Emergency Medical response & preparedness in Chemical Industry:

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DISASTER

- Defined in the Disaster Management Act, 2005 as:
- “A catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, leading to accidents, and resulting in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of environment, and is of such a nature and / or magnitude as to be beyond the coping capacity of the community of affected area”
MAJOR MAN-MADE DISASTERS

- Chemical
- Biological
- Radiological
- Nuclear
- Transport (Air/Railways/Road traffic/Marine)
- Urban Flooding – One of the major causes
- Riots/Civic Disturbances
- Terrorism

Industrial Accidents

These may originate in:

- Manufacturing and formulation installations including during commissioning and process operations; maintenance and disposal.
- Material handling and storage in manufacturing facilities, and isolated storages; warehouses and god owns including tank farms in ports and docks and fuel depots.
- Transportation (road, rail, air, water, and pipelines).
Major Threats

• Fire
• Explosion
• Toxic release
• Poisoning
• Combinations of the above

COMPOUNDING OF EFFECTS OF ACCIDENTS

• Meteorology of the area, wind speed and direction, rate of precipitation, toxicity/quantity of chemical released, population in the reach of release, probability of formation of lethal mixtures and other industrial activities in vicinity.
Major Consequences

- Loss of life / injuries
- Impact on livestock
- Damage to Flora/fauna
- Environmental Impact (air, soil, water)
- Financial losses to industry.

Types of Emergencies

- Onsite Emergency
- Offsite Emergency
Emergencies

• Explosion
• Toxic Release
• Combination of the above

Some high impact world-wide chemical disasters

• Flixborough, Nypro UK (1st June. 1974)
  Chemical released was cyclohexane due to which 28 persons died, 36 were injured. The plant was completely demolished and over 1821 houses and 167 factories suffered tremendous losses.

• Seveso, Italy (10th July 1976)
  Chemical released was 2,3,7,8-TCDD (Dioxin) which has resulted in the death about 1.0 lakhs animals, evacuation of 760 persons and contamination of an area of about 4,450 acres.
GASOLENE TANK FIRE- South East Asia 2000

FIRE RISK
EXPLOSION

Boiler Explosion
CATASTROPHE RISKS- CYCLONE
Flooding - industrial parks
Thailand Floods, 2011

Flooded cement factory

Flooded factories in a industrial estate in Ayutthaya province; nearly 200 factories had to temporarily close.

Photos: BBC
Indian Ocean Tsunami 2004
Damage to oil storage tanks – Indonesia

- Destruction to oil storage tanks, oil filled barrels and pesticide depots in Banda Aceh, Meulaboh and Krueng Raya areas were detected. Throughout the whole facility area, oil was mixed in with mud and water.

- Limited data regarding damage and loss on industrial locations from Indian Ocean Tsunami is available.

A displaced fuel storage tank in Kreung Raya

Dam Failure – environmental consequence

July 28th, 2010, Jilin, China - Heavy rain caused an upstream dam to rupture and flash floods rushed into warehouses of two chemical factories. The floods washed away about 7000 chemical barrels into Songhua River. The river was Jilin city’s main water supply to its inhabitants. Consequence – Public hysteria; authorities were finding it difficult to retrieve barrels and were blamed for irrational layout of chemical industries downstream of Songhua river.
Lightning strikes on petrochemical operations

Lightening strikes are indicated as one of the main causes for storage tank accidents (Chang and Lin, 2006).

**East Malaysia, 2012** - Petronas subsidiary, MISC Berhard, lost at least **US$40 million** when one of its oil tankers was struck by lightning and caught fire.

**Thailand/Map Ta Phut Industrial Park, 2012** – Bangkok Synthetics Co (BSC): Lightning Strike at a toluene vessel – 12 dead, 129 injured, environmental damages, fines and plant closure of several manufacturers. Reported Losses exceed **US$1 Billion**

Oil Rig Explosion
The 1984 Bhopal gas disaster

The human cost (estimates)

- Up to 10,000 deaths in first three days
- Additional 25,000 people died of related injuries by 1994

December 3, 1984
A cloud of methyl isocyanate gas leaks from the Union Carbide pesticide plant

Source: AFP/EPA/AU/ICMR

031209
BHOPAL GAS TRAGEDY, 1984

JAIPUR OIL DEPOT FIRE, 2009
Sivakasi Factory Fire, 2012

East Godavari Distt, Andhra Pradesh, GAIL Pipeline Accident, June 2014
Overall Indian Scenario

• In India, there are more than 40,000 hazardous industries, with around 3.1 million workers.

• 1861 Major Accident Hazard (MAH) units spread across total 301 districts, and 28 States and UTs, in India.

Source – NIDM, MoEF
Legislations related to Chemical Emergency Management

- Environment Protection Act, 1986
- Factories Act, 1948 as amended in 1987
- Public Liability Insurance Act, 1991 and Rules
- Chemical Accidents (Emergency Planning, Preparedness and Response Rules) 1996
- Central Motor Vehicles Rules, 1989 as amended in 1993

Legislations related to Chemical Emergency Management

- The Explosives Act, 1884
- The Explosive Rules, 2008
- The Gas Cylinders Rules, 2004
- The Petroleum Act, 1934 & The Petroleum Rules, 2002
Factories Act- Chemical Works– Schedule XV

• Chemical Works – Schedule XV is introduced under Dangerous operations
• This schedule requires
  – Identification of hazards
  – Remedial measures
  – Identification of Emergencies
  – Preparation of Emergency Plan
  – Practicing of Plan once in 3 months

MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICALS RULES, 1989

☐ INSPECTION OF THE FACILITY AT LEAST ONCE IN A CALENDAR YEAR
☐ NOTIFICATION OF MAJOR ACCIDENT WITHIN 48 HOURS
☐ UNDERTAKING OF ANY INDUSTRIAL ACTIVITY BY THE OCCUPIER ONLY AFTER EXPLICIT APPROVALS
☐ SAFETY REPORTS AND SAFETY AUDIT REPORTS
☐ REGULAR MONITORING AND SUPERVISION
☐ PREPARATION OF ONSITE EMERGENCY PLAN BY THE OCCUPIER
☐ PREPARATION OF OFF-SITE EMERGENCY PLAN BY THE AUTHORITY
☐ SPECIFICS WITH RESPECT TO IMPORT OF HAZARDOUS CHEMICALS
MSIHC Rules

- Framed under EPA
- 684 chemicals are identified to be hazardous and toxic
- Preparation of onsite emergency plan by industrial installation
- Preparation of offsite emergency plan by Government
- Information to public liable to be affected
- Safety audit once in a year

Responsibilities of MAH Installations

- Preparation of onsite emergency plan
- Notification of major accident
- Preparation of safety reports and safety audit reports
- Conducting mock drills to test the onsite emergency plan
- Aid, assist and facilitate functioning of District Crisis Group
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Essentials for Offsite Planning & Response

- Awareness to all Govt. Officials, nearby villagers & volunteers
- Prompt Communication to inform outside plant (DM, CO, Fire Station, CMO, DRM, RTO, DIO and nearby Village/Town Heads)
- Wind direction based evacuation of all concerned
- Law & Order enforcement through Police Deptt.
- Clearance/diversion of traffic by Transport Deptt.
- Food, water, telephone connectivity for people shifted

Contd..
Section 6 (2) (d & e) of the DM Act mandates NDMA to prepare Guidelines on the basis of which Plans will be made by the Ministries/ Departments of the Government of India and the States.

Approach

- All inclusive participatory and consultative process with representatives from the Ministries/ Departments of Government of India and other stakeholders
National guidelines on chemical disasters

REGULATORY FRAMEWORK:

- FACTORIES ACT 1948
- EXPLOSIVES ACT 1884
- THE INSECTICIDE ACT 1968
- THE PETROLEUM ACT 1934
- THE ENVIRONMENT PROTECTION ACT 1986
- REGULATIONS IN TRANSPORTATION, INSURANCE LIABILITY

SALIENT FEATURES OF THE GUIDELINES

INSITUTIONAL FRAMEWORK AND COMPLIANCE (MHA, MOEF, MOLE, MOA, MOP& NG, MO C&F, MOSRT &H, MO C& I), DEA, MOF

- MAJOR ACCIDENT HAZARD CONTROL SYSTEM
- HAZARD ANALYSIS STUDIES OF INDUSTRIAL POCKETS
- GIS BASED EMERGENCY MANAGEMENT SYSTEM
- ENVIRONMENT RISK REPORTING AND INFORMATIONS SYSTEMS (ERRIS)
- EMERGENCY RESPONSE CENTRES (ERCS) AND POISON CONTROL CENTRES
- CAPACITY DEVELOPMENT
- CONTROL ROOM CONCEPT
- NATIONAL NETWORKING OF EMERGENCY OPERATION CENTRES (EOCS)
- RESPONSIBLE CARE
OTHER COMMON FEATURES

- CODES OF PRACTICES, PROCEDURES AND STANDARDS
- STATUTORY INSPECTION, SAFETY AUDITING AND TESTING OF EMERGENCY PLANS
  - INSPECTION SYSTEM BY REGULATORY BODIES
  - SAFETY PLAN FOR COMMISSIONING AND DECOMMISSIONING
  - SAFETY AUDITING
  - REGULAR TESTING OF EMERGENCY PLANS
- EDUCATION AND TRAINING
- CREATION OF APPROPRIATE INFRASTRUCTURE
- AWARENESS GENERATION

Concerned Ministries and Enforcing Deptts.
IMMEDIATE CONCERNS

Search & Rescue
First Aid
Transfer/Evacuate to Medical institutions
Restoration of Essential services eg Medical services, Water, Electricity, Communication networks, etc
Provision of Minimum Standards of Disaster in Relief Camps eg. Food, Drinking water, Shelter, Sanitation, Medical cover
Disposal of Dead bodies
Prevention of Epidemics
Debris Removal

NATIONAL DISASTER MANAGEMENT GUIDELINES
MEDICAL PREPAREDNESS AND MASS CASUALTY MANAGEMENT

October 2007

NATIONAL DISASTER MANAGEMENT AUTHORITY
GOVERNMENT OF INDIA
Seven Chapter

Chapter 1 : Vulnerability and Effects, Need for creation of an institutional mechanism, Enhancing Capacity and Capabilities of Hospitals and Healthcare Workers


Chapter 3 : Salient Gaps in Preparedness and Mitigation, Hospital Preparedness, IDSP, Blood Transfusion Services, CBRN Management, Stakeholder Participation, Psycho-Social and Mental Health

Chapter 4 : Roles and Responsibilities of Various Stakeholders, Establishment of Early Warning, Medical First Responders, Emergency Medical Evacuation, EMS, Alternate Mobile Hospitals, HDM Plans, ICS, Capacity Development, Development of Trauma Services, Burn Wards, Blood Banks, Networking of Labs, R&D and Psycho-Social Support.

Chapter 5 : Response, Rehabilitation and Recovery

Chapter 6 : Medical Preparedness for CBRN

Chapter 7 : Approach for Implementation

Emergency Medical Response / Pre Hospital Care

Certified Medical First Responders (MFRs) will be :-

- Fully trained in resuscitation, triage and Basic Life Support;
- Well-equipped and supported by all emergency services and material logistics;
- Informed continuously about the dynamics of the disaster, based on indicators;
- Communication backups at the Incident Response site to handle all kinds of Mass Casualty events within the golden hour.
Casualty Evacuation

Integrated Ambulance Network (IAN) including road, rail, aerial and water ambulance networks integrated at various levels.

Equipped with:
- Personnel trained in Basic Life Support.
- Basic Life saving equipment and drugs.

It will work in conjunction with:
- Emergency Response Centres (ERCs),
- Medical services, and
- Evacuation Plan of district, based on the Public-Private Partnership model.

Specialized Medical Facilities

- Strengthening of Integrated Disease Surveillance Programme
- Trauma Care (Infrastructure and Capacity Development)
  - State Apex Trauma Centre (JPN Apex Trauma Centre)
  - Regional Trauma Centre (50 beds)
  - District Trauma Centre (10 beds)
- Licensed Blood Banks critical for management of shock, networked to cater to surge requirement during disasters.
- Burn Centres of 30 beds in Medical Colleges, Tertiary Care Hospitals and Districts having more than 10 Major Accident Hazards (MAH).
- Network of Bio-Safety Laboratories
- Tele-medicine
- National Highways Ambulatory Services and Infrastructure
Salient Gaps in Emergency Medical Response & Preparedness

- Non Implementation of Guidelines on Mass Casualty Management by States
- Lack of Designated Rapid Response Teams and certified first Medical Responders BLS PHTLS trained (Armed forces NDRF, CPF, State police)
- Lack of competency and Skills for Emergency care of Chemical Accidents in health workers

- Lack of proper communication facilities
- Lack of coordination between health, fire services, police, Govt and DM department
- Lack of Policy for competency development for BLS, PHTLS, ATLS for specialist Doctors and other staff in urban and rural areas
- Lack of proper regulatory mechanism
- Lack of adequate resources
- Non Availability of Training centers for Chemicals & CBRNE Response in the Health Sector
• Non-availability of PPE amongst the responders
• Lack of availability of antidotes
• Lack of inter agency coordination
• Poor communication and networking amongst the health institutions in Govt & Pvt Sector
• Lack of occupational health workers in India
• Lack of training institutions in Occupational Health

Hospital DM Planning

• Hospital DM Plan will be a part of “all Hazard”
  • District DM Plan catering to:
  • Coordinated Structured Framework with detailed actions and roles of each health care provider
  • Crisis Expansion of Beds/ Hospital Support Services
  • Emergency Medicines Disposables Blood Transfusion Services Diagnostic & Operative Service
  • Hospital Incident Command Structure (ICS)
  • Laboratory backup; and Bio safety
  • Hospital Evacuation Plans
  • Decon & Sepsis Wards
  • Patient referral / Movement Plans

• Treatment Protocols for Chemical Accidents
HOSPITAL DM PLANNING

Chemical Casualty Management
Resources Inventory as per Risk Analysis – Antidotes & Decomposition agents;
- Agent Bio-waste Disposal Facilities;

- Treatment Protocols
  - Immediate
  - Long Term
  - Delayed Effects

- Rehabilitation
  - Psychosocial Support & Mental Health Services
  - Rehearsed twice a year

Emergency Procedures

- Training of employees
- Rehearsal of the plan
- 10 % of workers shall be trained in first aid and fire fighting
- Information on chemicals to physician
Bhopal Gas Tragedy

- Worst industrial disaster in history
- 2,000 people died on immediate aftermath
- Another 13,000 died in next fifteen years
- 10-15 persons dying every month
- 520,000 diagnosed chemicals in blood causing different health complications
- 120,000 people still suffering from
  - Cancer
  - Tuberculosis
  - Partial or complete blindness,
  - Post traumatic stress disorders,
  - Menstrual irregularities
- Rise in spontaneous abortion and stillbirth

Consequence and Medical Response

- The gas being heavier than air, started entering into homes of unwary population. Many who panicked and ran out also got crushed in stampedes.
- Doctors and Hospitals were unaware of nature of the gas - lack of knowledge for management and treatment of MIC.
- Doctors/ practitioners were unable to diagnose and treat

Lack of hospital casualty management plans and mechanism for referral

Lack of knowledge and non-availability of antidotes
Observations & Lessons

- Information about leakage not given to police
- Excessive storage of MIC, 10 times more than permissible
- Critical refrigeration section not operational
- Iron pipelines used in MIC, instead of SS
- No improvements in safety, even after pointing out by the safety audit team
- Negligence on the part of factory officials for various safety aspects
- Lack of proper handing/taking over system

Observations & Lessons

- Offsite emergency plan was not prepared
- Lack of knowledge about alarm system
- Lack of knowledge and non-availability of antidotes
- **Doctors/ practitioners were unable to diagnose and treat**
- Large settlements permitted close to the hazardous plant
- Detailed Hazop study/ risk analysis not carried out prior to plant modification
- PPEs not available
Jaipur Oil Depot Fire 2009

Observations & Lessons

- Onsite medical response was not available. Workers were referred outside.
- Basic operating procedures were not followed. Accident could have been better managed if safety measures had been followed.
- Lack of coordination between the plant, district administration and district health officials.
MEDICAL PREPAREDNESS FOR CIDM

- Creating awareness amongst medical and paramedical staff as well as employees of industry and community
- Creation of trained specialised medical first responders (MFRs)
- Creation of decontamination facilities in the onsite and off site emergency plan of MAH units
- Uniform casualty profile and classification of casualties and their antidotes
- Risk inventory and resources inventory
- Plans for evacuation
- Proper chemical casualty treatment kits
- Crisis management plan at the hospitals
- Mobile hospital/medical team

EMERGENCY MEDICAL RESPONSE

- EMR including rescue, relief and remedial measures (QRMTs with PPE to reach site alongwith resuscitation, protection, detection and decontamination equipments)
- Triage and evacuation as per SOPs to be done
- Symptomatic treatment and antidote administration
- Blood analysis for identification of chemicals
- Hospital emergency room to be equipped with all the necessary equipment, antidotes etc
EMERGENCY MEDICAL RESPONSE

- Hospital DM and safety plans to be in place and rehearsed periodically
- Capacity development of health and hospital staff to deal with chemical emergencies
- Plans for surge in hospitals
- Networking and coordination within hospital and vital health set ups
- Coordination with other response agencies
- SOPS for management of dead
- Regular follow ups, medicare, reconstructive surgery and rehabilitation & close monitoring for long term effects

Burn Centres

- Non-availability of adequate facilities for management of burns at CHC/District Hospital level
- Some Medical Colleges have a Burn Wards
- All Tertiary Care hospitals have a Burn Centre
- Districts having more than 10 Major Accident Hazard (MAH) Unit should have a designated Burn Centre
PREPAREDNESS FOR PUBLIC HEALTH AND ENVIRONMENTAL EFFECT RESPONSE

- Preparation of Toxicology Database
- Availability of info on diagnostic facilities and specialised expertise
- Information on specific antidotes
- Creation and maintenance of public health response teams
- Safety and hygiene standards
- Strengthening of poison control centres
- Psychosocial support

Poison Information Centers in India

- Poison Information Centers (PIC) play a vital role in providing information and management
- All India Institute of Medical Sciences (Department of Pharmacology)
- National Institute of Occupational Health, Ahmedabad
- Government General Hospital, Chennai
- Amrita Institute of Medical Sciences and Research, Cochin
Functions of Poison Information Centers

• Information Service: Provide information and guidance to the public and healthcare professionals

• Technical Advise: to healthcare professionals and the public to avoid unnecessary exposure to toxins and contain the impact of the disaster

Areas of concern in India:

• Inadequate human resources/trained manpower
• Non-availability of PPE amongst the responders
• Lack of availability of antidotes
• Lack of inter agency coordination
• Poor communication and networking amongst the health institutions
• Lack of community awareness/education
Areas of concern in India:

- Improper drainage, uncontrolled dumping
- Lack of occupational health workers in India
- Lack of training institutions
- Lack of formal training curricula/courses
- Lack of Poison Centers in States/Major Urban Areas with Laboratory and Hospital Back-up
Not my job!

Safety - It's an Attitude
THERE IS A NEED TO THINK PROACTIVELY –
INVEST IN BUILDING CAPACITIES –
THROUGH
AWARENESS, TRAINING AND EDUCATION

BUILD PARTNERSHIP

DO NOT HANDLE IT ALONE
Key references

- Slide 7 - Indian Ocean Tsunami Disaster of December 2004, UNDAC Rapid Environmental Assessment of Aceh, Indonesia - Joint UNEP/OCHA unit, Feb 2005

“*If I have the belief that I can do it, I shall surely acquire the capacity to do it even if I may not have it at the beginning.*”

- Mahatma Gandhi
Thank you!

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