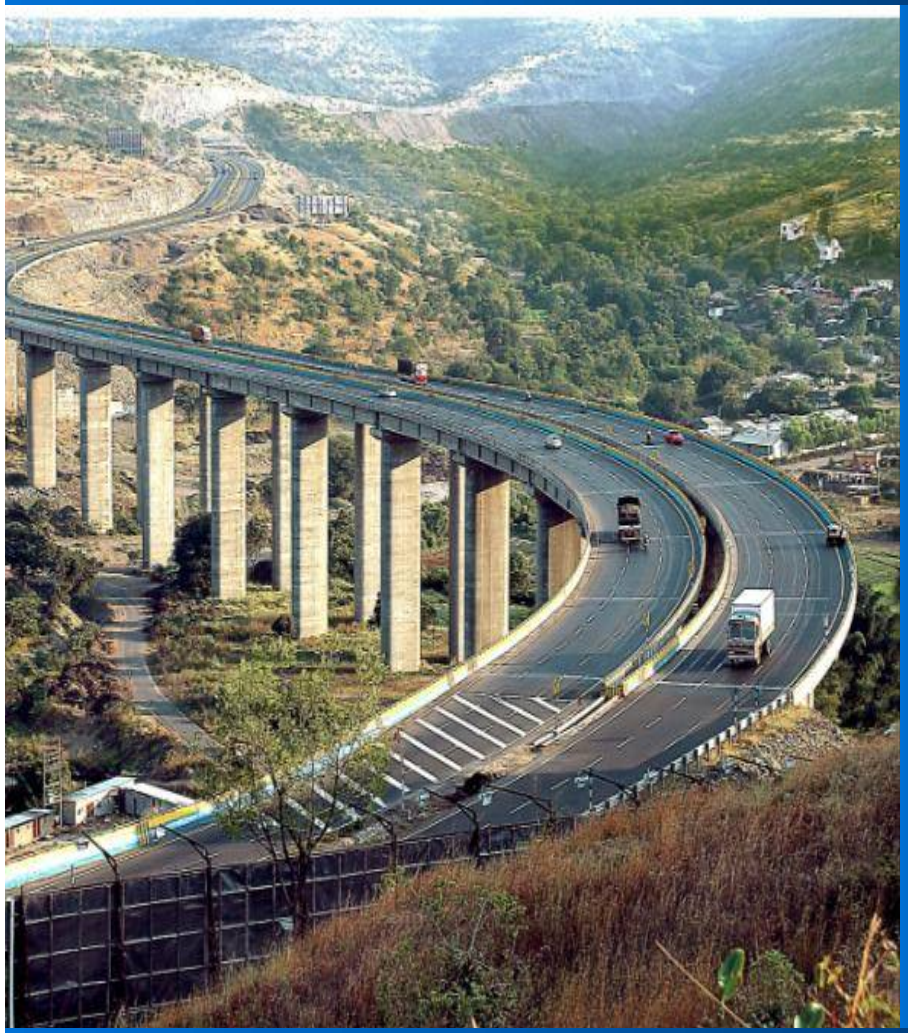

Building a Nation
Not just Highways

Advance Integrated Incident Management System for National Highways in India

WRM Paper Id 607

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14.11.2017

IRF World Road Meeting 2017,
November 14-17, 2017, Delhi, India

Currently, each concessionaire operates own on-road units & control room to handle incidents

Patrol Vehicles

Ambulances

Tow-away cranes

Key components of current system

<u>On-road units</u>: Patrol vehicles, ambulance, tow-away cranes

- No. of vehicles and specifications detailed in maintenance manual
  - Same for all concession types, but differs according to length of highway
- **Location: Ambulance/tow-away crane stationary at toll plaza, patrol vehicle patrols highways 24*7**
- Manpower owned by concessionaire, 24*7 and 3 shift operation

<u>Command Centre:</u>

- Each concessionaire operates a control room with **unique contact number**
- Contact numbers displayed on toll slips and sign boards across highways
- Control room monitors CCTVs and coordinates with on-road units
- Manpower owned by concessionaire, 24*7 and 3 shift operation

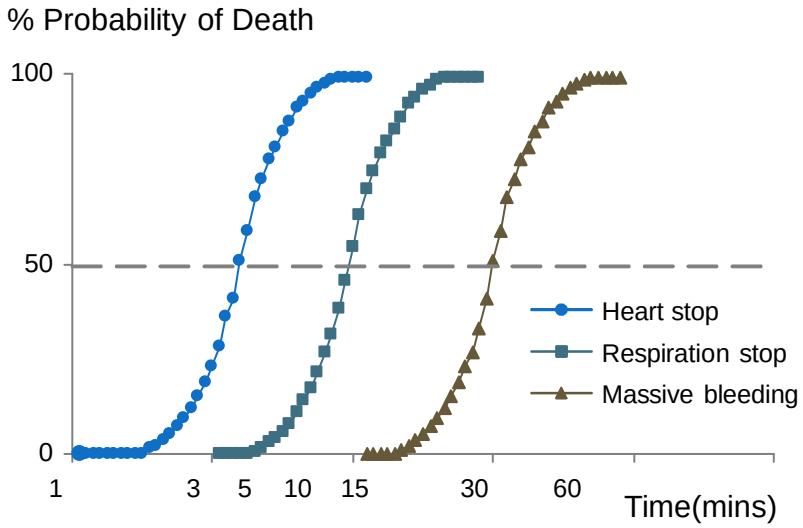
'Speed of response' and 'quality of response' have direct impact on fatalities

Speed of Response: Exponential increase in fatalities with increasing response time[2]

Accident victim should receive medical treatment within 'Golden hour'

- Prompt medical treatment within 60 mins. significantly reduces probability of fatality

Ambulance should hence reach accident site within 10-15 mins. of incident

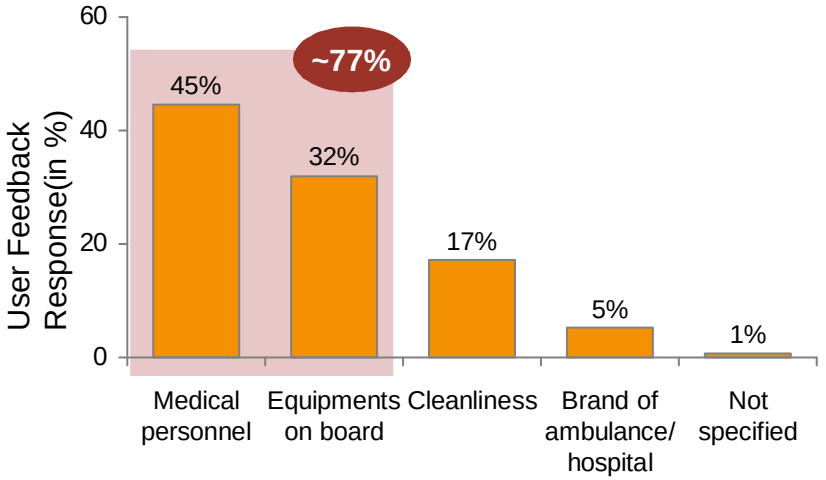


Quality of Response: Skilled medical personnel, suitable equipment essential

Fatalities can be reduced if:

- Medical personnel are suitably skilled (Minimum diploma in EMT, 3-4 years experience)
- Suitable equipment available on-board (E.g. to immobilize patient, to break glass, etc.)

77% Motorists agree that medical personnel and equipment are essential[1]:



Source: (1) Based on survey conducted across 1200+ highway users (2) Paper by National Highway Traffic Safety Administration (NHTSA), Washington DC - 2015

Six areas of improvement identified for NHAI on both 'speed of response' and 'quality of response'

Speed of Response

1. **Only partial 'Incident Management' coverage of NHAI highway network**
   - UI and BFA projects often do not have Incident Management services
   - Coverage of ambulances varies across ROs and even within ROs
2. **Ambulances are not optimally located to minimize response time**
   - Located at toll plazas instead of near accident hot-spots
3. **Lack of clarity on 'who' to call, and if call is being addressed**
   - Motorists are unclear on who to call, due to multiple helpline numbers
   - Response times are recorded but not centrally monitored on most stretches

Quality of Response

4. **Inconsistent specifications across on-road units**
   - Concessions awarded at different times have varying specifications
   - Limited audit / central tracking to ensure concessionaires adhere to specifications
5. **Specifications require to be upgraded to include latest technology**
   - Equipment for safe extrication and immobilization of victims required
6. **Personnel need to be adequately skilled to provide emergency care**
   - Qualifications, past experience of medical personnel not currently evaluated

1

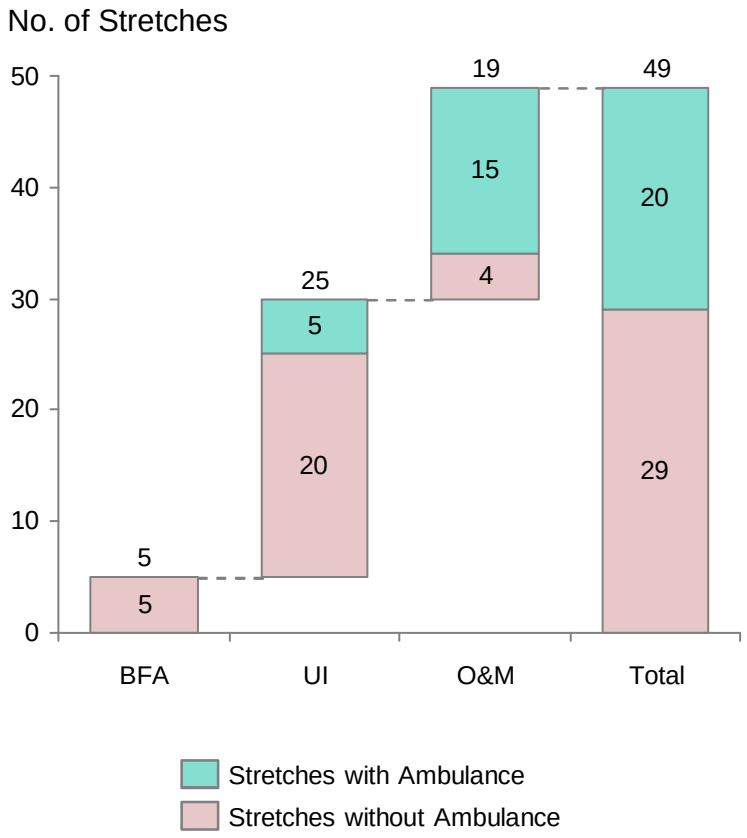
Areas of Improvement

Only partial coverage of NHAI IM network

Distances covered by ambulances varies across and within ROs

Example: RO Jaipur

29 out of 49 projects under RO-Jaipur do not have ambulances



Coverage of ambulances varies across ROs and even within ROs

Avg. distance covered by each ambulance varies across RO:

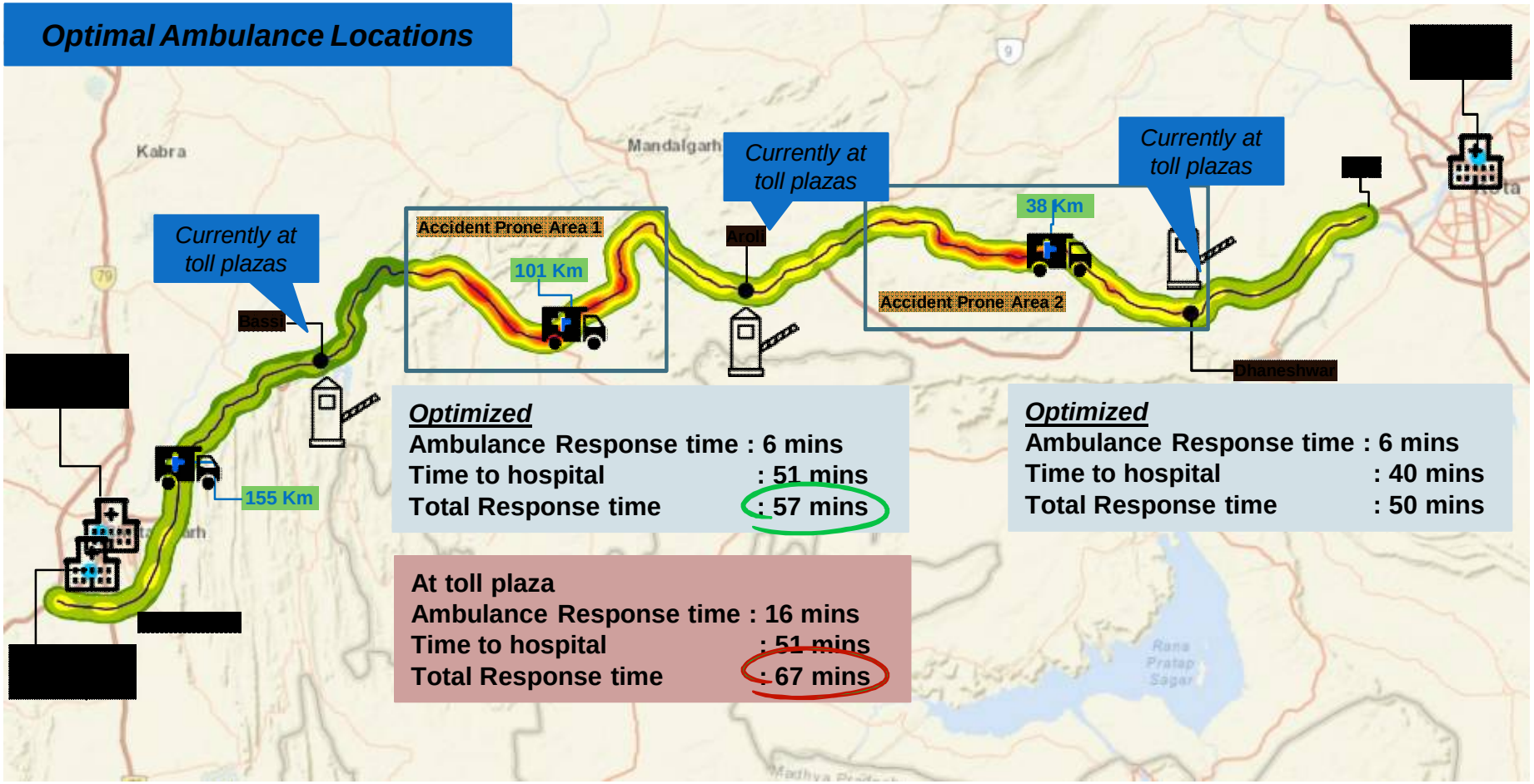
- Bhubaneshwar : 60 km
- Chennai : 48 km
- Gandhinagar : 52 km
- Guwahati : 55 km
- Jaipur : 52 km
- Kolkata : 46 km
- Thiruvananthapuram : 36 km

Coverage also varies within Ros:

- **Gomati Chauraha – Udaipur Stretch** of 79 kms has 2 ambulances whereas **Chittorgarh - Udaipur** stretch of 94 kms has only 1 ambulance
- **Gondal-Rajkot stretch** of 67kms has 2 ambulances whereas **Gandhidham (Kandla) - Mundra stretch** of 71 kms has only 1 ambulance

Ambulances need to be optimally located to reduce response time

Optimal Ambulance Locations



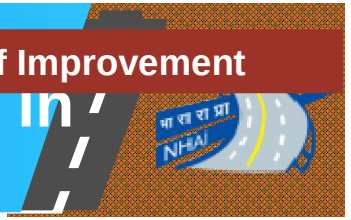
Optimized
Ambulance Response time : 6 mins
Time to hospital : 51 mins
Total Response time : 57 mins

At toll plaza
Ambulance Response time : 16 mins
Time to hospital : 51 mins
Total Response time : 67 mins

Optimized
Ambulance Response time : 6 mins
Time to hospital : 40 mins
Total Response time : 50 mins

Optimization of ambulance locations can reduce response time in accident prone area 1 by ~10 mins

Geo-analysis identified potential for 20%+ reduction in response time (E.g., RO Jaipur)



Total projects : 49

Projects with ambulance : 20

Projects with accident data reported, taken for geo-analysis : 16[1]

1. **46% reduction in Ambulance Response Time for three stretches obtained by adding additional ambulance and optimizing location of ambulance**

2. **22% reduction in Ambulance Response Time for remaining thirteen stretches obtained by optimizing location of ambulance**

1: Kishangarh-Ajmer-Beawar stretch: Accident location was not recorded in form of chainage; Rajsamand- Bhilwara: Only consolidated data was available ; In Jaipur-Reengus and Kishangarh-Chittorgarh highway stretch – no data available

3 Lack of clarity on who to call and no systematic tracking of response times

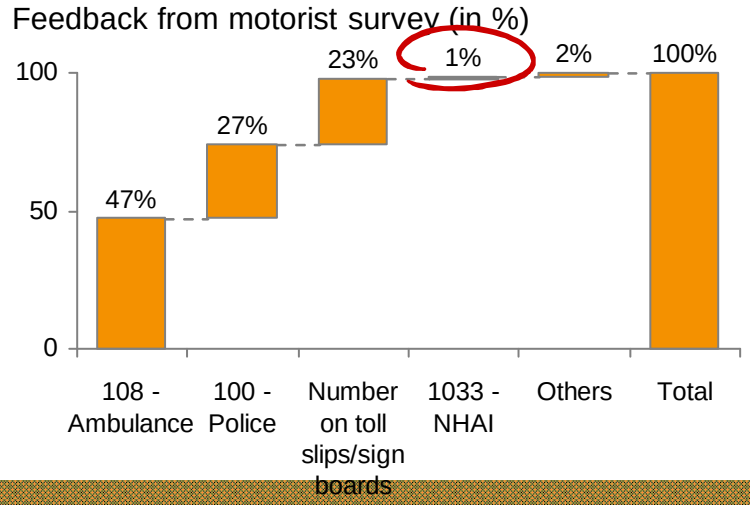
Areas of Improvement

Motorists are unsure of which helpline number to call…

Multiple help-line numbers available:

- **108** – State ambulance services
- **100** – Police
- **1033** – NHAI helpline
- Individual highway helpline numbers available on toll slips / sign boards

… leaving motorists confused on which number to call:

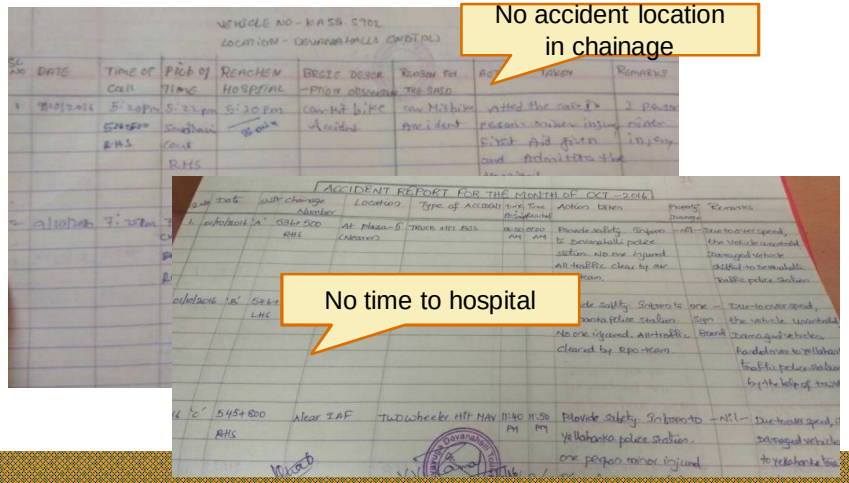


…and whether their call will be responded to in a timely manner

Calls to concessionaire control rooms are not monitored:

- No real-time tracking of time from receipt of call to closure of incident
- Cases observed of Helpline numbers being unreachable, and missed calls not being returned

Data currently reported only in manual form as a 'post-facto' analysis:



Equipment and specifications needs to be upgraded using latest technology

Additional equipment needed for immobilization in ambulances

- Vacuum mattress
  - used especially in vertebrae, pelvis or limb trauma
  - advantage is that it takes shape of patient and is much more comfortable compared to hard board

- Splint kit
  - used to immobilize fractures (arms/ legs)
  - majority road accidents lead to fractures

- KKendrick Extrication Device (KED)
  - used for securing head, neck & torso especially in severe back injury cases

Additional equipment needed for victim extrication in patrol vehicles

- Hydraulic cutter
  - Cut through vehicle's iron parts/ help in removing them
  - Used for making relief cuts for displacement of vehicle components

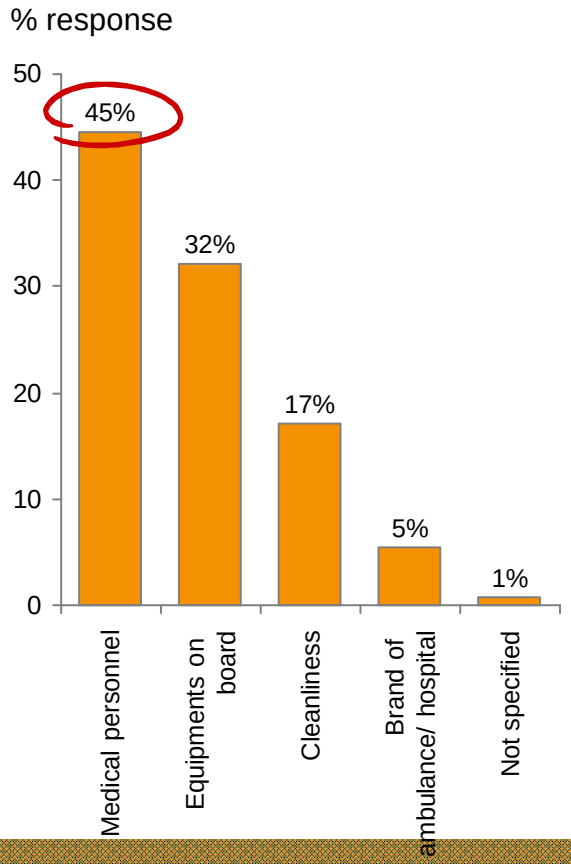
- Hydraulic spreaders
  - Spread components apart
  - Often used in spreading door from vehicle

- Electric windshield cutter
  - Glass debris concentrated outside
  - Airborne dust minimized

Source: Interviews with patrol car drivers

Personnel inadequately skilled to provide emergency care

~45% motorists ranked 'skilled medical personnel' as most important…



… yet qualification not defined in current O&M manual specifications

Current O&M manual specifications of manpower required are :

- Trained paramedical staff
- Nursing staff with first-aid knowledge
- Driver

No previous experience requirement

- Min. 2 years experience should be mandatory

No details of qualification required

- Min. diploma in EMT should be mandatory

Clear qualifications need to be mandated

1 trained EMT staff per shift with qualifications:

- **Diploma in E.M.T.**
- B.Sc. (PCB) with certification in BLS/ ALS/ ACLS/ ITLS (or) B.Sc Nursing/ GNM/ ANM, B.Pharma/ D. Pharma (or) any other equivalent paramedical course from **recognized** university/institution of **IMC/INC**
- **Minimum 2 years** experience in first-aid and life saving emergency skills
- At least **one training (minimum one month) in tertiary care institution** in handling life saving emergency medical equipment

Multiple organizations benchmarked to identify best practices in Incident Management and Safety

10+ agencies benchmarked

TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION

highways england
driving forward

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

NSW GOVERNMENT Transport for NSW

Texas Department of Transportation

MPRDC

Atlantia

GDOT Georgia Department of Transportation

FDOT

Multiple best practices observed

1. Command and control centers set up to monitor IM operations in 1000-2000 km network
2. Asset light model – most IM components are contracted or coordinated by Authority
3. Consistent standards & specifications maintained across on-road units
4. Incident response time and incident clearance time are tracked by all incident management centers
5. Inter-agency co-operation ensure coordinated response
6. Emergency rescue personnel undergo extensive training and certification courses

1 Command and control centers set up to monitor Incident Management operations in 1000-2000 km radius

	1 USA	2 England	3 Sweden	4 Italy
Agency	Washington State Department of Transportation	Highways England	Sweden Transport Administration	Autostrade per l'Italia
Length of Highways	7332 Km	6920 Km	8769 Km	3020 Km
Control Centers	6	7	4	10
Avg length covered by Control Center	~1200 Km	~1000 Km	~2100 Km	~300 Km

2 Asset light model – most IM components either contracted or coordinated by Authority

Highway Patrol

Owned

CCTV cameras / VMS

Owned
Contracted if BOT model

Ambulance

Coordinated with EMS

Command Centre

Owned (e.g. Australia)
Contracted (e.g. Italy)

Tow-Away Cranes

Contracted (e.g. England)
Coordinated (e.g. Italy)

Trauma Care Centres

Coordinated

Source: Expert Interviews, Secondary research, BCG Analysis

4 Incident response time and incident clearance time are tracked by all incident management centers

Incident Response Steps (Defined in Government Traffic Management Standards)

Automated traffic alert; incident recorded

Command center identify and dispatch closest on-road unit with automatic vehicle location

On-road controls traffic until incident is clear, then reopens traffic lanes

T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Incident Occurs	Incident Reported	Incident Verified	Response Identified & Dispatched	Response Arrives on Scene	All lanes open to traffic	Response Departs Scene	**Normal Flow Returns**

Law enforcement, or CCTV feed identifies / verifies incident

- **On-road unit assesses incident**
- **Clears vehicles from road**
- **Activates rapid tow incentive program**

On-road unit updates CC operator

Incident Response Time

Incident Clearance Time

Varies with type of incident
- Incident Clearance time (NSW)
  - Minor incident : ~40 mins
  - Major incident : ~360 mins

Varies with type of unit
- Incident Response time (NSW)
  - Patrol unit : 15 mins
  - Ambulance : 10 mins

Type of measurement
- Avg. incident Response time
- No. of incidents where target is not met

Source: Expert Interviews, Secondary research, BCG Analysis

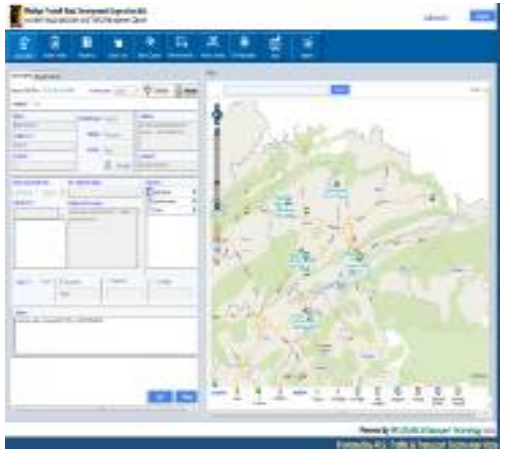
Indian benchmarks indicate that States hire dedicated Agency for Incident Management

108 Emergency Services operational in 20 states across the country

Single agency (E.g., GVK EMRI) operates and maintains control room and ambulances

- State level control centers established
- Control centers dispatch nearest ambulance
- Used for accident and other emergency response (e.g. pregnancy)
- Ambulances are not attached to State Healthcare Centres (SHCs)

MPRDC has engaged ARS TT&T for providing control room services



Control room set up to monitor response across all MPRDC highways

- User calls helpline number 1099 routed to common Command & Control Centre
- Accident location identified on GIS Map
- Call taker verifies location of incident
- Nearest vehicle identified & allotted via CAD
- A notification via SMS is sent to nearest police, trauma centre & toll plaza

Based on baseline and benchmarks, guiding principles defined for Incident Management Program

1 Data Analytics

Analysis of 11,000+ NH accidents
- Root-causes of accidents
- Optimal ambulance positioning

2 User Feedback

Interviews
- Route Patrol Officers, Paramedical Staff, Tow crane operators, Doctors, Accident Victims

Survey of 1000+ highway users

3 Benchmarking

- **International:** USA, Italy, Australia, South Africa, England
- **India:** MPRDC, Mumbai-Pune, Yamuna Expressway

Guiding Principles

1. **End-to-end ownership by single agency for Incident Management (Detection, Response, Clearance and Traffic Management)**
2. **Ownership of assets for Incident Management (Control Room, ambulances, etc.) should not vest with NHAI**
3. **Timely response (15 mins for incident response) should be ensured through clear SLAs**
4. **Consistent "Gold Standard" specifications to be provided across all units**
5. **Global best practices should be incorporated in designing the optimal model**

Single Incident Management Agency to be hired for each Region / State

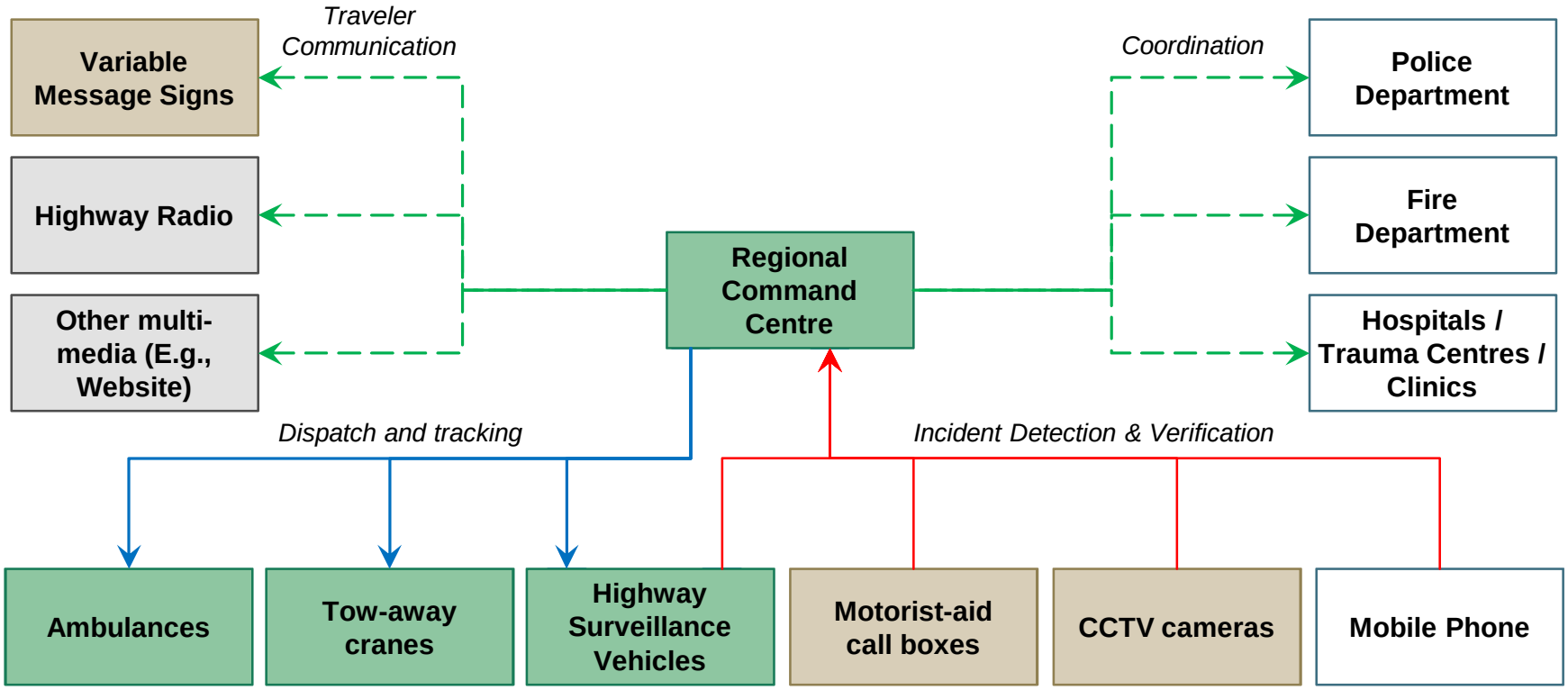
Two operating models can be considered for Incident Management Agency

	1 Provide on-road units on all stretches; de-scope from existing concessionaires	2 Provide on-road units only on unserved stretches; for existing stretches, take over concessionaire units
Details	**NHAI engages Agency to:** • Provide IM services for all stretches in RO • Set up Regional Control Room • Provide ambulances, tow-away cranes and surveillance vehicles on all stretches • Operate and maintain all equipment for 5 years after commissioning **IM services will be de-scoped from existing concessionaires purview**	**NHAI engages Agency to:** • Provide IM services for all stretches in RO • Set up Regional Control Room • Provide ambulances, tow-away cranes and surveillance vehicles on unserved stretches • Take over and operate existing on-road units provided by concessionaires • Operate and maintain all equipment for 5 years after commissioning **COS will be issued to concessionaires to upgrade equipment to required specs.**
Benefits	**All on-road units will be provided by Agency, and hence will be uniform in specifications.** **Roll-out time will be lower, as Agency has end-to-end responsibility for setting up system.**	**Cost will be lower, as new on-road units will be provided only on unserved stretches.** **Existing units deployed by concessionaires will be utilized, rather than being scrapped.**
Risks	**Cost will be higher as new on-road units are being deployed on all stretches.** **De-scoping process for concessionaires will need to be carefully planned.**	**Roll-out would take much longer, as COS needs to be finalized with multiple concessionaires.** **Challenging to ensure that each concessionaire upgrades on-road units to meet desired specs.**

Model 1: IM Agency to set-up Regional Command Center and provide on-road units on all stretches

- Owned by highway concessionaire
- Owned by Incident Mgmt. & Safety contractor
- Owned by NHAI
- External ownership

State Level



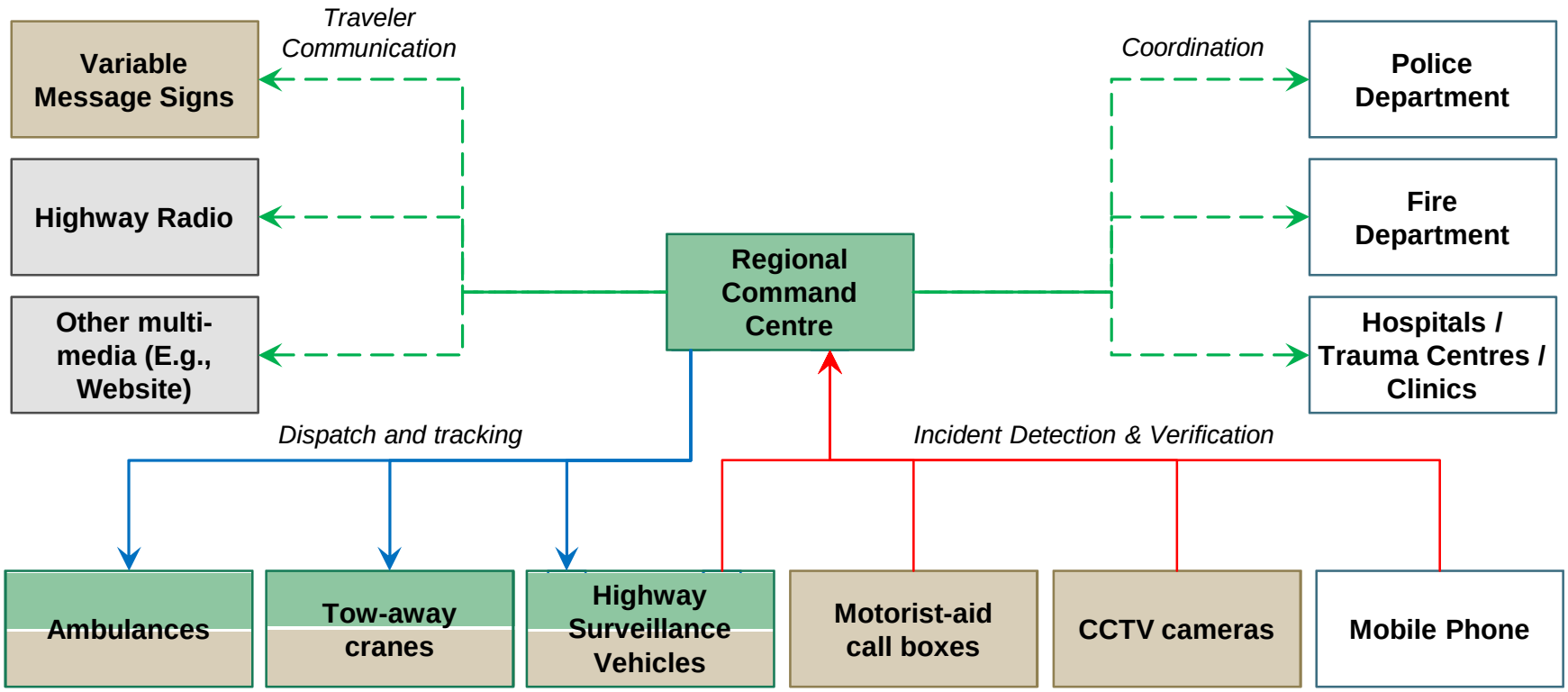
On-road units to be provided by IM Agency for all stretches.
IM services to be de-scoped from concessionaire purview.

Model 2: IM Agency to set-up Regional Command Center and provide on-road units on unserved stretches

Selected Model ✓

- Owned by highway concessionaire
- Owned by Incident Mgmt. & Safety contractor
- Owned by NHAI
- External ownership

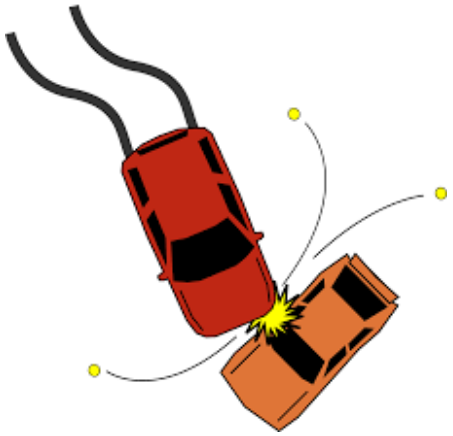
State Level



On-road units to be provided by IM Agency on unserved stretches. IM Agency to take over management of concessionaire equipment on other stretches.

Standard Operating Procedure

Illustration

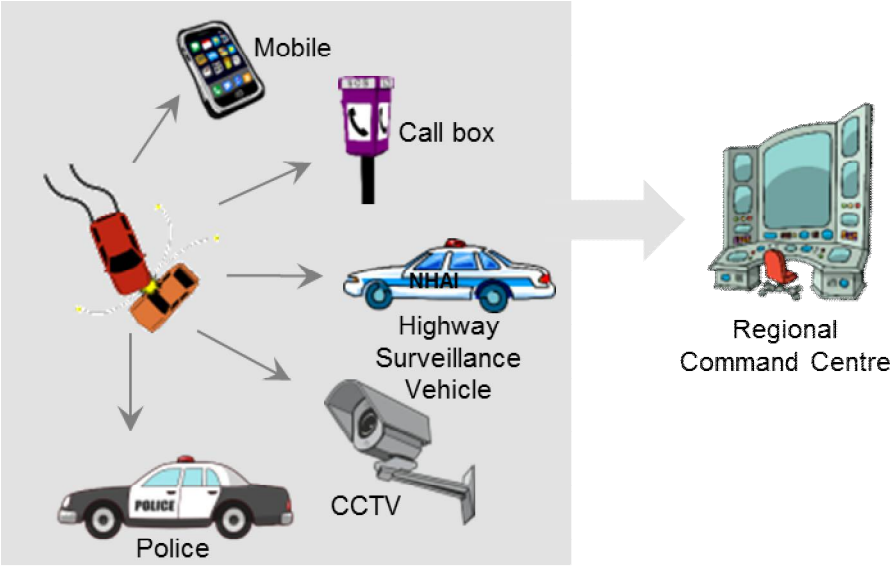


Details of process

T_0 **Incident occurs on National Highway**

Standard Operating Procedure

Illustration



Details of process

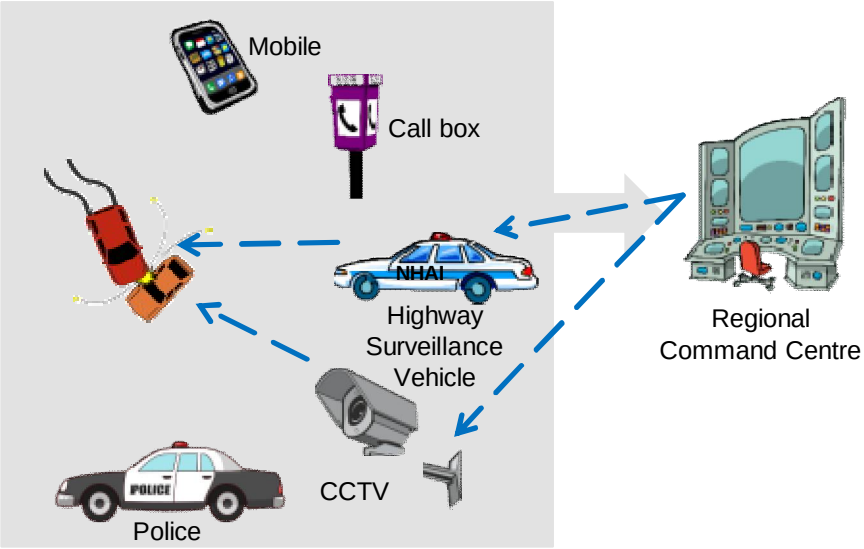
T_0 Incident occurs on National Highway

T_1 Incident is detected on highway and relayed to Regional Command Centre by any of the foll:

- Call from individual through cell phone to 1033 or concessionaire help line
- Call from individual through highway call box
- Highway Surveillance Vehicle detects incident
- CCTV camera (*only provision to be made*)
- Call from police

Standard Operating Procedure

Illustration

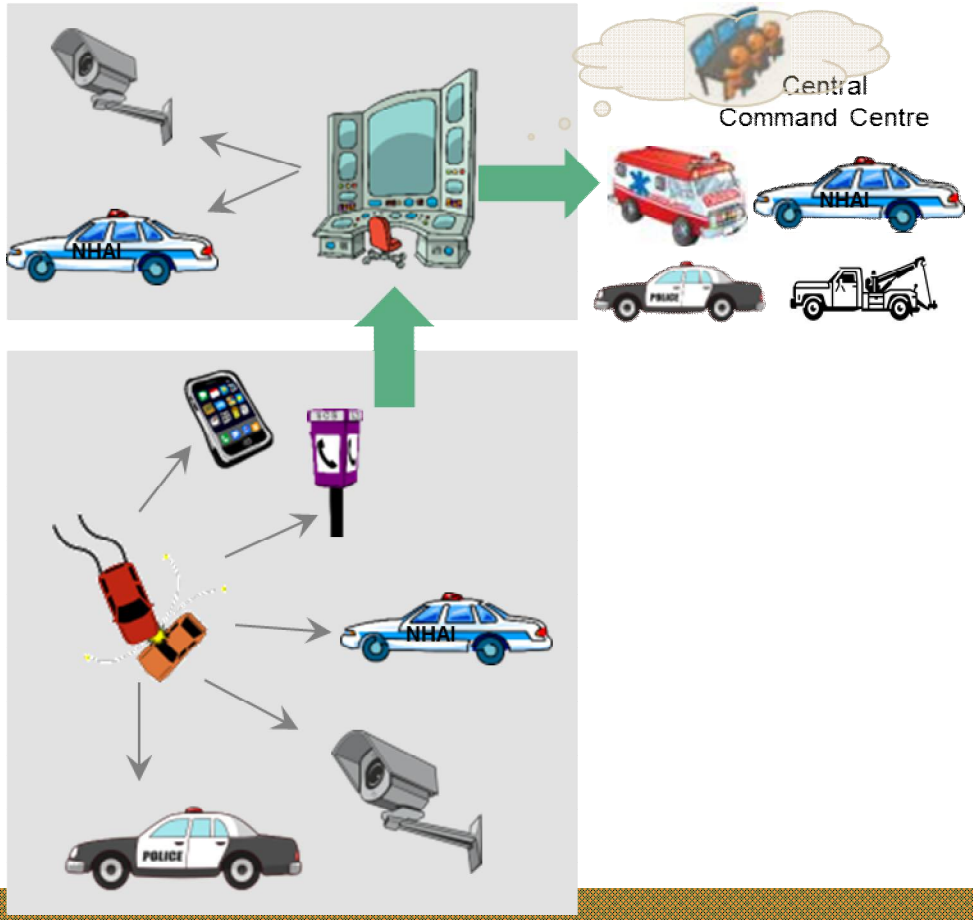


Details of process

- **T_0 Incident occurs on National Highway**
- **T_1 Incident is detected on highway**
- **T_2 Incident is verified at control centre through:**
  - CCTV Camera (*only provision to be made*)
  - Highway Surveillance Vehicle

Standard Operating Procedure

Illustration



Details of process

T_0 Incident occurs on National Highway

T_1 Incident is detected on highway

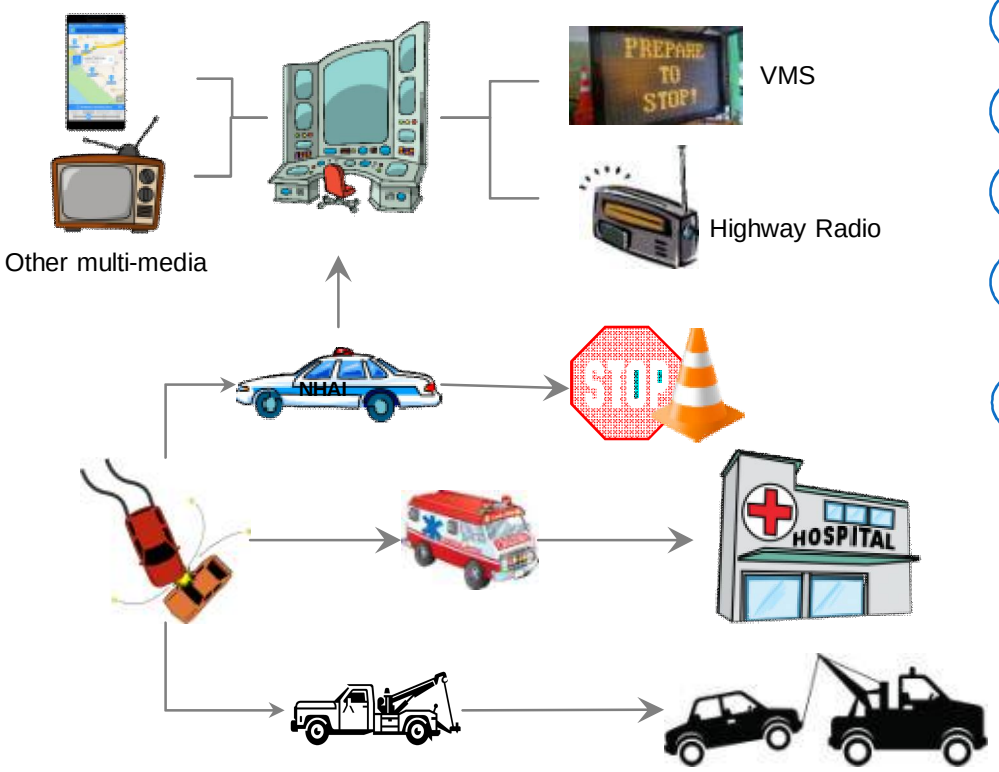
T_2 Incident is verified

T_3 Control room despatches appropriate response:

- **Highway Surveillance Vehicle** dispatched to control traffic
- **Ambulance** is dispatched if there are injuries
- **Tow away cranes** are dispatched if there are any vehicle breakdowns
- Informs local **police** (if not already informed)
- Activities monitored by **Central Command Centre** to response as per SLAs

Standard Operating Procedure

Illustration



Details of process

T_0 Incident occurs on National Highway

T_1 Incident is detected on highway

T_2 Incident is verified

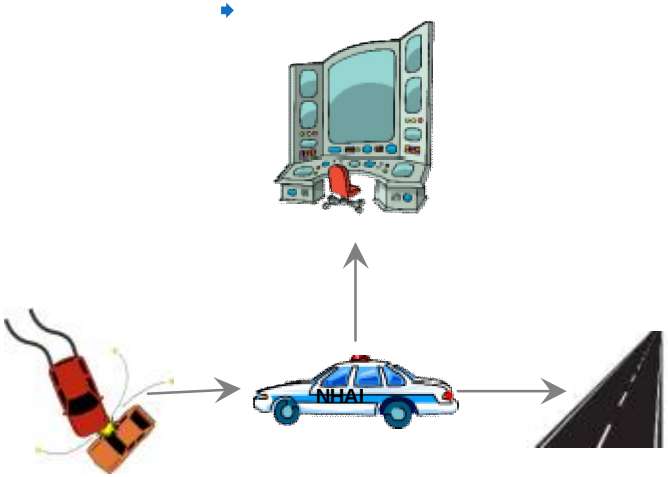
T_3 Control room despatches appropriate response

T_4 Response arrives on scene

- **Highway Surveillance Vehicle** closes lanes and controls traffic, constantly updates control centre
- **Ambulance** removes injured to the hospital
- **Tow-away crane** removes vehicles from road
- **Regional Command Centre** updates VMS, radio and other multi-media with details of incident and delay

Standard Operating Procedure

Illustration

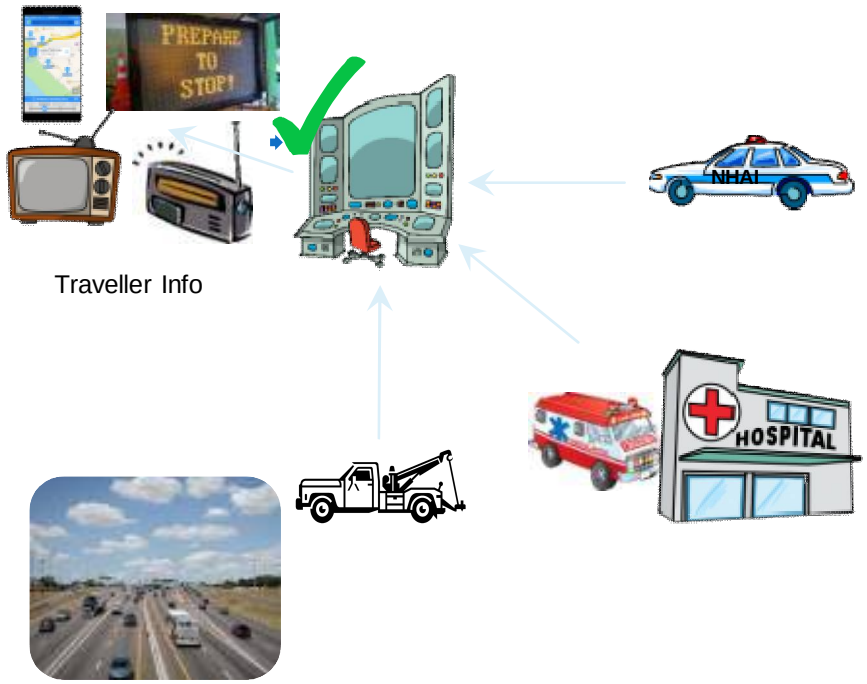


Details of process

- T_0 **Incident occurs on National Highway**
- T_1 **Incident is detected on highway**
- T_2 **Incident is verified**
- T_3 **Control room despatches appropriate response**
- T_4 **Response arrives on scene**
- T_5 **Roadway is cleared**
  - **Highway Surveillance Vehicle** updates Regional Command centre

Standard Operating Procedure

Illustration

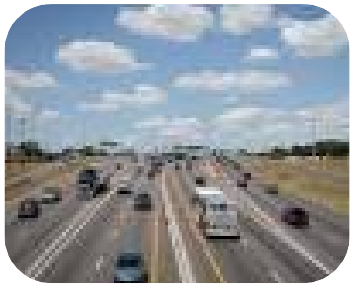


Details of process

- **T_0 Incident occurs on National Highway**
- **T_1 Incident is detected on highway**
- **T_2 Incident is verified**
- **T_3 Control room despatches appropriate response**
- **T_4 Response arrives on scene**
- **T_5 Roadway is cleared**
- **T_6 Incident closed**
  - **Tow-away crane** leaves the scene
  - **Ambulance** reaches hospital and updates command centre
  - **Highway Surveillance Vehicle** updates Regional Command centre and leaves scene
  - **Regional Command Centre** logs incident closed and updates traveller information

Standard Operating Procedure

Illustration



Details of process

- T_0 **Incident occurs on National Highway**
- T_1 **Incident is detected on highway**
- T_2 **Incident is verified**
- T_3 **Control room despatches appropriate response**
- T_4 **Response arrives on scene**
- T_5 **Roadway is cleared**
- T_6 **Incident closed**
- T_7 **Normal traffic flow resumes**

Thank You

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Not just Highways