and monitors the call, Records Management System (RMS) provides data relevant to incident call.
- Understanding the criticality of patient by gauging standardized patient condition using questionnaire based on Medical Priority Dispatch System (MPDS) by IAED.

- Geographic Information System (GIS) further provides requisite geospatial and geographical data to dispatcher for making infomed decisions.
- Automatic Vehicle Location (AVL) function pinpoints location of response vehicle corresponding to the type of criticality established.
- Appropriately qualified paramedics and ambulance with requisite equipment's based on Medical Transfer Protocol Suite (MTPS) is dispatched and patient telemetry data is shared with paramedics.

Medical advice given

Appropriate medical advice including audio/video consultation is given to the patient until paramedics arrive via Patient Information System (PIS).

Stage 1: Project Initiation and Discovery Session (contd.)

Design of EMS Workflow System

Dispatch of ambulance

Live tracking of ambulance location and sharing it with patient by call center

Paramedics reach the patient

- Paramedics attend the patient evaluation of patient at bedside, analyze the signs & symptoms, pre-morbidities and patient is stabilized and transferred to the hospital
- Patient and ambulance information shared with nearest and appropriate hospital according to care required by patient

Transferring patient to the hospital

- Appropriate care is given to the patient while constantly updating the concern health facility of the condition and ETA
- Based on the geography of the patient, sea ambulance / air ambulances are employed
- Required mode of connection (Ro-Ro ferries) is employed for connection between atolls according to the protocol established.

Patient arrival at the hospital

Message given to call center by ambulance of completion of work on walkie-talkie.

Ambulance ready for next call triaging in the algorithm.

Stage 2: Development of EMS System

The application build/configuration will commence after the design specifications sign-offs

Building of the entire EMS Application

The interface build and configuration will commence after the design specification and integration model sign-offs

Test plans and scenarios built for various types of testing

The solutions and interface components are tested and validated in this stage before releasing the application for any user training or user acceptance testing (UAT).

Reassessing, troubleshooting and coordinating the fitments of EMS with WHO EMS coordination mechanism

Tests for development of EMS include:

Unit Testing

It is to ensure that the configuration data developed matches to the CAD application requirements.

System Testing

It is the standalone functional testing of the application, conducted after the configuration of Consisting of testing of Computer Telephony Integration, CAD function, Call monitoring and recording and Real time tracking.

Interface Testing

It is conducted during the fitment for the functional testing of the WHO coordination mechanism.

System Integration Testing

It is conducted after the successful completion of the various tests mentioned and is done for testing integration and interoperability sequence. Various functional system tests along with workflow testing from call placement to triaging to reaching hospital.

Stage 3: Pre-Requisite Software and Hardware Installation

Approval from MOH, MOF & ADB for the Procurement of Hardware

Procurement will be done after the approval has been taken from MOH & ADB

Installation and Configuration of Hardware Components

Technical team will begin the hardware installation and the necessary configurations once the hardware and the necessary components are installed in Command Center and GPS Devices, Walkie Talkies and Tablets installed in Ambulances

Integration and Testing of Installed Hardware Components

Once the Hardware Components have been installed, their Integration have to be validated against other components in the System such as Mobile Devices, Mobile Terminals, Pagers etc.

Review of Performance of Installed Components

The Installed System will be monitored for the performance as any Emergency Response System have to be reviewed in all the real scenarios as well as building various Simulations and Mock Drill exercises.

Stage 4: Interface Build and Fitment into central EMS Coordination Mechanism

Hardware and software procurement according to SRS documents

The procured software will fulfill following goals:

- Automatically locate the patient and match them with the nearest ambulance;
- Dispatch the paramedic team as and when needed; and
- Provide medical advice that can be taken until paramedics arrive

Digital EMS information system installed and start operating

Establishment of interoperability between the EMS information system and other relevant health information systems to ensure the seamless patient information sharing and referral services

Installation and operation of GPS, walkie talkie and tablets for ambulances

Proper communication through GPS , walkie –talkie established among different stakeholders of EMS system

Automation of call center procured and installed

Coordinated EMS system as per WHO guidelines

Stage 5: Beta testing of the EMS System

- **Beta version of digital EMS information system will be developed and tested along with testing with for interoperability with other associated existing information systems.**
- **Selecting pilot testing sites based on :**
  Network connectivity
  Patient footfall
  Infrastructure readiness
  Skilled Manpower
- **Testing in selected sites**
- **Identification of challenges, shortcomings and their cause-and-effect analysis for their redressal**
- **Customization and tweaking of systems as per the identified challenges**
- **Testing and documenting the final stages before final roll-out**

- Smooth roll-out of EMS system with well established and well-connected system module.
- Assessment and evaluation of the performance of the EMS information system software and identify the remaining gaps
- Performing stress testing of the developed EMS system

Stage 6: Super User Training

- Super user personnel are trained in the configuration and administration aspects of the application
- Workflow training for super –users for gap analysis
- Compilation of training schedules and course material for future reference

Adopting Train-the-Trainer training approach

Super user personnel trained in the configuration and administration aspects of the application

Application Administration training is provided to those trainees who are identified by MOH as super-users / application administrators

Workflow training for super – users for gap analysis

Application Functionality training provided to ensure trainees are fully educated in the functional aspects of the application

Compilation of training schedules and course material for future reference

Stage 7: User Acceptance Testing

End-to-end testing of the solutions and rectification of any defects if identified

Test scripts submission to MOH as a guideline for testing

Based on final developed test scripts and scenarios UAT will be performed by MOH SMEs and core -users

Based on the set of required scenarios test scripts will be produced by IQVIA will consist of workflow scenarios, process steps, expected outcomes and application behaviours

The tester can document the status with priority indicator and the severity associate with each issue

Outcome

- Testing , piloting and upgradation of EMS as per government request.
- EMS system is working in accordance to test script
- Integration of EMS with other HMIS system
- Workflow of EMS system are properly established on field

Training Need assessment & Capacity Building

Ongoing keeping in view evolution in EMS system & expected attrition and on-boarding of new human capital

Capacity building plan

- Training need assessment – Develop tools to assess knowledge levels
- Develop training material – Training content as per latest guidelines
- Capacity building of key stakeholders – Introductory & refresher trainings to all National Call Center Staff, Paramedics Staff, Ambulance Drivers and other Stakeholders involved in the System

Details of training content

- Specific training content to be developed for National Call Center Staff, Paramedics Staff, Ambulance Drivers
- Training content as per latest national/ international guidelines to be developed for Healthcare professionals
- Draft training content to be shared before final development for review & feedback

Training methodology and handholding support

- Training Handbook
- Facilitator Guide
- Audio-Visual Content
- Presentation and Operational Training

- Training Handouts
- Group Discussion on Case Studies

- Pre & Post Training Assessment
- Training Schedule
- Support in Training Activity

- Setting up the new EMS Infra
- Monitoring Day to Day Operations
- Conducting Assessments
- Providing Feedback & Guidance

Stage 8: Pre-Go Live System & Operational Readiness

Verification — Pre-Go Live meetings are conducted to verify that all the necessary preparations and the readiness of the system to ensure for a successful Live operation of the project

Performance Assessment — Assessment and evaluation of performance of EMS and addressing remaining gaps.

Integrated System review — Review of Infrastructure & application readiness

Implementation — Phased roll out and go live followed by on –the –job user training.

Information broadcast — Implementation of IEC strategy.

- Review and Update support strategy and communication process during Rollout with MOH
- Distribute the support resources over required locations
- Manage Support calls, logs and issues tracking
- Daily system round for monitoring users and their feedback
- Install fixes as per the EMS system requirement

Stage 9: Post Implementation Review and Support

Handover of :

- Data base design
- Other information related to project design development and implementation

Exit management

1

Project monitoring and issue resolution

2

3

- Validation of documents
- Handing over of system design, user manual and solution details

4

5

Submission of closure report

Project monitoring and maintenance report

Document handover to MOH and ADB.

Knowledge transfer and successful sign off

Results summarized

- The designing of an EMS system is an intricate process, with highest level of understanding of the country it is being designed for. Hence, the current state analysis of Philippines is done. The results of which are utilized for need assessment and gap analysis. In Philippines, it was found that, there was no usage of tech intervention aids like walkie-talkies, GPS enabled vehicles, tablets for Emergency Response System and Traditional way of managing emergency response services, inadequate staff at National Call Center for handling EMS, delayed response to emergency calls during the pandemic, lack of coordination between health facilities, sea and land ambulances, police departments, fire departments and other stakeholders, capacity building and IEC, inability to locate and dispatch nearby paramedic team and vehicles.
- In response to this, the facilities that were offered were designed in a customized way. The computer-telephone integration which automatically detects the caller location is done, and a questionnaire establishes the criticality of the patient. Medical advice is then given which serves as the major catalyst in the survival of the patient. The criticality established is used to dispatch the right ambulance to the patient which is nearest to the patient's vicinity.
- The current skills, infrastructure is also determined and accordingly inculcated to form the basis of the designing of the program. The designed EMS system will be put across the country in stages and gauged over a period of 12 months.

Abbreviations

ADB: Asian Development Bank

EMS : Emergency Medical Service Information System

GPS: Global Positioning Devices

HMIS: Health Medical Information System

KPI: Key Performance Indicators

MOH: Ministry of Health, Maldives

MOF: Ministry of Finance, Maldives

SOP: Standard Operating Procedures

UAT: User Acceptance Testing

WHO: World Health Organization

RMS : Records Management Systems

GIS : Geographical Information Systems

AVL : Automated Vehicle Locater

Thank You