

Emergency Medical Preparedness & Response Mechanism for CIDM

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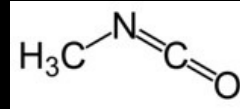
Bhopal Gas Tragedy

- 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 still birth





How it happened



- December 3-4, 1984: 40 tonnes of methyl iso-cyanate (MIC) released from Union Carbide plant at Bhopal
- Accidental release caused by leakage of water into MIC storage tank
- None of the safety systems worked
- Safety standards & maint system ignored for months
- Absence of community preparedness
- Public alarm system operated after the gas had leaked

Case Study: Tokyo Subway Sarin Attack

- Incident was not recognized as nerve agent attack until approximately 3 hours after release.
- 12 dead, 692 Actual Victims from exposure, total 5500 treated
- Only 688 of the 5,500 victims were medically transported. The rest were transported by passers-by or went themselves. Over 400 vehicles responded
- 4,500 persons approximately were "walking well"
- Nearest Hospital saw 500 patients in the first hour.
- Over 1000 units of atropine were available

Tokyo Subway Sarin Attack

Mass decontamination was not performed.

- 135 responders suffered effects of exposure.
 - 20% of the hospital workers suffered secondary exposure.
- Over 50% of those involved remain effected today.
 - 37% requested financial aid from the government.
 - \$2.6 M was spent on medical expenses in first year.
 - 10% of victims quit school or work.
 - Personal belongings were placed into bags and returned to victims who were told to burn them.

Sources of Chemical Disasters

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

Factors Leading to Chemical Disasters

- Fire
- **Explosion**
- Toxic release
- **Poisoning**
- Combinations of the above

Initiators of Chemical Accidents

- **Process and Safety System Failures:**
 - **Technical errors:** design defects, fatigue, etc.
 - **Human errors:** neglecting safety instructions, deviating from specified procedures.
 - **Lack of information:** absence of emergency warning procedures, nondisclosure of line of treatment etc.
 - **Organisational errors:** poor emergency plg, coord, communication, noncompliance with mock drills.
- **Natural Calamities**
- **Terrorist Attacks/Sabotage**

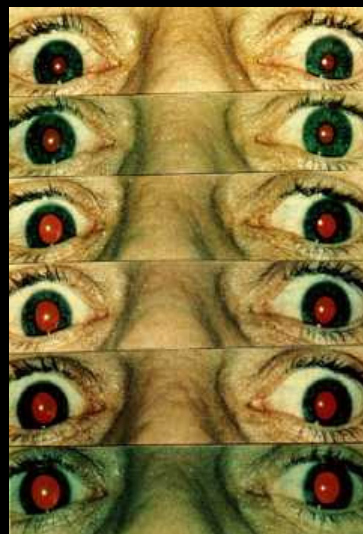
Deleterious Effects of Chemical disasters

- Breathing difficulties, eye irritation
- Skin abnormalities, nausea, respiratory problems
- Chest or abdominal pains & death.
- Precise symptoms would depend upon the **agent used**, and the severity of the symptoms can depend upon the person's **proximity to the contamination**.
- Internal organ failure, weight loss, fever, vomiting.

BLISTERS CAUSED
BY HD



MIOSIS CAUSED
BY BLISTER AGENTS



LESSONS LEARNT & GAPS IDENTIFIED

- Sensitization of Decision Makers. Clarify role of top mgmt in 'on-site' emergencies and Collector, SSP, CMO in handling 'off-site' disasters.
- **On Site' and 'Off Site' plans not as per schedule 11 & 12 of MoEF Rules. Revisit and review of plans by professional disaster managers.**
- District DM Plan & Industries Emergency Response Plans disjointed.
- **General Awareness of Community – family kits, knowledge of different siren sounds – of hazardous material handled/produced & action on any emergency – adoption of villages – giving emp.**

LESSONS LEARNT & GAPS IDENTIFIED

- Hazard and vulnerability assessment of industrial units not carried out in some cases.
- Upgradation of Fire Services
- Police. To be trained in their roles of cordoning, law & order, guidance of first responders, VIP visits, identification of missing persons & disposal of dead bodies after panchnama
- Incident Command System – Concept of ICS for command, control & reliable communications for management of disaster – ICS concept by industries.

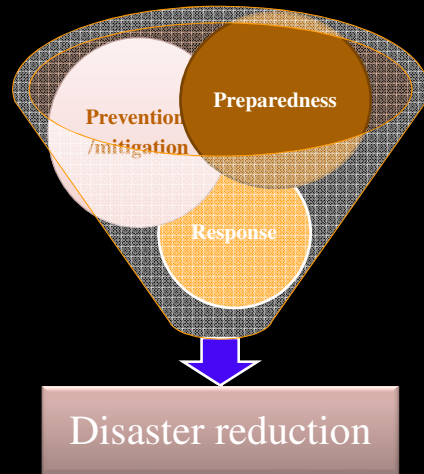
LESSONS LEARNT & GAPS IDENTIFIED

- Medical Preparedness. MFR to know hazardous materials and antidote – to be trained in Triage & pre-hospital care – surge capacity in hospitals (Govt & private) – shortage of ambulances with industries & with distt. Auth.
- Evacuation – of cas to nominated hospitals and affected community to temp Relief Camp/s.
- Cooption of NHAJ. During transportation of hazardous material, parking places to be developed along Highways by NHAJ.

Challenges

- Industrial and chemical safety assume greater importance due to high growth in manufacturing sector
- Quality standards and better norms of enforcement
- Standardization of on and off-site emergency plans
- Proper system of certification for risk assessment, emergency plans and safety audit
- Regular drills for checking the effectiveness of the plans and of the emergency preparedness
- Training and capacity building at all levels
- Involvement of insurance companies for better risk management in industrial sector
- Increased awareness among workers and communities

Objectives

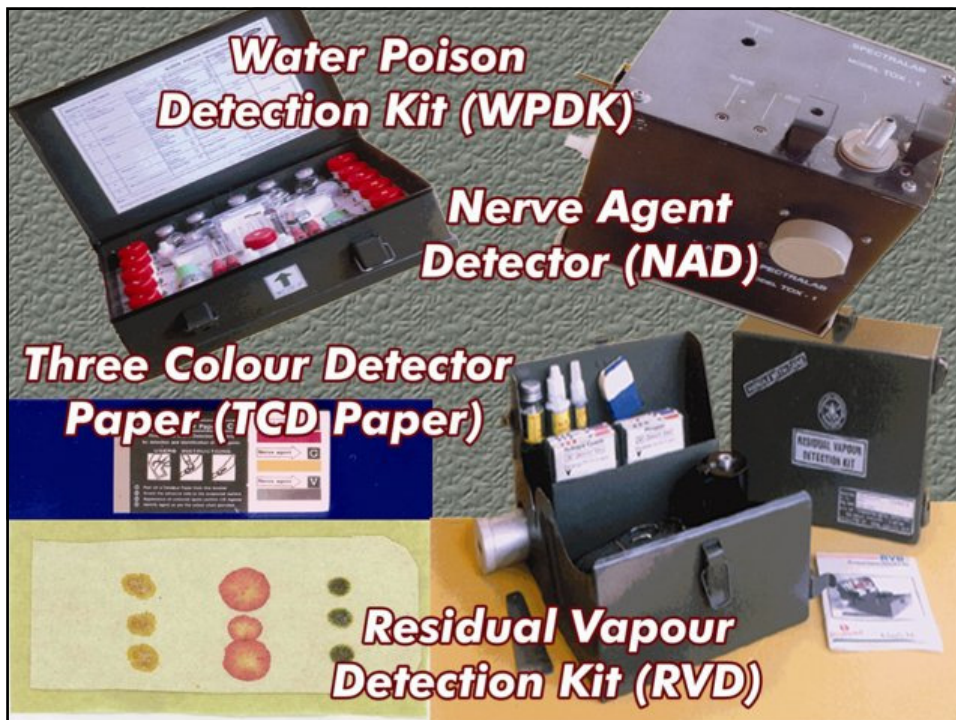


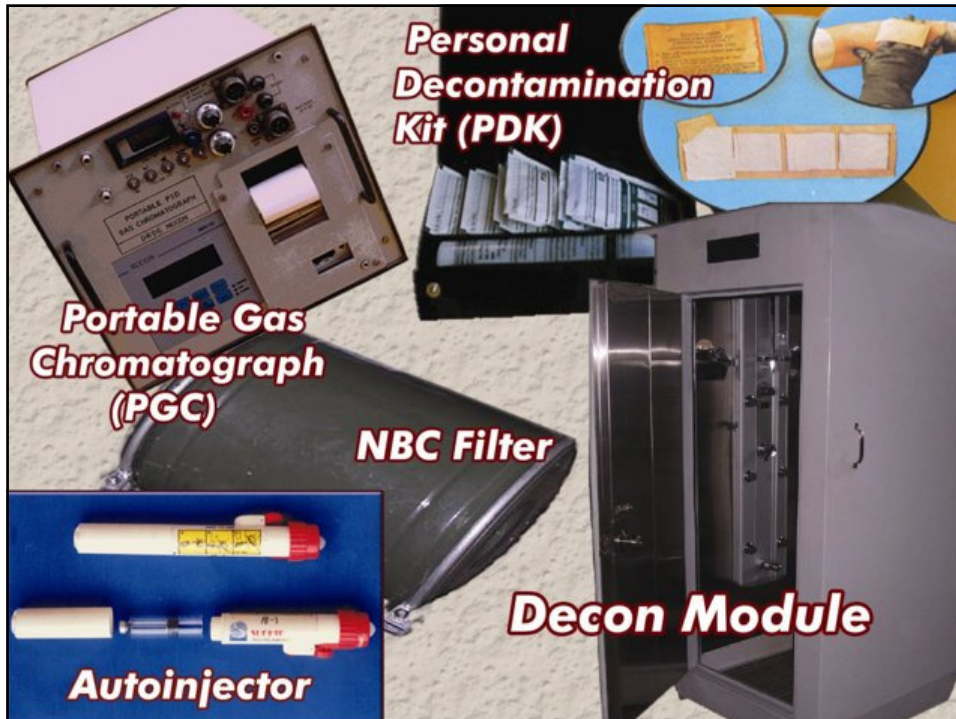
Preparedness

Preparedness

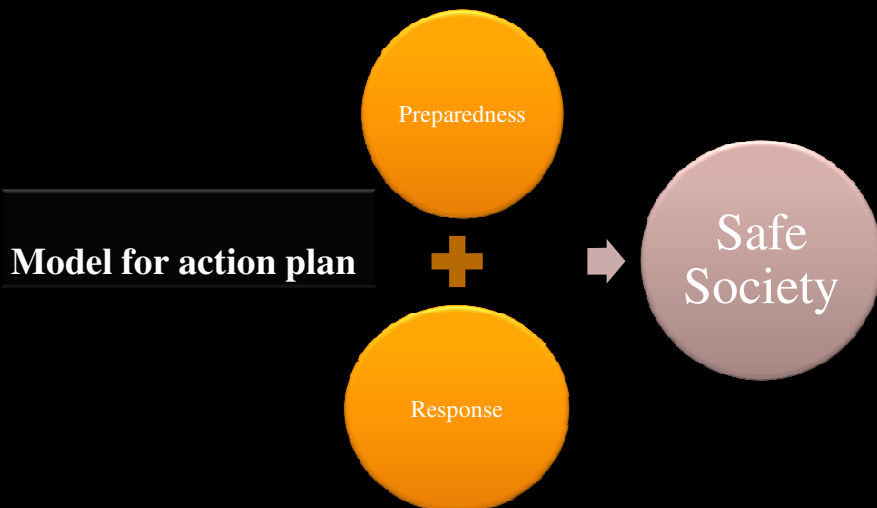
Preparedness Is the Key to combat Chemical disaster

- Awareness
- Training
- Equipment
- Resources
- Planning
- Exercises





Shelters



Preparedness :

includes planning, prevention and mitigation

Risk assessment

Strengthening the regulators by knowledge upgradation to meet the challenges

Formal education in the area of safety, risk assessment, medical, fire fighting, for cadre development

Planning:

- ✓ GIS based on-site and emergency management plans
- ✓ Risk assessment
- ✓ Reach to all stake holders

Prevention:

- ✓ Compliance of laws and rules

Mitigation

- ✓ Change in process, chemicals, instrumentation, machine, training of human beings, community and civil administration involvement

HAZARD IDENTIFICATION METHODS:

- Process hazard checklist
- Hazard survey
- Safety review

RISK ASSESSMENT:

- What can go wrong & how ?
- What are the chances ?
- Consequences ?

EXTREMES:

- Low probability
- Minimal consequences

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graph TD
    A[System description] --> B[Hazard identification]
    B --> C[Scenario identification]
    C --> D[Accident probability]
    C --> E[Accident consequences]
    D --> F[Risk determination]
    E --> F
    F --> G{risk & hazard acceptable ?}
    G -- N --> H[Modify design]
    H --> B
    G -- Y --> I[Accept system]
    
```

Hazards and Risks in industries

- LPG , Propane (under pressure in liquid phase)
- Ammonia (under pressure/refrigeration in liquid phase)
- Chlorine (under pressure in liquid phase)
- Hydrogen (under pressure in gases)
- CO + CH4 (under atmosphere)

Response

Human behaviour, community involvement and participation in emergency process, response of fire fighters, medical response, police (law and order) eg Mock drills

Compliance of regulations

Training

- Plant staff from top to bottom including the contractual labours, visitors, associates likes traders, suppliers consumers

Community

- Involvement of community in all important activities, disclosure of vital information with preparedness

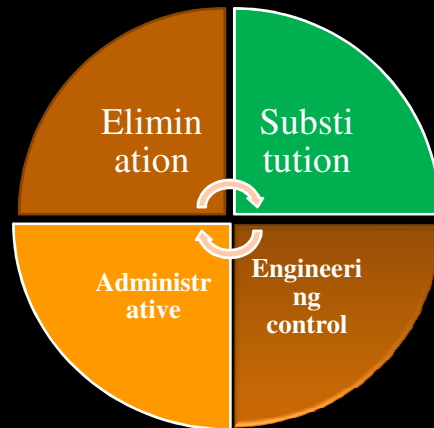
National/state/local Governments

- Assessment of weakness in medical preparedness, fire fighting, law and order and corrective measures

Mockdrills

- By involving all stakeholders including, armed forces, Fire Services SDRF and NDRF/ NDMA

Preparedness + Response have base



Preparedness & Response

1. Education and Training
2. Capacity Development
3. Awareness Generation
4. Institutional Framework
5. Networking and Information
6. Public Health & Environmental Effect Response

7. Creation of Appropriate Infrastructure

- Centralised control system
- Public address system
- Fire Tenders & Fire extinguishers
- Avail of well-equipped emergency medical rooms
- Emergency crew availability round the clock
- Adequate PPEs
- Hotline connection with emergency services
- Mutual-aid service in clusters
- Alternative power back-up
- Bomb disposal squads shall be available in the unit

Salient Gaps in Medical Preparedness

- **Weakest link in the emergency response system**
- Lack of awareness, trg, decontamination facilities, risk and resource inventory, trauma care, plans for evacuation, mechanisms to maintain uniform casualty profiles, proper chemical casualty treatment kits, mobile teams/ hospitals, hospital DM Plans and preparing and responding to public health and environmental effects.
- **Non-availability of specific antidotes for chemicals.**
- Inadequacy of infrastructure for trained medical and paramedical staff.

Salient Gaps in Medical Preparedness

- The SOPs for medical response not laid down.
- Inadequacies in poison information centres and regional laboratories that are close to disaster-prone areas with detection facilities for HAZCHEM.
- Mechanisms for medical rehabilitation need addressed
- There are inadequate studies on long-term effects of HAZCHEM and their medical management.

Emergency Planning and Response

- Regular running of equipment & tests on facilities
- Emergency Management Plans
- On site drills once in 6 months
- Off site drill with Dist. Administration once in a year
- Mutual aid Agreements with Neighboring industries/District Fire Services.
- Updating of plans

Industrial Incident

Incident Command System

Agent Identification by signs/symptoms

Estimation of Protective Distance/Threat Zone

On-site Activities

Personal Protective Equipment

Triage Guidelines

Hospital Activities

Developing a Plan and Response Strategy

Incident Command System (OSHA)

Approach site with caution.

Ensure safety of responders.

Transportation : Rescue of a injured, contaminated patient.

Communications: Notify hospital

Establish a control zone.

Prevent/fight fires as if toxic chemicals are involved.

Ensure contamination control.

Documentation

Unit Structure to manage CIDM

Attribute	Number
· Administrator	- One in staging area
· Team commander	- One (command post)
· Dy. Commander	- One (with IPE)
· Safety officer	- One (with IPE)
· Communication off-	One (with IPE)
Detection team	- Three (with IPE) (one team for detection and another team for demarcation of zone)

Unit Structure to manage CIDM

Rescue team- Four (with IPE) (one team for rescue and evacuation from the contaminated zone, another team for the shifting of the casualties after decontamination from decon. station to the designated clean zones or hospitals)

Decontamination team- Three (with IPE) (one for decon. of area, objects, buildings, vehicles, etc. another team for the decon. of the casualties and teams involved in the operation at decon. station)

Medical team- One doctor and four nursing staff



Quick identification by signs/symptoms

<http://chemm.nlm.nih.gov/chemmist.htm>

Substance identification

<http://webwiser.nlm.nih.gov/knownSubstanceSearch.do>

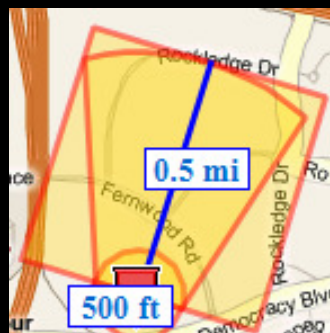


Estimation of Protective Distance/Threat Zone

Protective Distance - area likely to be affected during the first 30 minutes after a substance is spilled.

Threat Zone - indicates the geographical area in which an atmospheric release of a substance would impact a given area during a specified time frame.

where hazard has exceeded user-specified Level of Concern (LOC)



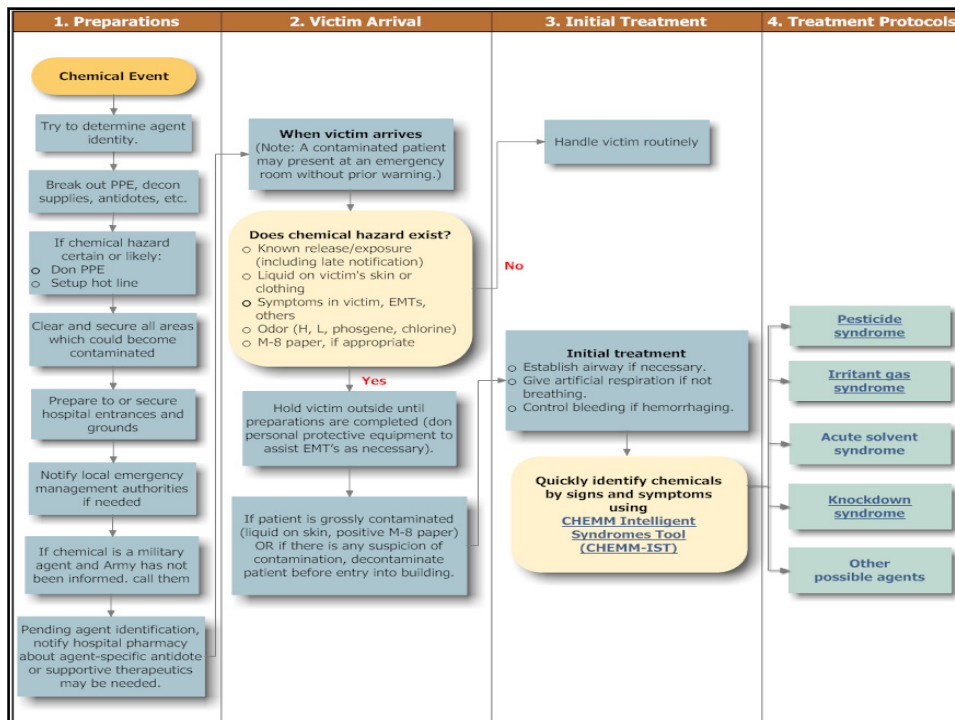
On-site Activities

Major Goals of the Initial Response

- Notify local authorities
- Establish local on-site Incident Command System (OSHA)
- Establish Control Zones:
 - Estimation of protective distance/threat zone
 - Hotzone/perimeter security
 - Decontamination zone
 - Support zone

Protective Actions

- Ensure safety of responders
- Identify specifics of the chemical hazard
- PPE
- Begin Triage



MUSTARD PROTOCOL

1. Airway obstruction? YES: **Tracheostomy**
2. If there are large burns:
 - **Establish IV line** - do not push fluids
 - **Drain vesicles** - unroof large blisters and irrigate area with tropical antibiotics.
3. Treat other symptoms appropriately:
 - Antibiotic eye ointment
 - Sterile precautions
 - Morphine (generally not needed in emergency treatment; might be appropriate for in-patient treatment.)

PHOSGENE PROTOCOL

1. Restrict fluids, chest x-ray, blood gases
Results consistent with phosgene poisoning? **YES: Go to # 4**
2. Dyspnea?
YES: OXYGEN, positive end-expiratory pressure
3. Observe closely for at least 6 hours.
IF SEVERE DYSPNEA develops, go to 4.
IF MILD DYSPNEA develops after several hours, go to 1.
4. Severe dyspnea or x-ray or blood gases consistent with phosgene poisoning-
 - **Admit & Oxygen under positive end-expiratory pressure**
 - **Restrict fluids & Chest x-ray**
 - **Blood gases**
 - **Seriously ill list**

CHLORINE PROTOCOL

1. **Dyspnea?**
 - Try bronchodilators
 - Admit
 - Oxygen by mask
 - Chest X-ray
2. Treat other problems and **reevaluate** (consider phosgene).
3. Respiratory system OK? **YES: Go to 5.**
4. Is phosgene poisoning possible? **YES: Go to PHOSGENE PROTOCOL.**
5. Give supportive therapy; treat other problems or discharge.

NERVE AGENT PROTOCOL

1. Severe respiratory distress?

YES: Intubate and ventilate

•ATROPINE

Adults: 6 mg IM or IV

Inf/ped: 0.05 mg/kg IV

•2-PAM C1

Adults: 600-1000 mg IM or slow IV

Inf/ped: 15 mg/kg slow IV

2. Major secondary symptoms?

NO: Go to 6.

YES:

•ATROPINE

•Adults: 4 mg IM or IV

Inf/ped: 0.02 - 0.05 mg/kg IV

•2-PAM C1

Adults: 600-1000 mg IM or slow IV

Inf/ped: 15 mg/kg

•OPEN IV LINE

3. Repeat atropine as needed

until secretions decrease and breathing easier

Adults: 2 mg IV or IM

Inf/ped: 0.02 - 0.05 mg/kg IV

4. Repeat 2-PAM C1 as needed

Adults: 1.0 gm IV over 20-30 min

Repeat q 1h x 3 prn

Inf/ped: 15 mg/kg slow IV

5. Convulsions?

NO: Go to 6.

YES: DIAZEPAM 10 mg slow IV

Inf/ped: 0.2 mg/kg IV

6. Reevaluate q 3-5 min.

IF SIGNS WORSEN, repeat from 3.

Note: Warn the hospital pharmacy that

unusual amounts of atropine and 2-

PAM may be needed

CHEMICAL	ANTIDOTE
Ammonia	Skin : Wash with Lactic Acid, Apply soframycin Eye : Benoxynate
Chlorine Phosgene	Wash the skin plenty of water . Apply sodium bi carbonate and again wash the skin plenty of water .
Hydrogen Cyanide	Sodium nitrite(1% solution), Sodium thio sulphate (30% solution)
Acid & Sulphur Oxide	Sodium Hydro- Carbonate
Ethylene	Ethanol, Calcium gluconate

A	Agent(s):	Type and toxicity (remember LD ₅₀)
S	State(s):	Solid? Liquid? Gas? Vapor? Aerosol?
B	Body site(s):	Where exposed/Route(s) of entry?
E	Effects:	Local? Systemic?
S	Severity:	Mild? Moderate? Severe?
T	Time course:	Onset? Getting better/worse? Prognosis?
O	Other diagnoses?	Instead of? In addition to? (Differential diagnosis)
S	Synergism?	Combined effects of multiple exposures or insults?

Developing a Plan and Response Strategy (The Golden Rules)

Managers of hazardous installations should:

HVA

Promote "safety culture"

Implement a safety management plan

Prepare for any accident that might occur.

Workers at hazardous installations should:

Make every effort to be informed and to provide feedback to management.

Be proactive in helping to inform and educate the community.

Developing a Plan and Response Strategy (The Golden Rules)

Authorities should:

Provide leadership and motivate stakeholders to improve chemical accident prevention, preparedness and response;

Develop, enforce and continuously improve regulations, policies, programs and practices;

Help ensure that there is effective communication and co-operation among stakeholders.

The public should:

Be aware of the risks in their community and what to do in the event of an accident; co-operate with local authorities and industry in emergency planning and response.

Medical Preparedness

- Creating Awareness
- Creation of Trained Specialised Medical First Responders (MFRs)
- Creation of Decontamination Facilities
- Uniform Casualty Profile and Classification of Casualties
- Risk Inventory and Resources Inventory
- Proper Chemical Casualty Treatment Kits
- Crisis Management Plan at the Hospitals
- Mobile Hospital/Medical Team

Take Home Message

- GPS mapping – incl all Critical infrastructure around MAH units
- Hospitals in chemical hubs should be aware of MAH units in their area, chemical manufactured and accidents which can occur
- Capacity building of Medical Personnel
- Availability of antidotes in health institution
- Networking and resource pooling
- Referral mechanism with surge capacity

Take Home Message

- Onsite at the plants
 - Employees as first responders
 - Avail of basic equipments – PPE
 - Essential drugs list to be available
 - Ambulances to be made available
- **Pre Hospital care for casualties**
- DDMP should invariably have HDMP incorporate the plans for CIDM

Take Home Message

- Specialised - Occupational health specialists
 - Lack of OHS
 - Lack of training institutions
 - Lack of standard curriculum
- **Lack of standardised treatment protocols**
- Plans for recovery and rehabilitation

THANK YOU