



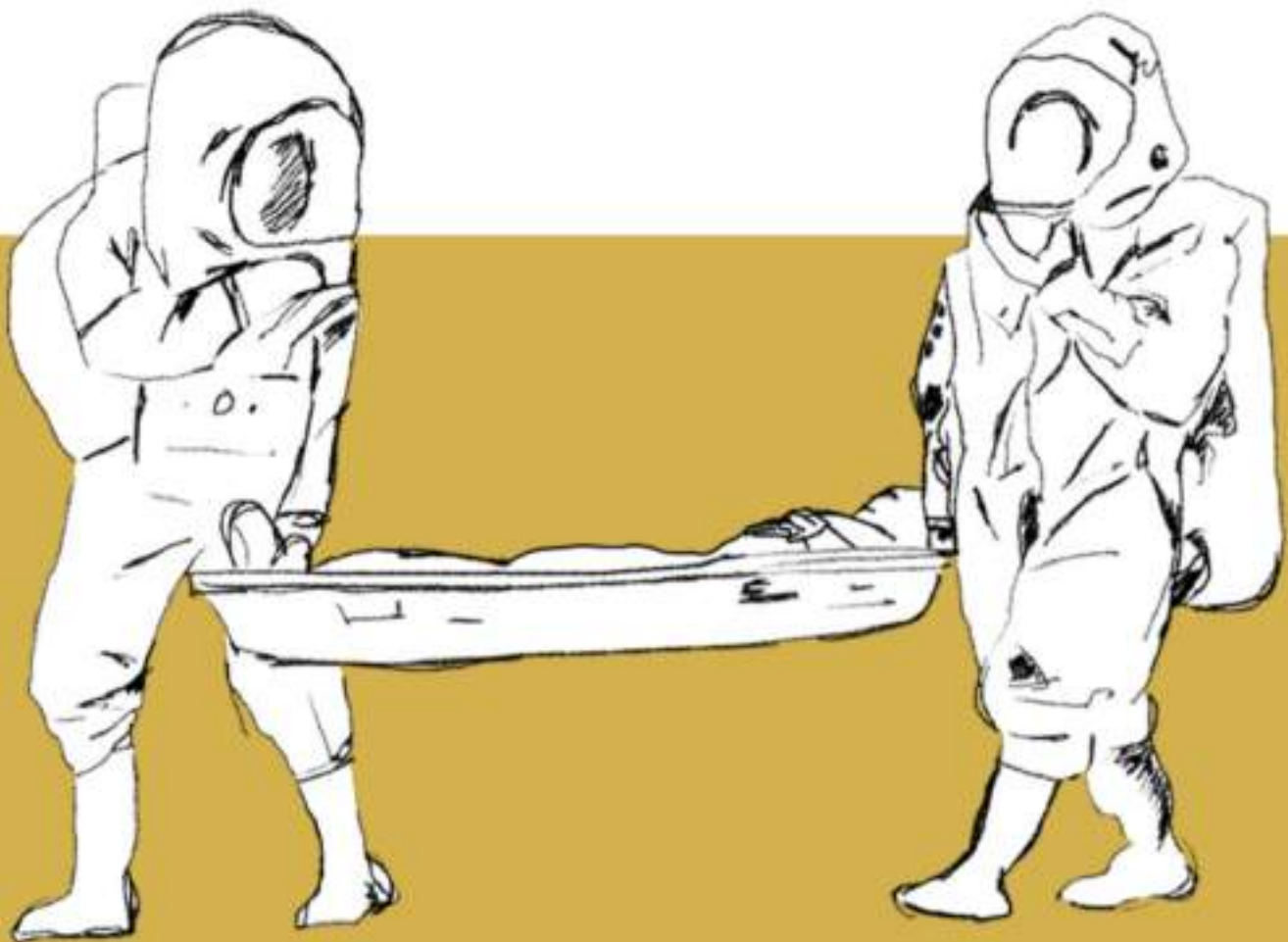
सत्यमेव जयते

Ministry of Health & Family Welfare
Government of India



World Health
Organization
India

Pre-Hospital Management of Chemical Emergencies



2025

Pre-Hospital Management of Chemical Emergencies





ABOUT THE BOOK

The “Pre-Hospital Management of Chemical Emergencies” is a specialized module that focuses on providing stakeholders with the knowledge and skills necessary to respond to chemical emergencies. The module is designed to cover a wide range of topics related to the pre-hospital management of chemical emergencies, including the identification and assessment of chemical hazards, patient triage and decontamination, and the appropriate use of personal protective equipment.

The module is typically offered as part of advanced training programs for medical professionals such as emergency medical technicians, paramedics, first responders, police force, fire fighters, factory workers, ambulance drivers , occupational health professionals and community volunteers. The module may also be included as part of broader public health management training programs for emergency management professionals, public health officials, and other relevant stakeholders.



A plume of smoke rises from a petrochemical fire at the Intercontinental Terminals Company, in Deer Park, Texas on March 18, 2019.

ACKNOWLEDGEMENT

India is rapidly emerging as a major global hub for industrial and technological development. As chemicals form an integral part of modern industrial systems, the pace of industrialization has simultaneously heightened the risk of exposure to chemical hazards. Uncontrolled releases of such substances can have serious implications for public health and the environment, potentially resulting in chemical emergencies. These chemical emergencies have a profound impact on human health, often resulting in casualties, long-term consequences, and damage to property and the environment.

These modules have been developed recognizing the importance of addressing public health concerns arising from chemical incidents. India's health sector is expanding its role and aligning with the International Health Regulations (IHR) to strengthen capacities for chemical emergency preparedness and National Centre for Disease Control (NCDC), as the national focal point for IHR implementation, coordinates with relevant sectors to enhance capacities for the management of chemical emergencies and undertakes capacity-building initiatives across all related core areas.

The Public Health Management of Chemical Emergencies modules are the outcome of an extensive process of consultation and collaboration among national and international experts, practitioners, and institutions engaged in health emergency preparedness, disaster risk management, and chemical safety, through a series of technical consultations, systematic peer reviews, and capacity-building workshops convened to ensure the relevance and applicability of the content to India's health and disaster management systems context.

From the Conceptualization, Contribution, Development and further scaleup capacity building efforts for Public Health Preparedness for Chemical Emergencies, the collective insights and experiences of all contributors have shaped this module into a practical tool to strengthen preparedness, response, and resilience against chemical emergencies across all levels of the health system.

We extend our sincere gratitude to the National Disaster Management Authority (NDMA), National Disaster Response Force (NDRF), Ministry of Health and Family Welfare (MoHFW), Ministry of Chemicals and Fertilizers, Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, Office of The Principal Scientific Advisor to the Prime Minister, Defense Research and Development Establishment (DRDE), National Authority for Chemical Weapons Convention (NACWC), National Institute of Disaster Management (NIDM), Directorate General of Factory Advice Service and Labour Institutes (DGFASLI), Disaster Management Institute (DMI) Bhopal, Employees' State Insurance (ESI) Hospitals, All India Institute of Medical Sciences (AIIMS), Indian council of medical research (ICMR), State Disaster Management Authorities, Gujarat Institute of Disaster Management (GIDM), State Governments, Local governments, Industry partners, World Health Organization (WHO) India - State and Field offices teams, and other institutions, hospitals and stakeholders who contributed to the development of the Chemical Emergencies Module. Your expertise and collaboration have been instrumental in shaping this module and enhancing preparedness, response and management for chemical emergencies.

ABBREVIATIONS

AAR	After Action Review
ALS	Advanced Life Support
BIS	Bureau of Indian Standards
BLS	Basic Life Support
CA (EPPR) Rules	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
CAS	Crisis Alert System
CCG	Central Crisis Group
CCR	Central Control Room
CFEES	Centre for Fire, Explosive and Environment Safety
CPCB	Central Pollution Control Board
CSR	Chemical Safety Report
CLI	Central Labour Institute
DAE	Department of Atomic Energy
DGFASLI	Directorate General Factory Advice Service and Labour Institutes
DDMA	District Disaster Management Authority
DISH	Directorate of Industrial Safety and Health
DM	Disaster Management
DMP	Disaster Management Plan
DOCP	Department of Chemicals and Petro-chemicals
EMS	Emergency Medical Services
EPA	Environmental Protection Act
ERF	Environment Relief Fund
ES	Exposure Scenario
EOC	Emergency Operations Centre
FE	Functional Exercise
FSE	Full-Scale Exercises
GIS	Geographic Information System
HAZAN	Hazard Analysis
HAZCHEM	Hazardous Chemical
HAZMAT	Hazardous Material
IDSP	Integrated Disease Surveillance Program
IHR	International Health Regulations
ILO	International Labour Organization
MAH	Major Accident Hazard
MoEFCC	Ministry of Environment, Forests and Climate Change
MoHFW	Ministry of Health & Family Welfare
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NIDM	National Institute of Disaster Management
OISD	Oil Industry Safety Directorate
OR	Operational Requirement
PESO	Petroleum & Explosives Safety Organization
PPE	Personal Protective Equipment
PCC	Pollution Control Committees
RLI	Regional Labour Institute
RMM	Risk Management Measures
RRT	Rapid Response Team
SAICM	Strategic Approach to International Chemicals Management
SDMA	State Disaster Management Authority
SPCB	State Pollution Control Board
WHO	World Health Organization
TTX	Tabletop Exercise

SYMBOLS



INDUSTRIAL ZONE



TOXIC MATERIALS



CORROSION

WARNING OF
SLIPPERY SURFACE

EXPLOSIVE MATERIAL



WEAR RESPIRATOR

WARNING OF
GENERAL HAZARD

FLAMMABLE MATERIALS



OXIDIZING AGENT

CHEMICAL
STORAGE AREA

WEAR SAFETY GLOVES

WARNING OF
MOVING MACHINERYSTRONG
MAGNETIC FIELDGAS UNDER
PRESSUREELECTRICAL
HAZARDHAZARD TO
ENVIRONMENT

TOXIC MATERIALS

WEAR SAFETY
HELMET

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"Hope for the best, plan for the worst"

INTRODUCTION

By the end of this chapter, you will be able to understand:

1. What are chemical emergencies?
2. What are the causes of chemical emergencies?
3. What is the need for the management of chemical emergencies?

1.1 Hazardous Chemicals

Hazardous chemicals are substances which are capable of causing adverse effects to people and/or the environment under conditions of exposure. Hazardous materials are poisonous by-products produced in manufacturing, farming, construction, automotive, laboratories, and hospitals which may contain chemicals, heavy metals, radiation, dangerous pathogens, or other toxins. Common examples are Hydrogen cyanide, Hydrogen sulfide, Nitrogen dioxide, Ricin, Organophosphate pesticides, Arsenic etc.

Toxic waste has become more abundant since the Industrial Revolution, causing serious global health issues. Disposing of such waste has become even more critical with the addition of numerous technological advances containing toxic chemical components. Even households generate hazardous waste from items such as batteries, used electronic equipment, and leftover paints or pesticides. Toxic materials can either be human-made or naturally occurring in the environment. Not all hazardous substances are considered toxic.

1.1.1 Routes of Chemical Exposure

1. **Ingestion** - Absorption through the digestive tract. This process can occur through eating with contaminated hands, through contaminated food or in contaminated areas.
2. **Absorption** - Absorption through the skin often causes dermatitis. Some toxins that are absorbed through the skin or eyes can damage the liver, kidney, or other organs and through misuse of sharp materials such as hypodermic needles.
3. **Inhalation** - Absorption through the respiratory tract (lungs) through breathing. This route is most severe in terms of severity.
4. **Injection** - Percutaneous injection of a toxic substance through the skin. This process can occur in the handling of sharp-edged pieces of broken glass apparatus and through misuse of sharp materials such as hypodermic needles. (Fig 1)

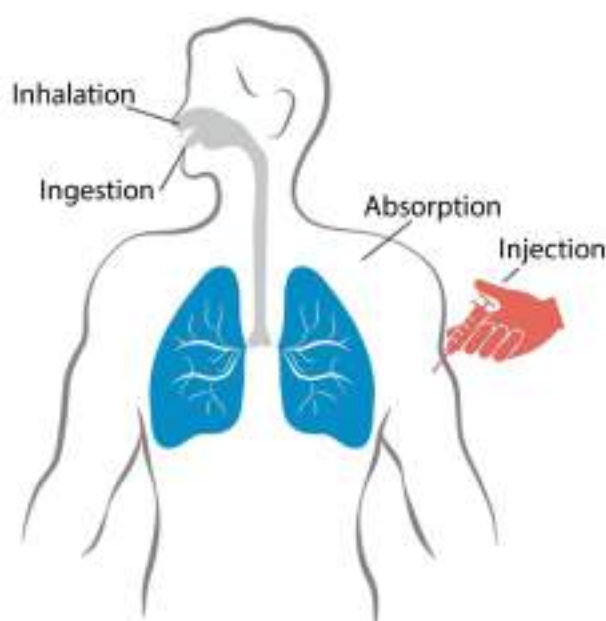


Fig. 1 : Routes of chemicals entering the body

1.2 Chemical Hazards

- Chemical emergencies can occur when hazardous substances are released into the environment, either accidentally or intentionally. These substances can pose a serious threat to human health and the environment, and it is important to respond quickly and effectively to minimize the potential damage.
- Chemical emergencies can range from small spills that can be contained relatively easily, to large-scale disasters that require a coordinated response from multiple agencies and organizations.
- It is essential to have plans and protocols in place to manage chemical emergencies, including strategies for assessing the situation, evacuating affected areas, and providing medical treatment to those who have been exposed to the hazardous substances.
- Proper training, equipment, and communication are also critical components of any effective response to a chemical emergency. The use of chemicals to enhance and improve life is a widespread practice worldwide. While on one side, there are benefits of using these chemicals, on the other side, there is also potential for adverse effects on people and the environment.



During the last decades, there has been increased concerns about the release of toxic chemicals in congested industrial sites or urban areas as many hazardous chemicals are being stored or transported in such places. If an accident/incident occurs, then the impact on the population can be significant.

Chemical emergencies are sudden in nature, provide less time to think and act and consequences are catastrophic. In case of chemical emergencies, the abnormal situation involving chemicals demands prompt action to mitigate the associated hazards such as fire, explosion, toxic gas release, etc.



CORROSIVES

Corrosives are materials that can injure body tissue or cause corrosion of metal by direct chemical action.

Major classes of corrosive substances are:

1. Strong acids (e.g., Sulphuric, Nitric, Hydrochloric & Hydrofluoric acids)
2. Strong bases (e.g., Sodium hydroxide & Potassium hydroxide)
3. Dehydrating agents (Sulphuric acid, Sodium hydroxide, Phosphorus pentoxide, & Calcium oxide)
4. Oxidizing agents (e.g., Hydrogen peroxide, Chlorine, & Bromine)



FLAMMABLES

Flammable substances have the potential to catch fire readily & burn in air. A flammable liquid itself does not catch fire; it is the vapors produced by the liquid that burn.

Important properties of flammable liquids:

- » Flash point is the minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with air.
- » Ignition temperature is the minimum temperature required to initiate self-sustained combustion



OXIDIZERS/ REACTIVES

Oxidizers/ reactives include chemicals that can explode, violently polymerize, form explosive peroxides, or react violently with water or atmospheric Oxygen.

1. Oxidizers: An oxidizing agent is any material that initiates or promotes combustion in other materials, either by causing fire itself or by releasing oxygen or other combustible gases. Examples - Aluminum nitrate, Ammonium persulfate, Barium peroxide.
2. Reactives: Reactives include materials that are pyrophoric ("flammable solids"), are water reactive, form explosive peroxides, or may undergo such reactions as violent polymerization.



TOXINS

Toxins are a broad class of chemical hazards that are distinguished by their capacity to damage living things via biochemical interactions. These compounds are very dangerous because they have the potential to cause serious health impacts even at low exposure levels. They can be created synthetically or organically. Toxic substance is one that, even in small amounts, can injure living tissue.

- » Examples – Hydrogen cyanide, Hydrogen peroxide, Hydrogen fluoride, etc.

Fig. 2 : Four categories of common chemical hazards: corrosives, flammables, oxidizers/ reactives, and toxins.



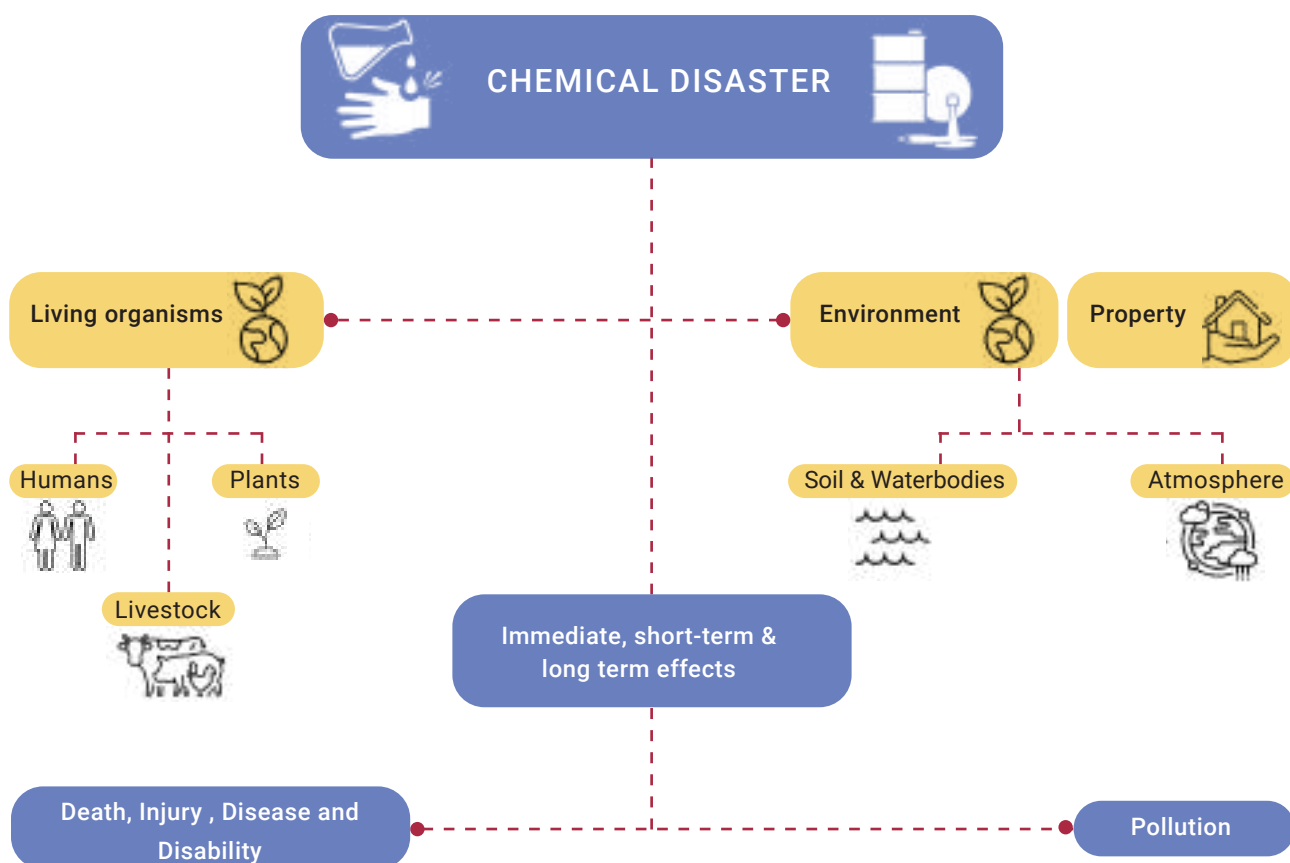


Fig.3 : Effects of Chemical Disaster

The various hazards associated with chemicals may be broadly put into three main categories-

- **Physical Hazards**, such as explosives, inflammable solid/liquid/gas, self-reactive substances; oxidizing liquids/solids; pyro-phoric liquids/solids etc.
- **Health Hazards**, such as acute toxicity-oral or dermal; skin corrosion/irritation; serious eye damage/eye irritation; respiratory/skin sensitization; specific target organ toxicity; germ cell mutagenicity; carcinogenicity, reproductive toxicity, aspiration hazard, secondary infections, radiotoxicity, etc.
- **Environmental Hazards**, such as very toxic/toxic/harmful to aquatic life; adverse impact on ozone layer etc.





1.3 Vulnerable Sites for Chemical Emergencies

Examples of vulnerable sites for chemical accidents and examples of the type of chemicals that might be released are as follows:

Fuel storage sites, tank farms

- o Kerosene
- o Petroleum
- o Propane
- o Butane



Waste storage sites

- o Oil
- o Solvents
- o Polychlorinated biphenyls



Gas and oil pipelines

- o Natural gas (methane)
- o Crude oil



Tailing Dams

- o Toxic sludge
- o Mine tailing containing Cyanide and Arsenic



Petroleum or Petrochemical Industries

- o Ammonia
- o Acrolein
- o Methanol
- o Organic peroxides



Acid mine drainage (abandoned mines)

- o Aluminium
- o Arsenic
- o Cadmium
- o Lead



Chemical factories

- o Alkalis
- o Acrolein
- o Methanol
- o Organic peroxides



Transport: Railways, Roads, Rivers, Sea

- o Ammonia
- o Chlorine
- o Petroleum
- o Methanol



Food processing plants

- o Ammonia



Hospitals, Laboratories, Pharmacies

- o Reagents
- o Disinfectants
- o Medicines
- o Radiological materials



Pesticide storage depots

- o Carbamates
- o Organophosphates
- o Organochlorines



Metallurgical Industries

- o Toxic metals
- o Cyanide
- o Sulfuric acid
- o Ammonia



1.4 Causes of Chemical Emergencies

Chemical emergencies can occur due to different types of hazardous substances, including toxic chemicals, gases, and radioactive materials. They can be released into the environment due to various reasons, such as:

1. Natural disasters leading to chemical emergencies -

Natural disasters, such as floods, earthquakes, and cyclone can damage industrial facilities and release hazardous substances into the environment. For E.g., Sandhurst Chemical blast following floods in Gloucestershire, United Kingdom in 2000; AKSA Acrylic Fibre Plant disaster following earthquake in Turkey in 1999, etc.

2. Manmade disasters -

These include accidents at industrial facilities, during transport storage and use of hazardous chemicals. These accidents can lead to the release of toxic chemicals, explosions, and fires. eg: Tulgalkabad Gas Leak in Delhi - 2017, Indian Oil Corporation, Jaipur fire, 2009.

3. Deliberate acts of terrorism -

Chemical emergencies can also be caused by deliberate acts of terrorism. For E.g., Sarin gas attack at Tokyo subway, Japan, 1995.



a) AKSA acrylic fibre plant disaster post Earthquake, Turkey, 1999



b) Indian Oil Corporation, Jaipur fire, 2009



c) LPG tank fire at the Chiba Refinery, Japan, after the earthquake, 2011



d) Release of nerve gas Sarin, in Tokyo subway, 1995

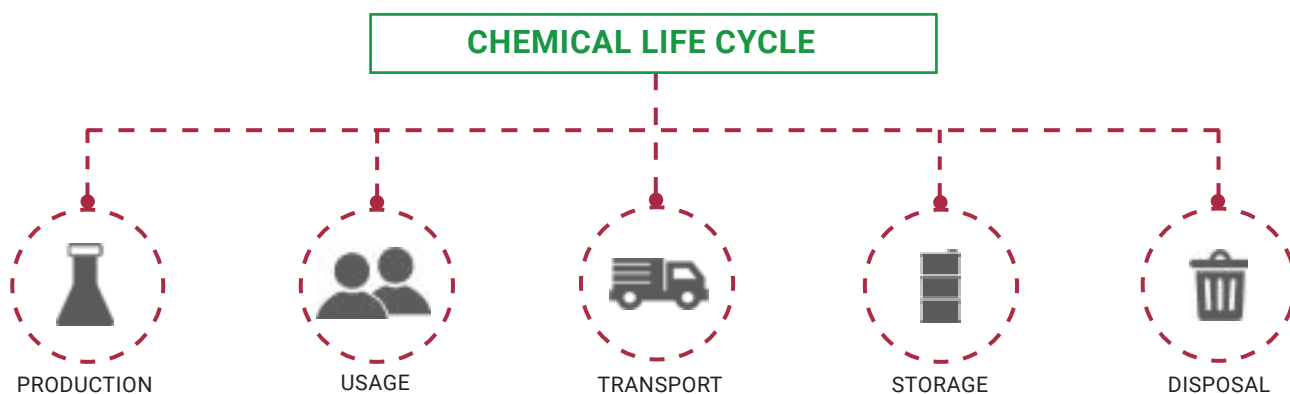


Fig. 4 - Components in Chemical Disaster Management

Chemical Emergency may arise at any of the above stages of chemical life cycle as depicted below:



1. Chemical Emergency at production stage - Bhopal Gas Tragedy, Madhya Pradesh, 1984



2. Chemical Emergency at usage stage - Hapur Factory boiler explosion, Hapur, Uttar Pradesh, 2022



3. Chemical Emergency during transportation stage - Kanpur LPG Truck explosion, Uttar Pradesh, 2001



4. Chemical Emergency at storage stage - Gas leakage in LG Polymers Chemical Plant Visakhapatnam, Andhra Pradesh, 2020



5. Chemical Emergency during disposal stage - Mumbai port trust - Sewri Chlorine gas leak, Maharashtra, 2010



1.5 Need for management

The management of chemical emergencies is essential to protect human health, wildlife, and the environment from the harmful effects of hazardous substances. Chemical emergencies can occur due to various reasons, including accidents at industrial facilities, transportation mishaps, natural disasters, and deliberate acts of terrorism. These emergencies can have immediate and long-term impacts on the health and safety of individuals, wildlife, and ecosystems.

Effective management of chemical emergencies can help to minimize the potential damage caused by such events. Emergency planning and preparation can help to identify potential hazards and develop procedures for responding to emergencies, including notification, evacuation, and communication protocols.

The components in chemical disaster management are mentioned in Figure 5.



Fig. 5 - Components in Chemical Disaster Management



Bhopal Gas Disaster - Plant structure UCIL Factory, 1984



Bhopal Gas Disaster, 1984

2

“Failing to prepare is preparing to fail”

EXISTING REGULATORY & INSTITUTIONAL FRAMEWORKS

By the end of this chapter, you will be able to understand:

1. What are the list of laws and acts pertaining to the Management of Chemical Events
2. What are MAH Units?

2.1 List of Laws and Acts related to the Management of Chemical Emergencies in India

NAME OF THE ACT/LAW/RULES	PROVISIONS
 The Water (Prevention and Control of Pollution) Act,1974	Provides for the prevention and control of water pollution and the establishment of boards for the prevention and control of water pollution.
 The Environment (Protection) Act, 1986	Provides for the protection and improvement of the environment and the prevention of hazards to human beings, other living creatures, plants, and property.
 The Manufacture, Storage, and Import of Hazardous Chemicals Rules, 1989	Provides for the regulation of the manufacture, storage, and import of hazardous chemicals.
 The Public Liability Insurance Act, 1991	Provides for mandatory insurance coverage for industrial units handling hazardous substances to compensate for the damages caused to third parties in case of an accident.
 The Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996	Provides guidelines for emergency planning, preparedness, and response in case of a chemical accident.
 The Disaster Management Act, 2005	Provides for the management of disasters, including chemical disasters, and the establishment of institutions for disaster management.
 The Petroleum and Natural Gas Regulatory Board (Emergency Management Plan) Regulations, 2010	Provide for the establishment of emergency management plans for petroleum and natural gas installations.
 The Hazardous Waste (Management, Handling, and Transboundary Movement) Rules, 2016	Provides for the management, handling, and transboundary movement of hazardous waste in a safe and environmentally sound manner.

These laws and acts aim to ensure the safe handling, storage, transportation, and disposal of hazardous chemicals, and to prepare and respond to chemical emergencies effectively.



Amendments to Pre-Bhopal legislations including Factory Safety Act and Motor Vehicles Act.

- o The Insecticides Act, 1968 (amended 2000) and The Insecticide Rules, 1971 (amended 1999).
- o The Motor Vehicles Act, 1988 (amended 2001).
- o The Central Motor Vehicles Rules, 1989 (amended 2005).
- o The Explosives Act, 1884 (amended till 1983).
- o The Gas Cylinder Rules, 2004.
- o The Static and Mobile Pressure Vessels (Unfired) Rules, 1981 (amended 2002).
- o The Explosives Rules, 1983 (amended 2002).

Apart from the above, there are legal instruments for management of hazardous wastes like the Biomedical Wastes Management & Handling Rules, 2016 and Batteries (Management & Handling) Rules, 2001, Battery Waste Management Rules, 2022 and Hazardous Microorganism Rules, 1989. Major responsibility for implementing these Rules is with the Central Pollution Control Board and State Pollution Control Board (SPCBs) / Pollution Control Committees (PCCs) and also with the State Departments of Environment.

These laws and acts aim to ensure the safe handling, storage, transportation, and disposal of hazardous chemicals, and to prepare and respond to chemical emergencies effectively.

2.2 Environmental Regulations: Liability and Litigations

- o Development of legislation in area of chemical disaster management owes to environmental jurisprudence and also to the lawsuits in form of public interest litigations.
- o Under the Public Liability Insurance Act, 1991 as amended in 1992, all the Major Accident Hazard (MAH) units handling chemicals in excess of the threshold quantities referred to in the Schedule, are mandated to take an insurance policy before starting his activity, on behalf of the off-site population, and deposit an equal amount in the Environment Relief Fund (ERF) to ensure immediate payment to the chemical accident victims.
- o This relief shall be paid on "Principle of no fault" i.e. the claimant shall not be required to plead or establish that the death, injury or damage was due to any wrongful act neglect or default.
- o The National Environment Tribunal Act, 1995 is enacted to setup legal institutions across the country to provide for strict liability for damages arising out of accidents occurring during the handling of hazardous substances and for establishment of National Environment Tribunal for effective and expunction disposal of cases arising from such accidents, with a view to giving relief and compensation for damages to person, property and the environment.
- o Several verdicts of the Hon'ble Supreme Court of India under the Article 21, Right to Life also provided standards for the environmental jurisprudence in the country.
- o A number of chemical specific codes of practices have been published by the Bureau of Indian Standards (BIS), the Oil Industry Safety Directorate (OISD) and guidelines have been brought out for chemical accident management by the Ministry of Environment, Forest and Climate Change (MoEFCC).



2.3 International Health Regulations (IHR) and Chemical Events

The chemical industry is one of the largest economic sectors worldwide. Despite the omnipresence of chemicals worldwide and their predicted increase in production and use, many countries lack adequate capacities to deal with the health aspects of chemical events and emergencies. In 2005 the WHO Member states adopted the revised IHR (2005) which included Chemical events.

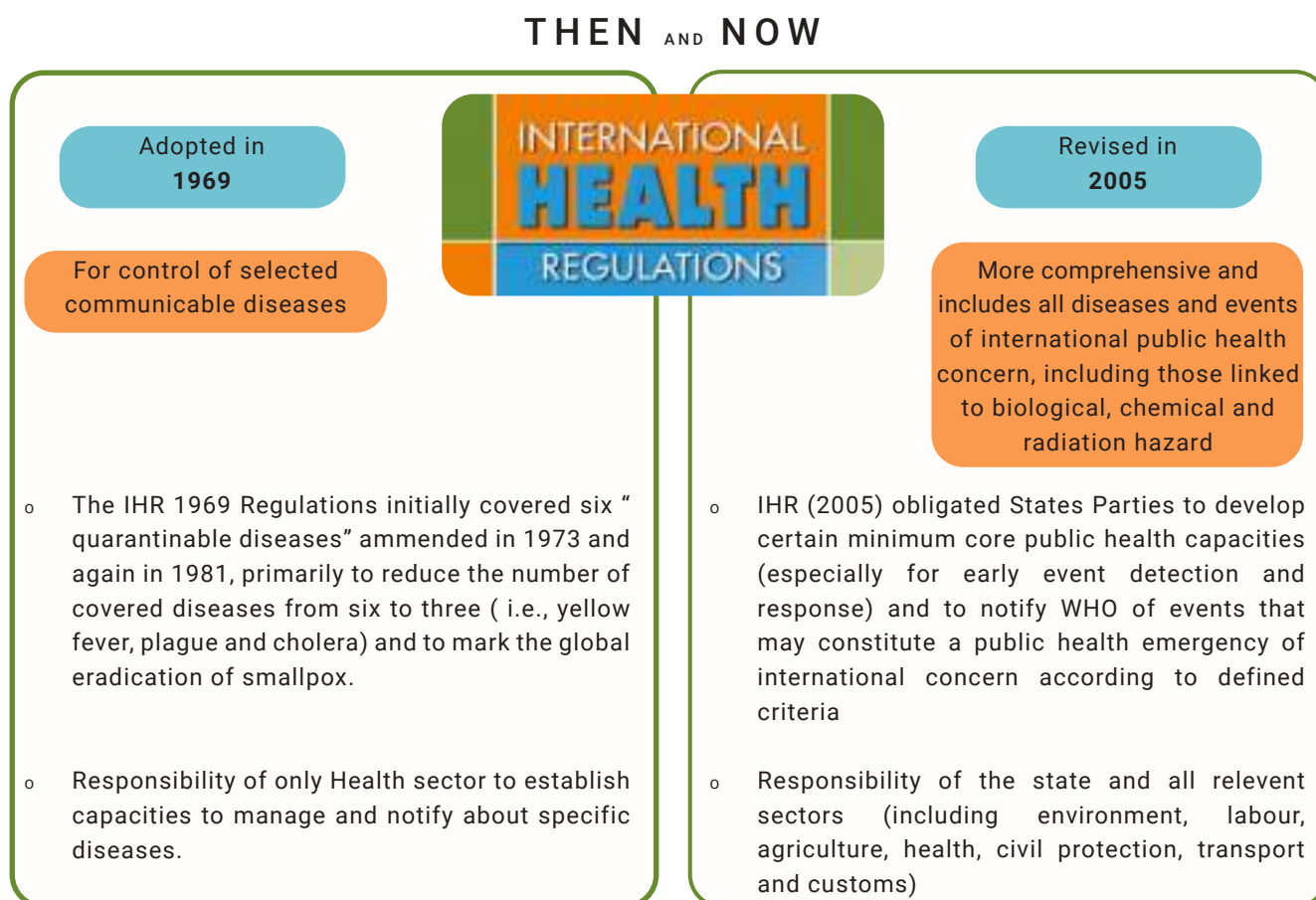


Fig.6 : IHR in 1969 vs IHR 2005

- New fund for pandemic prevention, preparedness and response the revision of the International Health Regulations (IHR) are ongoing initiatives aimed at improving the international response to public health emergencies
- Pandemic Accord-Member States of the World Health Organization have agreed to a global process to draft and negotiate a convention, agreement or other international instrument under the Constitution of the World Health Organization to strengthen pandemic prevention, preparedness and response.
- Pandemic Accord, International Health Regulations Amendments and Health Emergency Preparedness and Response (HEPR) are thus the upcoming instruments that focus on concept of building and strengthening capacities and fostering coordination. The worldwide production, trade and use of chemicals are predicted to increase further, particularly in developing countries like India thus the importance of these treaties and regulations

01

POLICY PLANNING AND COORDINATION

- Capacity building of designated focal points for the IHR in all authorities i.e., health sector, labour, environment, agriculture, transport, security etc., that have important role in the management of chemical events.
- Others - operators, emergency services, workers, customs, food authorities, consumer protection organizations, academia and public.

02

PREPAREDNESS AND CAPACITY BUILDING

- Multi-disciplinary response requiring a range of skills and expertise.
- Training for individuals and organizations with specific responsibilities.
- Poison Centers as key sources of expertise.

03

EVENT DETECTION, VERIFICATION AND RISK ASSESSMENT

- Multi-hazard surveillance strategy
- An integrated surveillance system should link these important sources of information about chemical events together and be supported by a surveillance plan. Multiple sources of notification and alert:
 1. Within health sector - Poison Centres, hospital emergency departments, primary health-care facilities and toxicology laboratories
 2. Outside health sector - agency for consumer protection and food safety, plant operators, environmental agencies (surface water, air and soil), first responders, public/community (overt release, such as an explosion, a chemical plume, contaminated drinking water, dirty surface water or dead wildlife)

04

EMERGENCY RESPONSE

- Authorities respond by evaluating risks and implementing actions based on guidelines.
- National chemical event emergency response plan is crucial.
- Consideration of existing legal and technical instruments or plans.

05

CHEMICAL EVENT SCENARIO ANALYSIS

- Technique to explore how chemical events occur and their consequences which guides the building of surveillance and response plans and related capacities.
- Monitoring national and international chemical events to identify major impacts, and risks
- Risk mapping - inventories of major hazard sites

06

INTERNATIONAL CHEMICAL SAFETY AGREEMENTS

- Responsibility usually with ministries of environment or industry.
- Recognition of the need for a multisectoral approach.
- Sectors should be aware of and collaborate with each other.



2.4 Major Accident Hazard (MAH) units

In India, Major Accident Hazard (MAH) installations are regulated under the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, which were amended in 2000 and 2009. MAH installations are those that handle hazardous substances in large quantities and have the potential to cause major accidents that can result in loss of life, property, and environmental damage.

TYPES OF MAH INSTALLATIONS

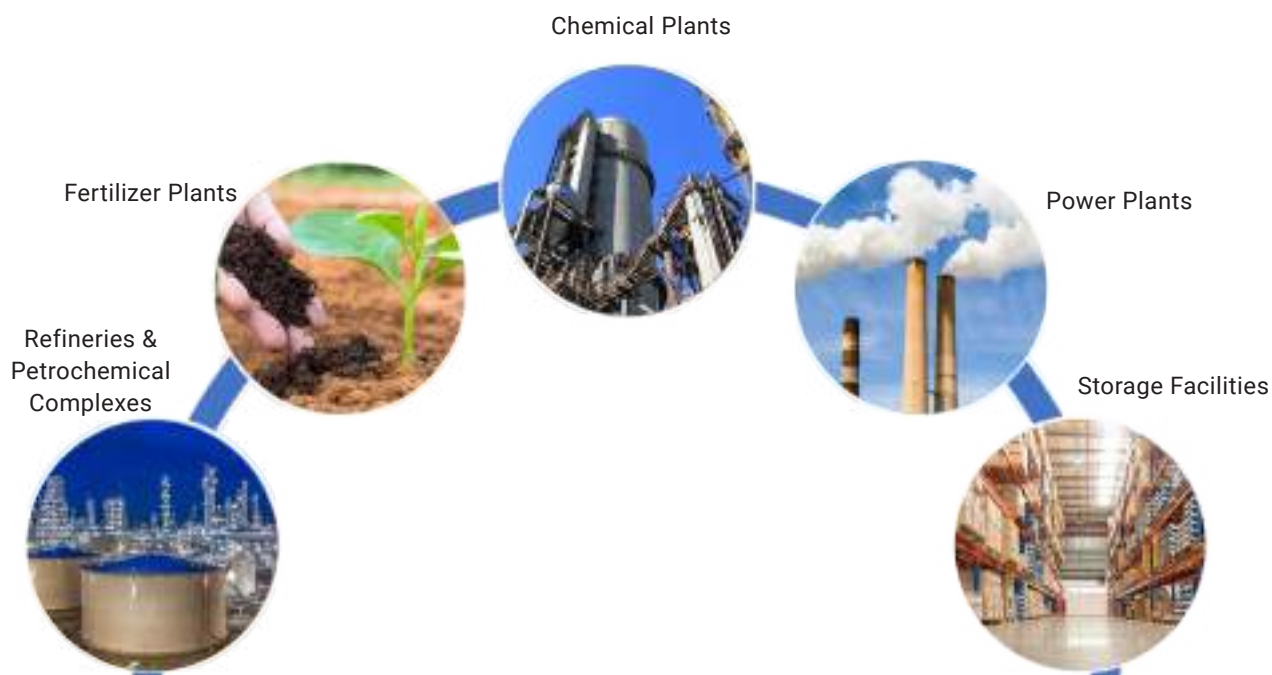


Fig.7 : Types of MAH Units

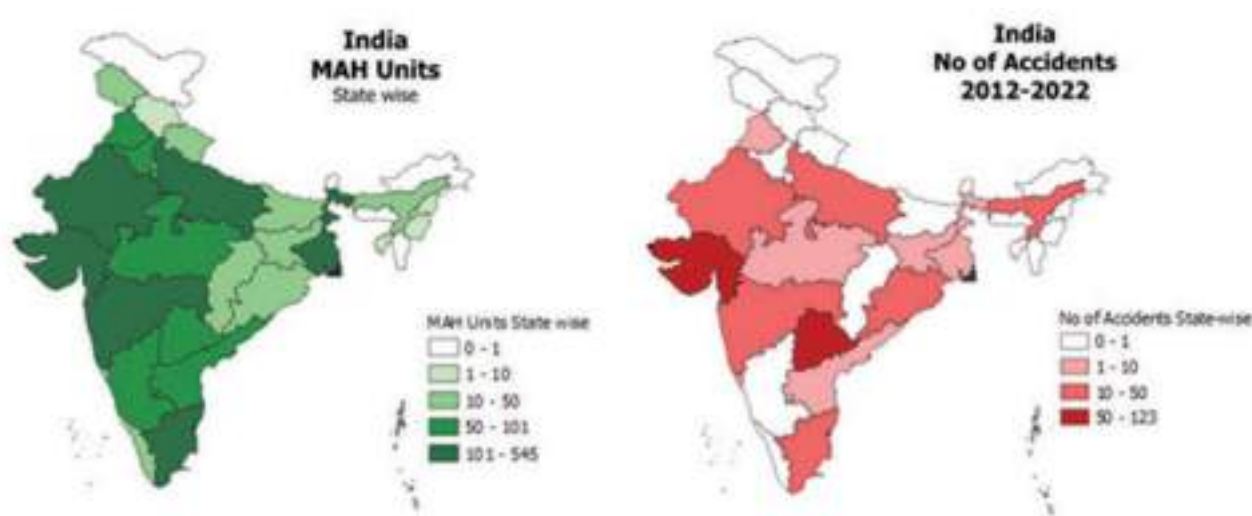


Fig. 8 : No of MAH Units state-wise. Ref: Data from MoEFCC & No of Accidents state wise in last 10 years (2012-2022)



Indian Oil depot fire - Jaipur, Rajasthan, 2009



East palestine,Ohio train derailment,2023

3

"In times of disaster, we all play a role"

INSTITUTIONAL MECHANISMS

By the end of this chapter, you will be able to understand:

1. List of stakeholders with their roles and responsibilities in the management of chemical emergencies
2. What are Crisis Group and Directorate of Industrial Safety and Health (DISH) Centres
3. What is the role of RRT Team and Surveillance officers during chemical emergencies

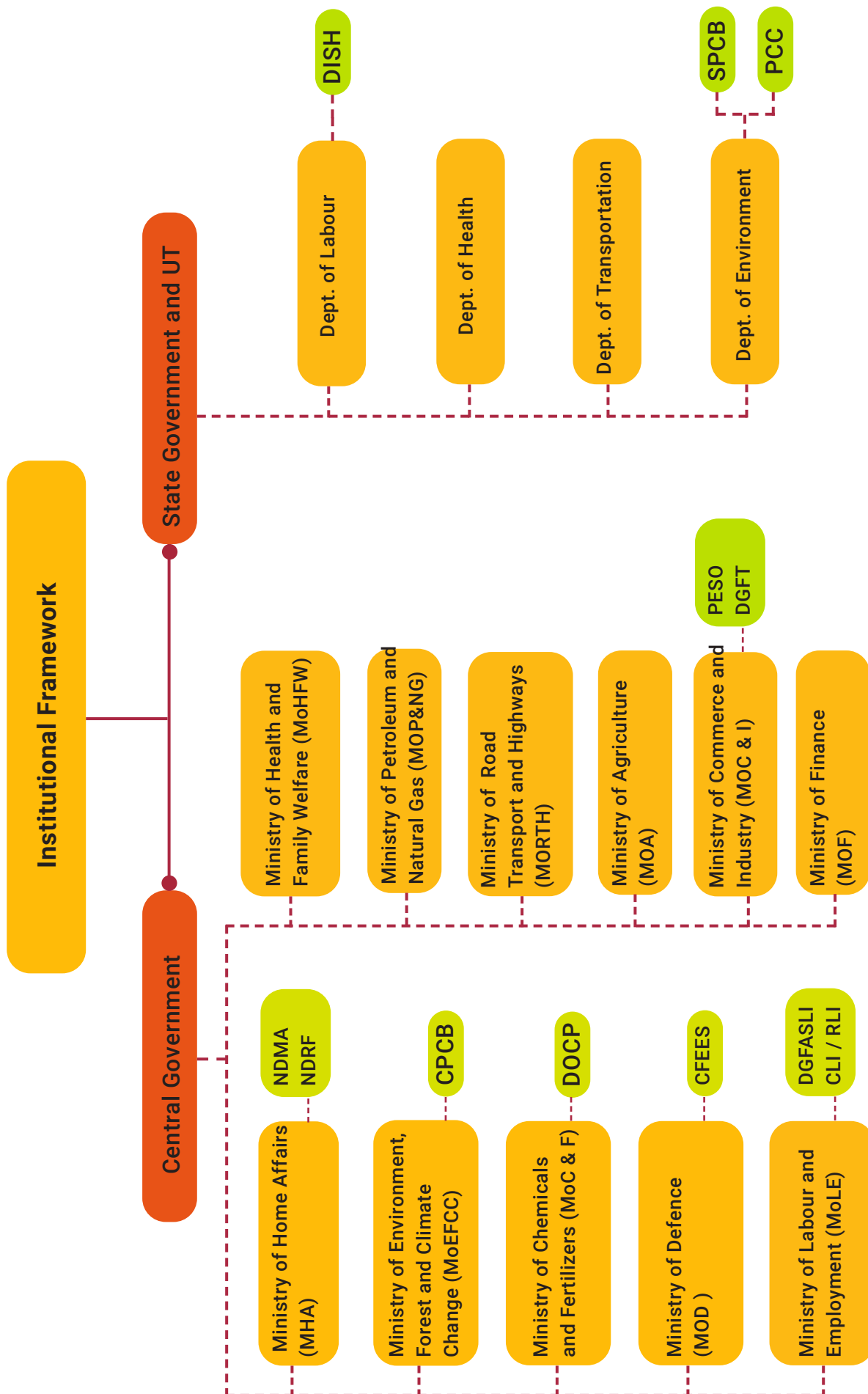


Fig. 9 : Institutional Framework for chemical emergencies

* Adapted from NDMA guidelines on chemical disasters



3.1 List of Stakeholders and their Roles and Responsibilities in the Management of Chemical Emergency

There has been a paradigm shift from relief centric approach to pre-disaster preparedness and mitigation since the 1999 super cyclone in Odisha for disaster management in India. The Disaster Management Act (DM Act, 2005) provides for the establishment of National Disaster Management Authority, District Disaster Management Authority and Local Disaster Management Authority. The legal and institutional mechanism set up by the Environmental Protection Act (EPA), 1986) has been dovetailed with the DM Act, 2005. Convergence of institutional mechanisms for chemical disasters with the holistic disaster management framework is essential for achieving this goal.

In India, at the national level following ministries and associated departments are involved in chemical disaster management:

- o Ministry of Environment, Forests and Climate Change (Nodal Ministry)
- o Ministry of Home Affairs
- o Ministry of Health and Family Welfare
- o Ministry of Chemicals and Fertilisers
- o Ministry of Defence
- o Ministry of Labour & Employment
- o Ministry of Petroleum and Natural Gas
- o Ministry of Commerce and Industry
- o Ministry of Road Transport and Highways of India
- o Ministry of Agriculture
- o Ministry of Finance

Various departments related with Central level ministries include :

- o **CPCB** - Central Pollution Control Board
- o **NDMA** - National Disaster Management Authority
- o **NDRF** - National Disaster Response Force
- o **DGFASLI** - Directorate General Factory Advice Service and Labour Institutes
- o **CLI** - Central Labour Institute ,Mumbai,
- o **DAE** - Department of Atomic Energy
- o **RLI** - Regional Labour Institutes
- o **CFEES** - Centre for Fire, Explosive and Environment Safety
- o **DOCP** - Department of Chemicals and Petrochemicals
- o **PESO** - Petroleum and Explosives Safety Organization
- o **DISH** - Directorate of Industrial Safety and Health

The other associated research institutes and organisations working in the field of chemical emergencies include - Defence R&D Establishment (DRDE) which is the nodal laboratories of Defence Research & Development Organization (DRDO) for providing technological solutions for chemical and biological defence, and National institute of disaster management (NIDM), Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad; Indian Institute of Toxicology Research (CSIR- IITR), Lucknow, National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur; National Chemical Laboratory (NCL), Pune and National Institute of Occupational Health (NIOH), Ahmedabad, which work in the field of occupational hazard and safety. Limited facilities for the collection of environmental toxicants, released during a chemical disaster also exist in the Council of Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR).

Following departments are responsible for chemical disaster management at the state level:

- o Department of Labour - DISH
- o Department of Health
- o Department of Environment - State Pollution Control Board (SPCB) and Pollution Control Committees (PCC).
- o Department of Revenue and Disaster Management



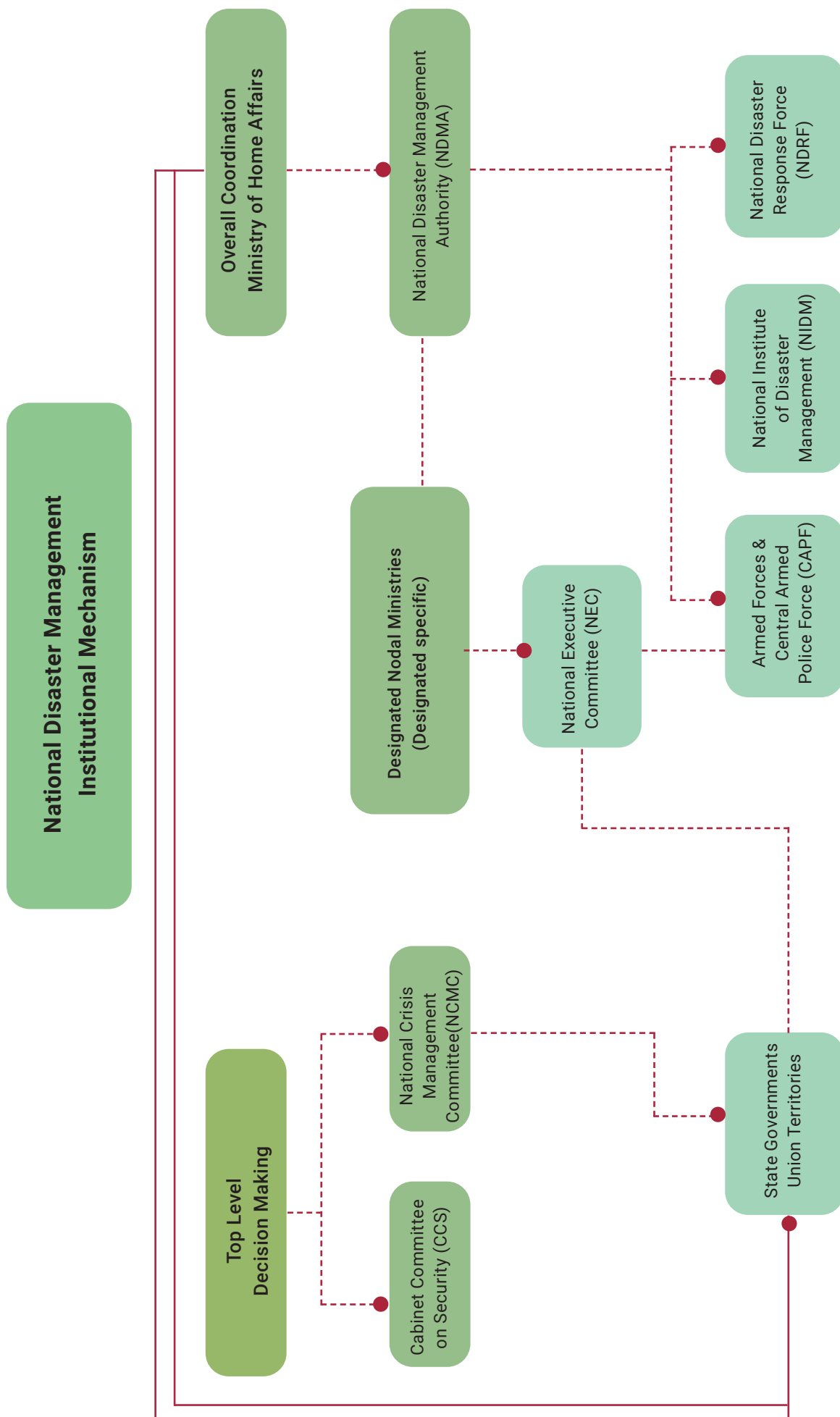


Fig.10 : Components in Chemical Disaster Management

* Adapted from NDMA guidelines on chemical disasters



3.1.1 National Disaster Management Institutional Mechanism

- o Ministry of Home Affairs is the responsible Ministry for overall coordination of disaster management in the country. There are nodal ministry identified for various disasters, for example, Ministry of Environment & Forests for Chemical Disasters, Ministry of Health and Family Welfare for Biological disasters, Ministry of Atomic Energy for Nuclear Disasters, Ministry of Railways for Rail accidents, etc. Ministry of Agriculture now looks after Drought.
- o For chemical disaster management in our country, many ministries are involved – Ministry of Environment and Forests, Ministry of Labour & Employment, Ministry of Agriculture, Ministry of Petroleum and Natural Gas, Ministry of Commerce and Industry, Economic Affairs & Finance, Ministry of Road Transport & Highways takes care of the aspects related to accidents during road transport of chemicals.
- o There is a National Crisis Management Committee that meets at the time of a calamity but not in the pre-disaster stage. At the time of a calamity of national scale, crisis management committee under the chairmanship of the Cabinet Secretary gives policy directions and guidelines for the crisis management group where the national and international efforts are required.
- o Crisis management Group at the Ministry of Home Affairs reviews the situation in Inter-ministerial meeting to coordinate various emergency support functions to the affected areas. Union Cabinet can set up the task force or committee for effective coordinate of the relief measures.
- o The National Disaster Management Authority has been constituted under the Chairmanship of the Prime Minister of India. There are nine members in the authority. NDMA's role is to lay down the guidelines and plans for disaster management, development of guidelines of minimum standards of relief, providing guidelines to the state governments and relevant central ministries.
- o Training and education are given significant focus and a number of workshops, training and awareness initiatives have been undertaken by NIDM and NDMA.
- o It is important to note that the roles and responsibilities of these stakeholders may vary depending on the specific circumstances of the emergency and the laws and regulations in place in the affected area.(Fig. X)

3.1.2 State Level Disaster Management Coordination Mechanism

- o Similarly, there is a mechanism at the state level where the crisis management committee under the Chief Secretary, responsible for the emergency management at state level. This committee comprises of the state departments officers with representative of central government organisations.
- o State Department of Relief has now been changed to Department of Disaster Management, will be the nodal coordinating the relief operations and disaster preparedness at the state level. It is also proposed to rename Relief Commissioners as Disaster Management Commissioners.
- o State Disaster Management Authority (SDMA) has the functions at states similar to NDMA has at national level and is chaired by Chief Minister. It provides guidelines to the state departments and the Districts.
- o District Disaster Management Authority (DDMA) is chaired by the District Collector or the District Magistrate. District Authority is responsible for formulation of District Disaster Management Plan. In some states like Gujarat and Odisha the Disaster Management Authority was formed prior to the National Disaster Management Authority. So, in those states now also the chairperson is not the Chief Minister but the Relief Commissioner. This is because these authorities were formed before the enactment of the Disaster Management Act.
- o Odisha Disaster Management Authority (OSDMA) was formed in 2000 and Gujarat Disaster Management Authority (GSDMA) was formed in 2001. Disaster Management Act provides the constitution of a Disaster Response Fund and now a Disaster Mitigation Fund.



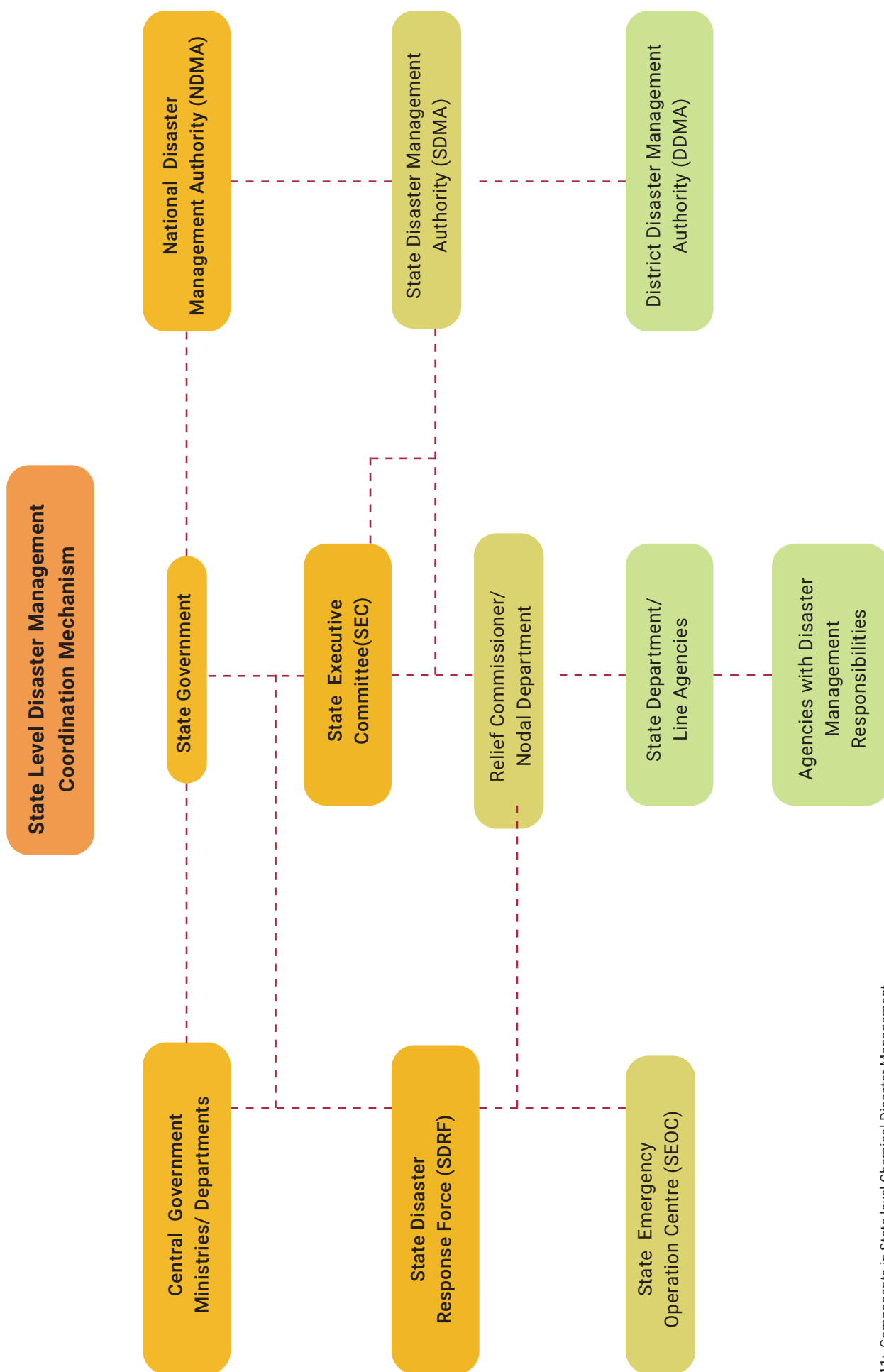


Fig.11: Components in State level Chemical Disaster Management

* Adapted from NDMA guidelines on chemical disasters

3.2 Crisis Groups

Crisis groups are constituted at the Central, State, District and local (industrial areas) levels. They act as bodies at their respective levels, to deal with chemical accidents and provide expert guidance for handling major chemical accidents.

The Central Crisis Group shall be the apex body at Central level and its functions include

- Continuously monitor the post-accident situation arising out of a major chemical accident and suggest measures for prevention and to check recurrence of such accidents.
- Conduct post-accident analysis of such major chemical accidents and evaluate responses.
- Review district off-site emergency plans with a view to examine its adequacy in accordance with the Manufacture, Storage and Import of Hazardous Chemicals Rules, and suggest measures to reduce risks in the Industrial pockets.
- Review the progress reports submitted by the State Crisis Groups.
- Respond to queries addressed to it by the State Crisis Groups and the District Crisis Groups.
- Publish a State-wise list of experts and officials who are concerned with the handling of chemical accidents.
- Render, in the event of a chemical accident in a State, all financial and infrastructural help as may be necessary.

3.3 Directorate of Industrial Safety and Health (DISH) Centres

- The (DISH) in India is pivotal in safeguarding the health, safety, leave with wages, work-environment, and working hours and welfare of workers across various sectors. It undertakes the enforcement of labour laws within industrial settings and construction sites, ensuring adherence to the Factories Act, the Building and other Construction Workers Act, and related labor legislations. DISH's primary focus is to foster safe working environments through regular inspections and by classifying factories into high, medium, or low risk categories, based on criteria such as the manufacturing process and workforce size. etc.
- DISH from all the states are the members of Technical Committee on Explosives.
- Factories are assigned a risk category by DISH: high-risk for those with significant accident hazards or dangerous operations usually involving over 100 workers; medium-risk for those with hazardous operations or processes with up to 100 workers, and non-hazardous factories employing over 250 workers; and low-risk for non-hazardous factories not engaged in dangerous operations and having fewer than 250 workers.
- Additionally, DISH plays a role in labor welfare through initiatives like the Labour Welfare Fund, which supports activities for employee welfare including social education, vocational training, and recreational programs.
- Overall, DISH is essential in upholding a safe and healthy work environment in India's industrial and construction sectors by enforcing legal standards, conducting inspections, and promoting worker welfare.



3.4 Agencies in the Preparedness, Surveillance & Response to Chemical Emergencies

3.4.1. National Disaster Management Authority (NDMA)

NDMA has the responsibility for laying down the policies, plans and guidelines for disaster management including chemical disasters for ensuring timely and effective response in the country. NDMA provides directions to ministries, departments and state authorities for the preparation of their detailed disaster management plans and calls for a proactive, participatory, multi-disciplinary and multi-sectoral approach at various levels for chemical disaster preparedness and response.

3.4.2. National Disaster Response Force(NDRF)

It is a specialized force trained to handle various types of disasters, including chemical emergencies, and they are equipped with the necessary expertise, equipment, and resources to effectively respond to such situations.

- **Emergency Response:** They assess the situation, implement safety measures, and initiate rescue operations to protect affected individuals and mitigate the impact of the chemical incident.
- **Containment and Mitigation:** They have specialized knowledge in handling hazardous substances, implementing control measures, and mitigating the risks associated with chemical emergencies.
- **Evacuation and Rescue:** They conduct rescue operations, provide medical assistance to those injured or exposed to hazardous chemicals, and ensure their well-being during the evacuation process.
- **Decontamination:** They establish decontamination zones and follow protocols to ensure the safe removal of hazardous substances from affected individuals, equipment, and the environment.
- **Coordination and Support:** They provide support, technical expertise, and guidance to local agencies involved in the management of such incidents.

3.4.3. National Centre for Disease Control (NCDC)

NCDC is the premier organisation involved public health activities in the country .NCDC is the International Health regulations (IHR)secretariat in the country and chemical emergencies including transboundary movement of chemicals are major risk to public health. NCDC has been assigned the job of carrying out trainings in chemical hazards prevention and it cooperates with pertinent central and state agencies in the creation of standards, guidelines, and standard operating procedures (SOPs) for chemical disaster management

3.4.4. Other Agencies involved in the Chemical Emergencies management

- **Medical Health and safety agencies:** They are responsible for providing medical treatment to those affected by the emergency, like civil hospital, nearest health facility, specialty hospitals/designated hospitals. They are responsible for ensuring the safety and health of workers during the emergency response.
- **Public health agencies:** Agencies such as the National Centre for Disease Control (NCDC) and local health departments shall monitor and conduct investigations into the health effects of the emergency.
- **Chemical Industries:** Chemical Industries are responsible for cooperating with emergency response teams and providing information about the chemicals involved in the emergency, as well as for taking steps to prevent similar emergencies in the future. (both Big and Small)
- **Media:** The media is responsible for reporting on the emergency, providing accurate information to the public, and serving as a source of information for the public during the emergency.
- **Storage and Transportation Companies:** crucial role in ensuring the safe handling and transport of hazardous materials. They should follow best practices and comply with regulations and contribute to protecting public safety, minimizing environmental impacts, and supporting effective emergency response

3.5 Role of RRT and Surveillance Officers

The role of Rapid Response Teams (RRTs) and Surveillance Officers is critical in the effective management of chemical emergencies.

Rapid Response Teams (RRTs) are specialized teams that are trained to respond quickly and effectively to chemical emergencies. Their main role is to provide immediate assistance to affected people, contain the spread of hazardous substance, and prevent further damage to the environment. RRTs typically consist of emergency responders, medical professionals, and hazardous materials specialists, who work together to provide a coordinated response to chemical emergencies. Some of their specific tasks include: Assessing the situation: RRTs are responsible for assessing the situation and determining the level of risk to human health and the environment.

- Containing the hazardous substance: RRTs work to contain the hazardous substance and prevent it from spreading to other areas.
- Evacuating affected people: RRTs are responsible for evacuating people who have been exposed to the hazardous substances and transporting them to medical facilities for treatment.
- Providing medical assistance: RRTs work to provide medical assistance to affected people, including administering first aid, providing oxygen, and treating injuries.
- Decontaminating affected areas: RRTs are responsible for decontaminating affected areas and ensuring that the hazardous substance is properly disposed of.

Surveillance Officers are also critical in the management of chemical emergencies. They play a key role in monitoring and identifying any potential health effects associated with exposure to hazardous substances. Some of their specific tasks include:

- **Monitoring affected areas:** Surveillance Officers monitor affected areas for any potential health effects associated with exposure to hazardous substances.
- **Conducting epidemiological investigations:** Surveillance Officers conduct epidemiological investigations to identify the source of exposure and determine the extent of the outbreak.
- **Collecting and analyzing data:** Surveillance Officers collect and analyze data on the number of cases and the severity of symptoms associated with exposure to hazardous substances.
- **Providing recommendations:** Surveillance Officers provide recommendations to emergency response teams and healthcare providers on how to manage and treat cases of exposure to hazardous substances.



Massive Fire Breaks Out at Govt Hospital in Amritsar, May 2022







4

"Preparation today ensures a secure tomorrow.."

OVERVIEW OF PREPAREDNESS, SURVEILLANCE & RESPONSE FOR PUBLIC HEALTH MANAGE- MENT OF CHEMICAL EMERGENCIES MODULE

By the end of this chapter, you will be able to understand:

1. Overview of preparedness, surveillance & response for public health management of chemical emergencies



Chemical Safety drill at NCDC,Delhi.

Preparedness, Surveillance & Response for Chemical Emergencies Module provides guidance on how to prepare for such events, how to detect and monitor chemical releases, and how to respond effectively to minimize the damage caused by such incidents.

It is important for a coordinated and collaborative approach to manage chemical emergencies and highlighting the need for effective communication and information-sharing among all parties involved.

It is an essential resource for anyone involved in the management of chemical emergencies. It provides a comprehensive overview of the key issues and challenges involved in dealing with such incidents and provides practical guidance on how to prepare, detect, and respond to chemical emergencies effectively.

EVENT NOTIFICATION -

Surveillance and Monitoring - Surveillance and Monitoring systems are critical for effective management of chemical emergencies. They provide important information for decision-making, response planning, and evaluation of the impact of the emergency. By detecting chemical emergencies early and evaluating their risks and impact, surveillance and monitoring systems can help protect public health and minimize the environmental impact of these incidents.

Risk assessment of the event - Risk Assessment can help to minimize the potential harm and damage caused by a chemical event and ensure that appropriate measures are taken to protect people, the environment, and infrastructure.

Assessment of preparedness measures:

- o Facility readiness, local and national chemical incident response plans (with health involvement).
- o Databases on chemicals, sites, transport routes and expertise.
- o Mechanism for interagency communication and public communication.
- o Emergency response guidelines, including environmental protection guidelines.
- o Capacity building plans- undertaking incident exercises, training, and audits.
- o Capacity for chemical incident surveillance.
- o Health system capacities in health facilities to decontaminate and treat casualties

CAPACITY BUILDING PROGRAMS

Capacity building is an ongoing process that equips officials, stakeholders and the community to perform their functions in a better manner during a crisis/disaster. In the process of capacity building, we must include elements of human resource development, i.e., individual training, organizational development such as improving the functioning of groups and organizations and institutional development.

ADVOCACY AND SENSITIZATION OF STAKEHOLDERS -

Organizations can create a network of informed and prepared individuals who can work together to respond to chemical emergencies and protect public health and the environment. It is important to tailor sensitization efforts to the needs and priorities of each stakeholder group and to continuously evaluate and improve the effectiveness of these efforts.





“The first step in any kind of disaster management is always to be prepared”

CHEMICAL EMERGENCY RESPONSE - BASICS OF SAFETY DATA SHEET (SDS)

By the end of this chapter, you will be able to understand:

1. Understand what an SDS is
2. Understand where to find an SDS
3. Learn how to read SDS (understand its symbology)

5.1 Basics of Safety Data Sheets

The Safety Data Sheets (SDS) information acts as a reference source for the management of hazardous chemicals and their mixtures. SDS of different chemicals, associated mixtures and their potential hazards are available in public domain

5.1.1 What Is an SDS?

SDS is a comprehensive, standard document that chemical manufacturers and suppliers should provide to the end user; it should include information on physical and chemical properties, environmental hazards, health hazards, first aid measures, and accidental release measures. Safety Data Sheets (SDSs) are documents prepared by the manufactures/ suppliers of the chemicals and contain information on physical and chemical properties of the material, potential hazards of the material and how to work safely with these materials. They also contain information on usages, storage, handling and emergency procedures related to the hazards of the materials. In fact, they provide a single reference for all information about hazardous substances. Provision of SDS is mandatory for an occupier, who has control of an industrial activity under Rule 17 of the Manufacture Storage and Import of Hazardous Chemical (MSIHC) Rule, 1989 The Safety Data Sheets (SDS) contain Sixteen (16) Sections, however, different countries provide for 9 to 16 sections and their format varies from country to country.

5.1.2 What is the purpose of a SDS?

Safety data sheets provide information on the properties of each chemical, protective measures and precautions for handling, storing and transporting the chemical. It also provides specific information pertaining to each chemical with respect to personal protective equipment, first aid and spill-clean up. In the event of a chemical exposure, this information can be used by workers, authorities involved in the emergency response and those aiding with the pre-hospital management and treatment of patients.

5.1.3 Where to find a SDS?

SDS could be found on Specific manufacturers' websites or it could be found on organizations providing SDS or any common search engine such as Google.

An alternative to MSDS may be the International Chemical Safety Cards (ICSC) which are data sheets intended to provide essential safety and health information on chemicals in a clear and concise way. The primary aim of the Cards is to promote the safe use of chemicals in the workplace and the main target users are workers. The ICSC project is a joint venture between the World Health Organization and the International Labour Office (ILO), with the cooperation of the European Commission.

5.1.4 Different types of SDS

(Classification of SDS on the basis of common use or Toxidromes)

In India, Safety Data Sheets (SDS) are governed by the Chemicals (Management and Safety) Rules, 2021, which are based on the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

The types of SDSs in India include:

- o GHS-compliant SDS: This is the most common type of SDS used in India and follows the guidelines of the GHS. It provides information about the hazards of chemicals, as well as recommendations for their safe handling and use.

- Indian Standard (IS) SDS: These SDSs are developed by the Bureau of Indian Standards (BIS) and are used for certain specific chemicals. The IS SDSs provide information on the physical and chemical properties of the chemicals, as well as their hazards and safe handling procedures.
- Other local SDSs: Some industries or companies may develop their own SDSs that are specific to their products or processes. These SDSs may provide additional information or guidelines that are specific to the industry or company.
- It is important to note that all SDSs in India must comply with the guidelines and requirements set forth in the Chemicals (Management and Safety) Rules, 2021.

SCHEDULE - 9

(SEE RULE 17)

SAFETY DATA SHEET

1. CHEMICAL IDENTITY

CHEMICAL NAME		CHEMICAL CLASSIFICATION	
SYNONYMS		TRADE NAME	
FORMULA	C.A.S.NO	U.N. NO.:	
REGULATED IDENTIFICATION	SHIPPING NAME CODES/LABLE	HAZECHEM NO.:	
HAZARDOUS WASTE I.D. NO.:			
HAZARDOUS INGREDIENTS	C.A.S. NO.	HAZARDOUS INGREDIENTS	C.A.S. NO.
1		3	
2		4	

2. PHYSICAL AND CHEMICAL DATA

BOILING RANGE/POINT °C	PHYSICAL STATE	APPEARANCE
MELTING/FREEZING POINT °C	VAPOUR PRESSURE @ 35 °C mm/Hg	ODOUR
VAPOUR DENSITY (AIR=1)	SOLUBILITY IN WATER AT 30°C	
SPECIFIC GRAVITY WATER=1	Others	
	pH	



3. FIRE AND EXPLOSION HAZARD DATA

FLAMMABILITY	YES / NO	LEL	%	FLASH POINT °C	AUTO IGNITION TEMPERATURE °C
FLAMMABILITY		UEL	%	FLASH POINT °C	
EXPLOSION SENSITIVITY TO IMPACT	EXPLOSION SENSITIVITY TO STATIC ELECTRICITY			HAZARDOUS COMBUSTION PRODUCTS	
HAZARDOUS POLYMERISATION COMBUSTIBLE LIQUID	EXPLOSIVE MATERIAL			CORROSIVE MATERIAL	
FLAMMABLE MATERIAL	OXIDISER			OTHERS	
PYROPHORIC MATERIAL	ORGANIC PEROXIDE				

4. REACTIVITY DATA

CHEMICAL STABILITY
INCOMPATIBILITY WITH OTHER MATERIAL
REACTIVITY
HAZARDOUS REACTION PRODUCTS

5. HEALTH HAZARD DATA

ROUTES OF ENTRY					
EFFECTS OF EXPOSURE / SYMPTOMS					
EMERGENCY TREATMENT					
TLV (ACGIH)	ppm	mg/m ³	STEL	ppm	mg/m ³

PERMISSIBLE EXPOSURE LIMITS LD 50	ppm	mg/m ³	ODOUR THRESHOLD LD 50	ppm	mg/m ³
NEPA HAZARD SIGNALS	HEALTH	FLAMMABILITY	STABILITY SPECIAL		

6. PREVENTIVE MEASURES

PERSONAL PROTECTIVE EQUIPMENT
HANDLING AND STORAGE PRECAUTIONS

7. EMERGENCY AND FIRST AID MEASURE

FIRE	FIRE EXTINGUISHING MEDIA
	SPECIAL PROCEDURES
	UNUSUAL HAZARDS
EXPOSURE	
	FIRST AID MEASURES
	ANTIDOTES / DOSAGES
SPILLS	
	STEPS TO BE TAKEN
	WASTE DISPOSAL METHOD

HAZARDOUS MATERIALS CLASSIFICATION

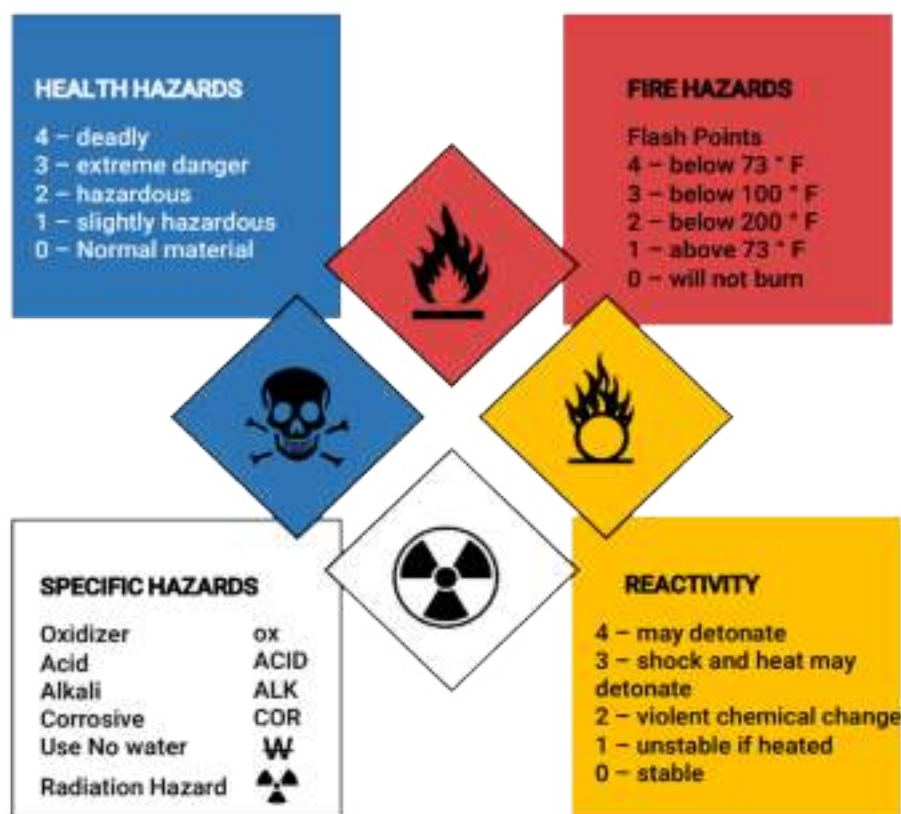


Fig.12: Hazard Classification



product identifier **AMMONIA**

signal word **DANGER**

hazard statement **TOXIC IF INGESTED**

precautionary statements

Wash hands thoroughly after handling. Keep container tightly closed when not in use. Keep away from heat, sparks and open flames - may explode when exposed to high heat. Use in an open area that is well-ventilated. Breathing in ammonia is irritating and corrosive. Wear protective gloves and safety goggles to prevent burns and irritation.

supplier information ABC Chemicals - 123 Main Street - Cincinnati, OH - www.abcchem.com - 800-733-5252

pictograms

See Safety Data Sheet (SDS) for further details regarding safe use of this product.

Fig.13: GHS compliant label

GHS Pictogram

Oxidizers	Flammables, Self Reactives, Pyrophorics, Self-Heating, Emits Flammable Gas, Organic Peroxides	Explosives, Self Reactives, Organic Peroxides
Acutely Toxic (severe)	Burns Skin, Damages Eyes, Corrosive to Metals	Gases Under Pressure
Carcinogen, Respiratory Sensitizer, Reproductive Toxicity, Target Organ Toxicity, Mutagenicity, Aspiration Toxicity	Toxic to aquatic environment	Acutely toxic(harmful), Irritant to skin, eyes or respiratory tract, Skin sensitizer, Hazardous to the Ozone layer.

Snapshot of the SDS according to the Schedule-9 of the Manufacture Storage and Import of Hazardous Chemical (MSIHC) Rule, 1989

The information in the MSDS should normally be presented using the following 16 headings in the order given below:

S.NO	INFORMATION	POSSIBLE DETAILS
1	Identification	1. Product identifier 2. Relevant identified uses of the substance or mixture and uses advised against 3. Details of the supplier of the safety data sheet 4. Emergency telephone number
2	Hazard (s) identification	1. Classification of the substance or mixture 2. Label elements 3. Other hazards 4. Pictograms
3	Composition /information on ingredients	1. Substances » Chemical name » Common name and synonyms » Chemical Abstracts Service (CAS) number and other unique identifiers » Impurities and stabilizing additives, which are themselves classified and which contribute to the classification of the chemical. 2. Mixtures » Same as substance
4	First-aid measures	1. Description of first aid measures 2. Most important symptoms and effects, both acute and delayed 3. Indication of any immediate medical attention and special treatment needed
5	Fire-fighting measures	1. Extinguishing media 2. Special hazards arising from the substance or mixture 3. Advice for firefighters
6	Accidental release measures	1. Personal precautions, protective equipment and emergency procedures 2. Environmental precautions 3. Methods and material for containment and cleaning up 4. Reference to other sections
7	Handling and Storage	1. Precautions for safe handling 2. Conditions for safe storage, including any incompatibilities 3. Specific end use(s)

S.NO	INFORMATION	POSSIBLE DETAILS
8	Exposure controls/personal protection	1. Control parameters 2. Exposure controls
9	Physical and chemical	1. Information on basic physical and chemical properties (Appearance physical state, color, etc.); Upper/lower flammability or explosive limits; Odor; vapor pressure; vapor density; pH; Relative density; Melting point/freezing point; Solubility(ies); initial boiling point and boiling range; Flash point; Auto-ignition temperature; Evaporation rate; Decomposition temperature; flammability (solid, gas); Viscosity, etc.) 2. Other information
10	Stability and reactivity	1. Reactivity 2. Chemical stability 3. Possibility of hazardous reactions 4. Conditions to avoid 5. Incompatible materials 6. Hazardous decomposition products
11	Toxicological information	1. Information on toxicological effects
12	Ecological information	1. Toxicity 2. Persistence and degradability 3. Bioaccumulative potential 4. Mobility in soil 5. Results of PBT and vPvB assessment 6. Other adverse effects
13	Disposal Considerations	1. Waste treatment methods
14	Transport information	1. UN number 2. UN proper shipping name 3. Transport hazard class(es) 4. Packing group 5. Environmental hazards 6. Special precautions for user
15	Regulatory information	1. Safety, health and environmental regulations / legislation specific for the substance or mixture 2. Chemical safety assessment
16	Other information	1. Date of the latest revision of the SDS





Rescuers tries to control fires, Balasore, Odisha, 2023



“Risk assessment is not about predicting the future, it’s about reducing uncertainty”

INITIAL RESPONSE

By the end of this chapter, you will be able to:

1. Understand steps of initial response
2. Understand onsite and offsite plans
3. Learn about timeline for response
4. Learn how to create demarcation zones
5. Understand the process of decontamination
6. Understand Risk communication

6.1 Steps of Initial Response

The onset of an emergency creates a need for time-sensitive actions to save lives and property, as well as for actions to begin for stabilising the situation so that the jurisdiction can regroup. Such response actions include notifying emergency management personnel of the crisis, warning and evacuating or sheltering the population if possible, keeping the population informed, rescuing individuals and providing medical treatment, maintaining the rule of law, assessing damage, addressing mitigation issues that arise from response activities, and even requesting help from outside the jurisdiction. The major steps include -

1. Terminate the release, limit contamination and exposure.
2. Call a Poisons information center (PIC)
3. Activate the incident management system, including a public health response.
4. Provide an initial assessment and advise and alert the first responders, emergency management personnel, and health care services.
5. Ensure coordination and integration of the public health response.
6. Warning and evacuating the population if possible
7. Conduct a outcome assessment for both immediate and long-term actions.
8. Disseminate information and advice to responders, the public, and the media.
9. Register all exposed individuals and collect samples to eliminate exposure.
10. Conduct investigations.
11. Rescuing individuals and providing medical treatment
12. Assessing damage, addressing mitigation issues that arise from Response activities,

National Disaster Response Force (NDRF) is the trained force that has the mandate to respond in case of chemical emergency. Responding quickly and effectively to the concerns of a population potentially exposed in a chemical release incident is vital for the rehabilitation of a community.

Also, undertaking additional investigations to make sure that neither health effects nor environmental contamination can be detected may be an effective way to reassure exposed individuals. Involving the community in plans to reduce the risk of further incidents, and to quickly alert responders and the public if further incidents occur, can be reassuring, and can be protective of the public's overall sense of well-being.

6.2 Onsite and Offsite plans

On-site Emergency Plans

The Purpose of an Onsite emergency plan is to make plans to detect the emergency, contain the emergency if possible and alert the necessary stakeholders of the quantum of the incident and the help that is required. As part of emergency plan, individuals should be nominated for the following roles, among others:

1. A site incident controller to take control on scene in the event of an emergency
2. A site main controller to take overall control of an emergency from the emergency control centre

The role of these controllers in relation to community emergency response personnel should be clearly spelt out in order to avoid any potential conflicts. On-site emergency plans, in identifying the roles and responsibilities of all parties concerned, should clearly indicate:

- The chain of command and co-ordination among the parties
- Lines of communication

The Onsite Emergency plan should be specific to the Industry or site which handles the chemicals.

- All employees and contractors at a hazardous installation should be made fully aware of the relevant provisions of the on-site emergency plan.

- The employees should be made aware of what to do in the event of an emergency such as taking action to limit the release of hazardous substances and/or evacuating the installation and gathering at a previously designated assembly point.
- The means of obtaining necessary information.

The factors to be assessed in the onsite plan should include:

- Assessing the risk of the different types of chemicals in the factory and the potential accidents that can occur due to the chemicals
- Developing emergency measures within the factory including measures to contain chemical spills, extinguish fires and contain toxic gas leakage
- Formulate evacuation plans for the site by identifying multiple exit routes, assembly points
- Train an Industrial safety unit within the factory to contain issues like spills, control fires, for rescue activities, to provide first aid etc. Make sure they have the modern and updated equipments.
- Identify areas beforehand to set up decontamination units and temporary medical facilities and ensure protocol for personal, equipment and terrain decontamination.
- Ensure availability of specialized PPE, equipment and Hazmat suits for the workers and responders.
- Conduct regular training and drills for the personnel.
- Maintain a repository of important phone number including hospitals, fire services, Poisons information center, district authorities, police.
- Assist with providing resources and facilities for the prompt treatment of exposures and injuries. In order to treat severe injuries or chemical exposures, make arrangements with the local hospitals.

Off-site Emergency Plans / District Disaster management Plan

Off site emergency preparedness plans, in identifying the roles and responsibilities of all the parties concerned, should clearly indicate the chain of command and co-ordination among the parties, the lines of communication and the means of obtaining the necessary technical, meteorological and medical information.

Public authorities/district authorities should ensure that there is an adequate off-site emergency plan wherever there is a hazardous installation.

Such a plan should:

- Set out its objectives
- Provide relevant information on the hazardous installations and surrounding areas
- Evaluate the hazard (including transport hazards) which may result in emergency situations in the community
- Establish the procedures to be followed, and identify the officials responsible, in the event of an accident. In the development of an off-site emergency plan, all emergency response participants should be identified.
- Include steps for coordinating with District Disaster Management Authority/ District Emergency Operations centre (EOC), National Disaster Response Force (NDRF), Police, fire, medical (including hospitals), transport and welfare services, civil defence agencies, communication outlets and environmental agencies.
- Mechanisms to ensure that hospitals and other treatment facilities that may be involved in responding to an accident should be provided, as soon as possible, with information on the hazardous substance(s) involved, the type of accident (spill, fire, etc.), the likely number of victims, and the nature of their injuries
- Evaluating the affected area, type and probability of chemical events and foreseeing its possible effects to humans and environment
- Conduct an assessment regarding probable persons who could be affected and probability of foreseeable events.
- Establishing protocols for raising alarms and risk communication.
- Formulate evacuation plans by identifying assembly points and multiple routes to emergency facilities
- Identifying areas near the factory/ installation where mobile medical units can be set up
- Provisions for regular mock drills and training for the community and members
- Provisions for regular review and updation of the off-site plans
- Involve the community in the planning process, supplying information on hazards and countermeasures, and soliciting input to enhance the emergency plan.



6.3 Table: Timeline for Response

TIME FRAME	TASK
Pre-disaster	Co-ordinate with SEOC, DEOC for Chemical Mock Drills.
T+1 Minute	On detection of Chemical Emergency, raise alarm and alert the occupants and security
	Safely evacuate the occupants of respective office
	Perform the following » If caught in smoke » Stay low to avoid smoke, fumes, and super-heated gases » Hold your breath as much as possible and breathe shallowly throughout your nose using » cloth/wet cloth as a filter. » Cover mouth and face with wet cloth to avoid eye and skin irritation » Drop to hands and knees and crawl or crouch low, watching the base of the wall as you go. » Use the stairs - NEVER use elevators for evacuation.
	Gather at nearest Refuge Area provided in the building & safely evacuate to the assembly area
	Inform Command and Control Centre and fire services, regarding the incident
	Cordon off the affected area
	In case of Blast, follow the Fire Action Plan
	Inform district administration, corporation/municipality, hospitals and update about the incident status
	Activate Crisis Management Committee (CMC)
T+20 Minutes	Immediately monitor the affected area through active CCTV and security surveillance to identify immediate impacts
	Coordinate with concerned Owner / Manager of the Industry, developers, security services, medical services in-charge of utility services and heads of department & officers
	Ensure that the Response Team is well equipped with personal protective equipment.
	Search and rescue trapped and injured persons and handover them to medical team.
	Reach at the site and attend to injured and effected persons
	List out the resource needs not met internally and seek help from district collectorate and other external agencies and request them to be on standby for additional support: » Fire and Emergency Services » Medical Services » Primary Health Center » 108 Emergency Response Service » Hospitals » other pre-identified medical and ambulance services, » Police station » DEOC » DISH

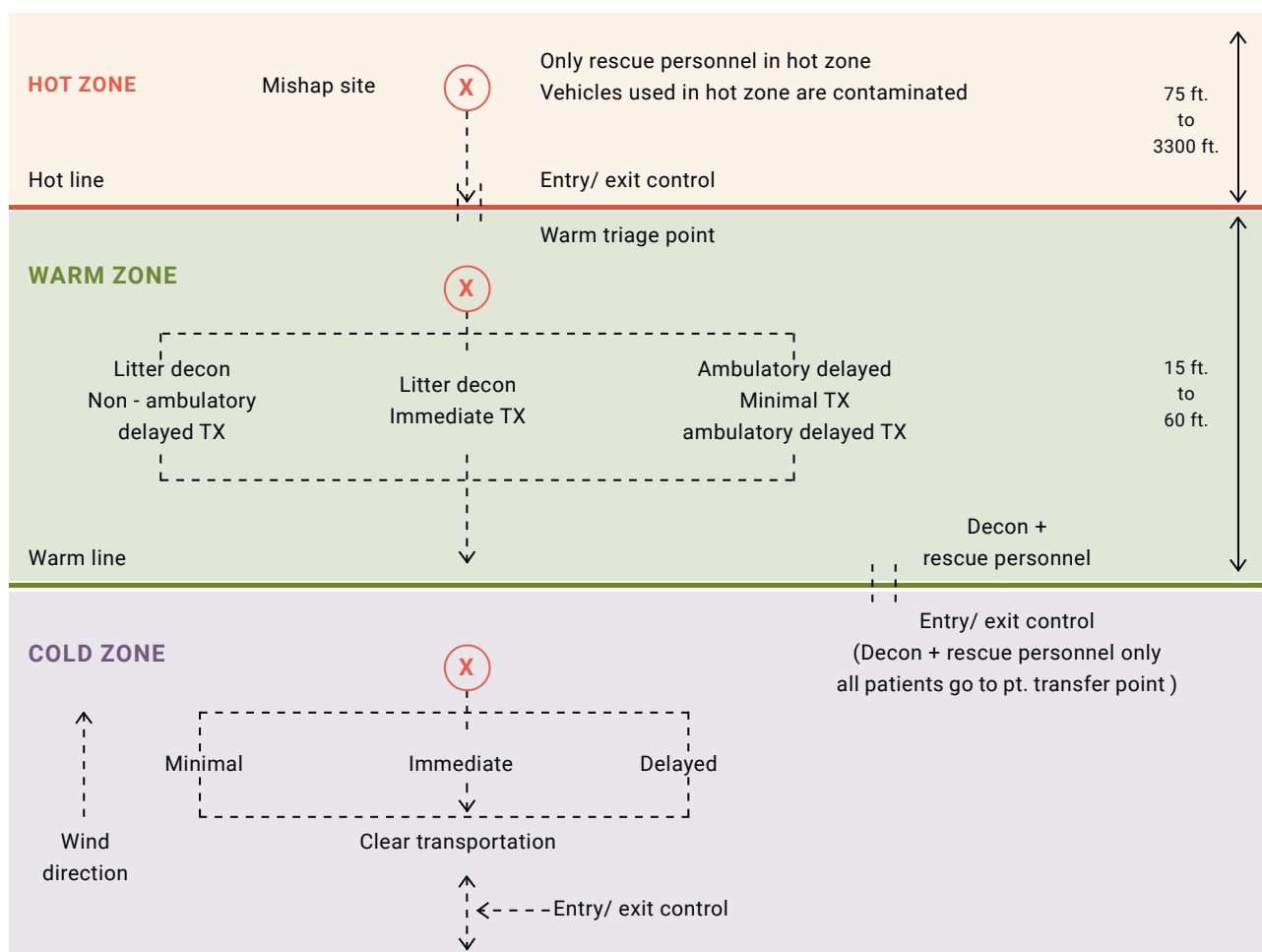
TIME FRAME	TASK
	Provide information on safe routes to responding agencies
	Provide vehicles for evacuation, if needed
T+30 Minute	Reach the incident site as early as possible and takeover the ongoing operations
	Reach the incident site as per request and provide necessary medical and ambulance services
	Manage traffic to clear the way for emergency service vehicles
	Reach the incident site as per request and takeover the law and order and security operation.
	Maintain law and order at affected areas
	Cut and restore power supply of affected area as and when required for re-sponse operations
T+1 hour	Regularly reassess the situation and deploy additional resources, if required
	Clear debris and other obstacles on roads for unhindered passage to emergency services and vehicles
	Seek additional support, if required, from pre-identified earthmovers service providers for clearance of debris and obstacles
	If the nature and magnitude of fire demand so, coordinate with state Government and seek other necessary support search and rescue operation
T+5 hour	Conduct rapid damage and need assessment through Multi-cluster/sector initial rapid assessment (MIRA)
	Establish staging area at a pre-identified safe location near the affected site for immediate, effective and quick deployment of resources
	Restore essential services in the affected areas like power, water supply, tele-communication, critical infrastructure
	Establish temporary shelter for evacuated and rescued persons at suitable area.
	Provide necessary transportation support for movement and distribution of relief and emergency supplies
	Ensure distribution of food and drinking water to responding agencies and care providers
	Support distribution of relief material at various facilities and maintain record of the same
	Ensure equitable distribution of relief material giving priority to pregnant and lactating mothers, infants & young children, old, differently-abled and sick persons
T+12 hour	Ensure proper handover of dead bodies to the concerned authorities, in case of any casualty
	Ensure mechanism for complaints regarding missing persons and initiate search in shelters, hospitals and police records
T+24 hour	Ensure proper documentation of damage, taking photographs and related evidences for prompt procedure of insurance claims for people and assets/businesses
	Conduct rapid damage and need assessment through Multicluster/sector initial rapid assessment (MIRA)



6.3.1 Key points to remember for any first responder

- **A**ttention: Don't pay attention to the rumors and don't spread rumors
- **B**roadcast: Forward messages only from verified sources/ only after verification, Social media , news should be delivered.
- **C**onsume: Do not consume the uncovered food/ water/liquids etc open to the air, drink only from bottle.
- **C**over: Use wet clothes to cover Piece of Cloth: Keep a wet handkerchief or piece of cloth on nose and mouth during evacuation.
- **D**irection of wind: evacuate calmly and quickly perpendicular to wind direction through the designated escape route
- **E**lderly: Keep the sick, elderly, weak, handicapped and other people who are unable to evacuate inside house and close all the doors and windows tightly.
- **F**resh: Change into fresh clothing after reaching safe place/ shelter, and wash hands properly.
- **I**nfarm: Fire, Police, Emergency & Medical Services from safe location by calling the Disaster Helpline number : (Call for help)
- **I**nfarm: Inform others on occurrence of event at public gathering places (like schools, shopping centre,theatres etc.).
- **I**nformation: Provide correct and accurate information to government official
- **L**isten: Listen to PA (Public Announcement) System of the plant/ factory, local radio/ TV channels for advice from district administration/fire/health/police and other concerned authorities.
- **P**anic: Do not panic

6.4 Demacration Zones



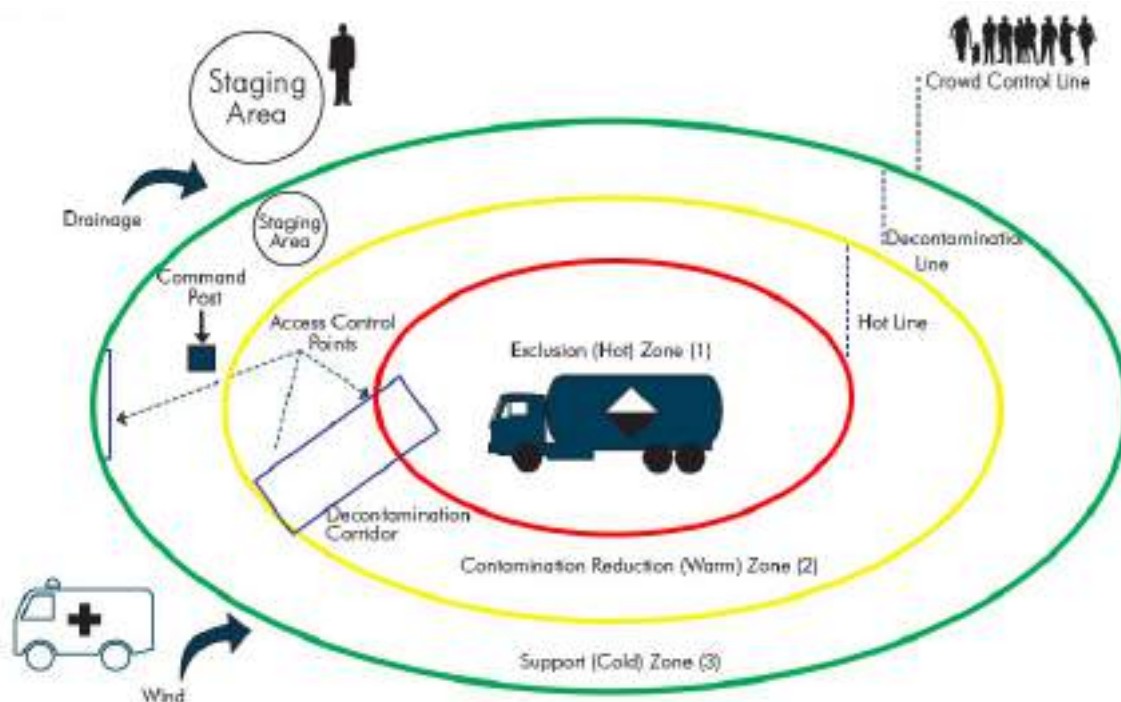


Fig.14: Demarcation zones

Zone Management and Responsibility

Medical Personnel and PPE Requirements

If medical personnel are available, a triage can be made for assigning priority for decontamination. In case of severe casualties, an emergency medical treatment site can also be established to administer vital life support of cardiovascular and respiratory functions before going through the decontamination process.

- o Medical Personnels in hot zone is strictly limited high levels of training needed and Usually avoided
- o Medical personnel in the warm zone:
 - Must wear Level B or C PPE, depending on the situation.
 - Only highly trained individuals under tactical supervision may operate in warm zones
 - Perform initial triage and emergency stabilization of patients before decontamination
- o Medical personnel are primarily positioned in the cold zone
 - This must be clearly understood by all emergency services

6.5 Decontamination

- o Decontamination is the process of removing or neutralising a hazard from the environment, property or life form. It is the process, method, or action that leads to a reduction, removal, neutralization or inactivation of contamination on or in the patient in order to: prevent or mitigate adverse health effects to the patient; protect emergency first responders, health care facility first receivers, and other patients from secondary contamination; and reduce the potential for secondary contamination of response and health care infrastructure.
- o Objective of decontamination is to prevent further harm and optimise the chance for full clinical recovery or restoration of the object exposed to the contaminant
- o CBR agents has potential to seriously threaten community health and safety, property and the environment.
- o Chemicals accidentally or deliberately released have catastrophic effects and cause mass casualties.
- o People exposed to these agents will require decontamination.
- o If patient is ill, ventilatory support and administration of medications may be required while undergoing decontamination.



6.5.1 Decontamination Plans

Decontamination Plan should :

- Determine the number and layout of decontamination stations.
- Determine the decontamination equipment needed.
- Determine appropriate decontamination methods.
- Establish procedures to prevent contamination of clean areas.
- Establish methods and procedures to minimize worker contact with contaminants during removal of personal protective clothing and equipment (PPE).
- Establish methods for disposing of clothing and equipment that are not completely decontaminated.

Develop contingency plans for:

- The physically and cognitively impaired
- Culturally and linguistically diverse populations
- Casualties suffering from chronic long-term illness
- Toddlers, as they are liable to increase self-contamination by sucking thumb or explore their nasal cavity and eyes. Pacifiers must be avoided, as it is a potential contamination risk.
- The sooner the patient is decontaminated, the sooner the patient can be transferred to the support or treatment zone for further evaluation and treatment.
- Decontamination of non-ambulatory patient is more difficult and labor-intensive
- The complexity of managing a HAZMAT incident is increased when children are involved.

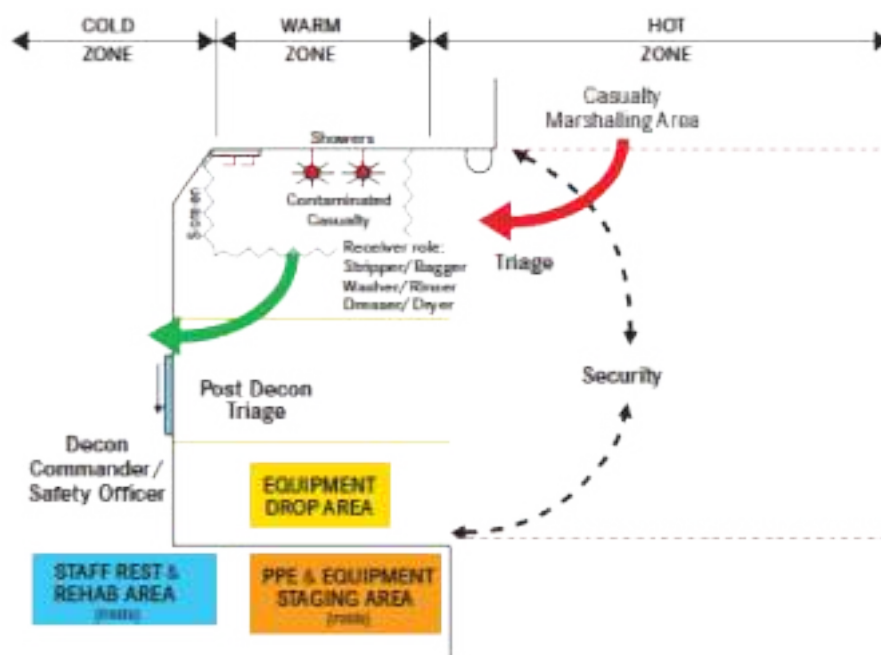


Fig 15 : Fixed decontamination facility

All reasonable efforts should be made to determine the level of exposure and detect latent symptoms.

These efforts should include the following:

- **Air and environmental monitoring** to be carried out to assess potential exposure (through inhalation, skin or eye absorption, water or food ingestion) to the ambient chemical concentration at the time of exposure. Sometimes, if not frequently, measurements of the ambient chemical concentration are not possible due to the amount of time which has elapsed
- **Biological monitoring** may be undertaken. This type of monitoring is used to assess overall exposure to chemicals that may have been present, through the measurement of appropriate determinants in biological specimens (urine, exhaled breath, blood) collected within a specified time frame

- o If competent public health experts at the scene still have reason to suspect exposure, the acute and sub-acute symptoms of overexposure to the chemicals in question should be identified and the placed under observation for a suitable period.

6.5.2 Decontamination Process

Decontamination must be conducted in an organised, stepwise manner. If certain pieces of the protective equipment are removed prior to the elimination of potential problems by decontamination, the worker may suffer damage due to inhalation or skin contact with contaminants.

It is therefore important that persons doing the decontamination work know the proper procedures and the order in which to perform them to ensure that such potential personal injuries do not occur. It is also important that site workers avoid contaminating themselves until after they have been cleared to exit the contamination reduction zone.

6.5.3 Steps of victim decontamination

If a contaminated victim is treated as a regular uncontaminated victim it opens a floodgate to a massive secondary emergency. The exposed victim can decontaminate unexposed/unaware rescuers. The transport vehicle that carries them and the hospital they are treated at.

Which all persons at the scene need decontamination?

People don't always need to be decontaminated just because they were in the building or nearby areas.

- o Are they showing signs and symptoms of exposure to a hazardous material?
- o Do they have the chemical product on them?
- o Were they in the immediate proximity of the hazardous chemical that was released?
- o Were they in a confined area when a hazardous material was released?
- o Decontamination of the Critical patients should not be undertaken on site they should be referred directly to the hospital.

Primary Decontamination of victims/Decontamination at site

The primary decontamination in India is done by NDRF which is the designated agency for the handling of CBRN emergencies.

- o Remove victim to a safe site preferably in the cold zone
- o All the decontamination staff should wear appropriate PPE to avoid being contaminated.
- o Remove all the clothes of the victim and store them in a labelled bag set aside for disposal.
- o Place personal items like Spectacles, jewellery, gadgets in a separate bag and label it for offsite cleaning or disposal whenever that's not possible and contain as much runoff as possible.
- o Remove as much contaminant as possible using appropriate decontamination solutions, water, soap. Use low pressure water streams to avoid splashing and overspray.
- o Dry the victim using towels and keep the used towels in a labelled bag set aside for disposal.
- o Place the victim on a clean sheet and wrap them in it.
- o Place the victim on a plastic sheet and wrap them, Place the plastic down with sheet on top. Then place the victim on the sheet and fold
- o Any victims needing evaluation or treatment will be triaged at this station. Victim will then be sent to the designated area for his/her triage level for further treatment and transport

A secondary decontamination should be done once the patient has been referred to the designated hospital.

Refer annexure 1 for decontamination of ambulatory and non ambulatory/vulnerable population





Fig 16 : Steps of victim decontamination

- o Contamination detected on the patient using appropriate detection technology;
- o The chemical identity (if known), physical state, characteristics, and behavior

- o **Basic Technique:** Use copious water and soap with the “rinse-wipe-rinse” method after clothing removal
- o **Eye Exposure:** Irrigate thoroughly with clean water or 0.9% saline, Remove contact lenses before rinsing
- o **Hair:** Requires special attention as it can retain vapors and reduce evaporation of liquid agents
- o **Dry Decontamination:** Apply absorbent materials (e.g., Fuller's earth) to liquid-contaminated skin
- o **Wound Care:** Use 0.9% saline to irrigate wounds and limit rapid agent absorption in combined injuries

Evaluating effectiveness of Decontamination

Decisions on whether contamination has been reduced to a level that is safe or additional decontamination is necessary can be guided by the following indicators (and others as appropriate)

- o Elimination of visible contamination from the skin and/or clothing
- o Observable improvement in signs and symptoms which prompted the decision to perform decontamination
- o Patient perceptions of the effectiveness of decontamination
- o Results from appropriate detection technologies
- o If an effective decontamination method, which is known to be appropriate given the nature of the incident and chemical involved, is properly executed, then a sufficient reduction in contamination can be implied.

Note: Immediate, lifesaving medical care and/or antidotal therapy should ideally be a priority, over patient decontamination.

6.5.4 Personnel Decontamination

All personnel, clothing, equipment, and samples leaving the contaminated area of a site (generally referred to as the Exclusion Zone) must be decontaminated to remove any harmful chemicals. Various steps involved in complete decontamination of personnel, equipment and terrain decontamination.

- Individual gear drop- Remove as much contaminations possible from personal equipment like helmet, detectors, other equipment
- Overboots and hood decontamination-Neutralize contamination from footwear covers and lower trouser legs. Remove gross contamination for hood and mask.
- Over garment off-Remove contaminated over garments before the agent penetrates over garments material and touches undergarments or skin.
- Overboots and gloves off-Remove contaminated over boots to limit the spread of contamination.
- Monitor-Identify contamination on personnel, provide spot decontamination capability and provide medical aid as required.
- Mask removal-Remove the mask from the personnel without contaminating him and take the mask to the decontamination point.
- Mask decontamination point- Remove as much contamination from the masks as possible.
- Personnel Decontamination shower- Removes contamination from the body

Decontamination Stations

- No one should exit the hot zone or enter hospitals without completing decontamination
- Level C PPE is usually acceptable-PPE level may need to be upgraded based on scenario
- Workload Management:
 - Monitor staff for fatigue, dehydration, heat stress
 - Establish rotation schedules through emergency planning

Striking the right balance between delivering lifesaving medical care and executing decontamination procedures is inherently complex. It requires a careful evaluation of both the risk level and the operational capacity of responders and healthcare personnel to determine whether it is appropriate and feasible to provide medical interventions within the contamination reduction zone while patients are still awaiting full decontamination. Often, healthcare providers trained in emergency care may not be proficient in operating under the constraints of PPE, while personnel experienced in PPE use may lack the clinical expertise to administer effective medical treatment. Additionally, the setup of decontamination facilities can be time-intensive, necessitating the provision of urgent medical care before decontamination can occur. Diagnostic procedures should be strictly avoided until decontamination is completed.

- Patients requiring decontamination as a prerequisite for the administration of immediate, lifesaving interventions—including antidotal therapy—should be prioritized.
- Within the same decontamination priority category, children should be given precedence over adults.
- Factors such as age, pregnancy status, and pre-existing chronic medical conditions should be taken into account when assessing relative risk and establishing decontamination priorities.
- In large-scale chemical exposure events, those in critical need of decontamination may not arrive first; ambulatory patients often reach first responders or healthcare facilities more rapidly than non-ambulatory individuals.
- Patients who self-report to healthcare facilities should be triaged and prioritized for decontamination based on the same risk-based criteria.



6.5.5 Dos and Don'ts

Dos -

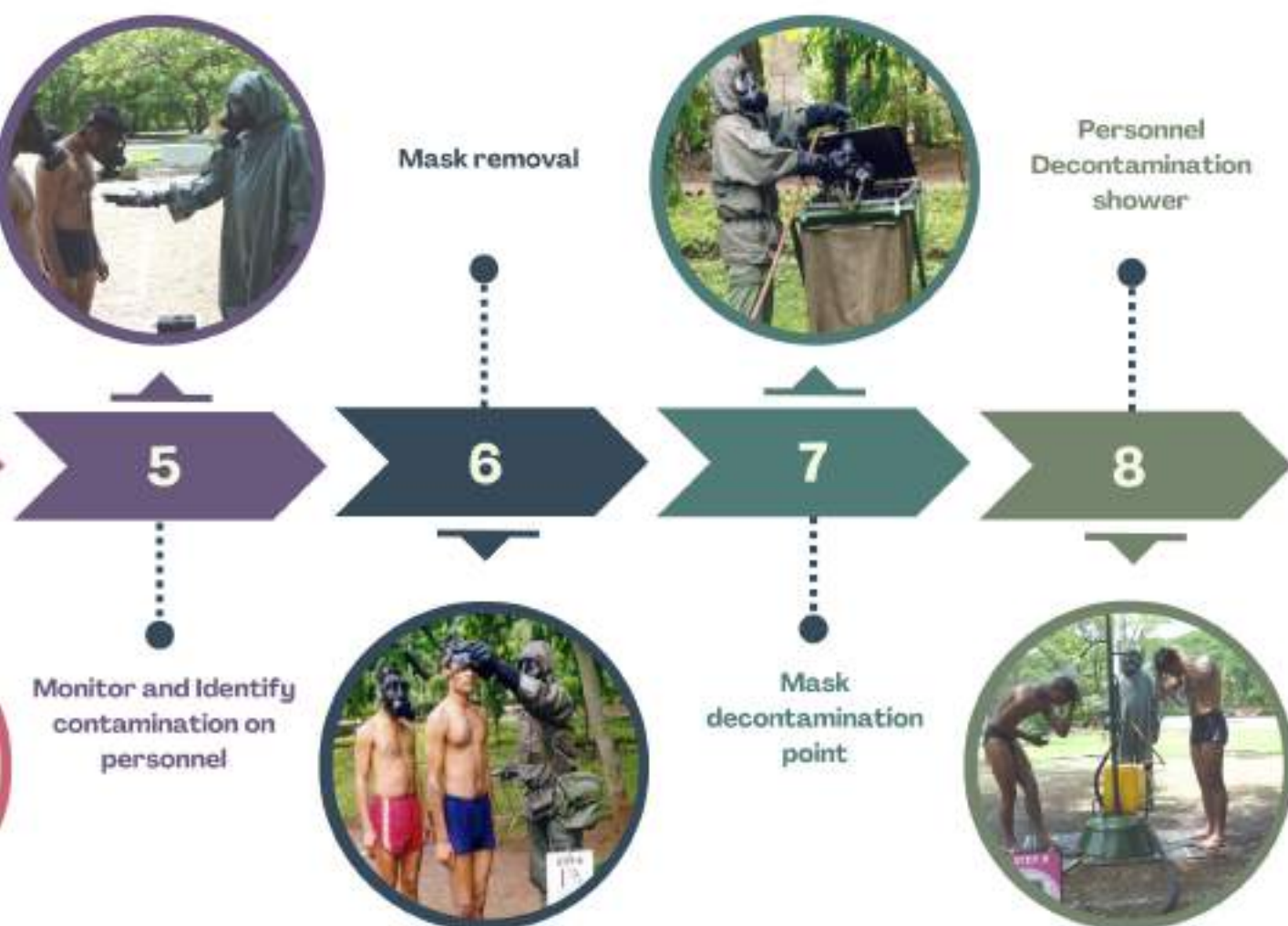
- Cover your entire body.
- Keep a wet cloth on face and take breaths slowly.
- Move in opposite direction of air flow.
- Close all doors, window, fans, coolers etc. and seal doors and windows.
- If there is itching on skin then use Fuller's earth (Multani Mitti) or flour.
- Listen to information given on Radio and television.
- Neither spread rumors nor listen to them.
- Identify the wind direction and create a protected area for personal safety



Fig 17 : Steps of personal decontamination

Don't –

- Don't consume food/water/drinks etc, that has been lying uncovered in the affected area.
- Don't move out of shelters/basements unless instructed by authorities.
- Don't use flour from gunny bags, foods wrapped in paper, water from open pools/lakes.
- Don't kneel, lie or sit on the open ground and don't walk bare foot.
- Don't enter the scene immediately ,evaluate and assess the situation at the scene.
- Don't consume open food and drinks.



6.6 Crisis Communication

Communication about actual risk and appropriate risk-reducing (avoiding) behavior during an incident. In the event of a chemical incident, a prompt and effective method is required to alert and deploy national and local governmental agencies, nonprofit organizations, and responders in order to coordinate the response with the industry where the incident occurred. The cornerstones of crisis communication are speed, openness, transparency, and continuity of communication. The information should be effectively disseminated to public, media and the responders

- Public warnings and directives must be accurate, clear, and repeated over more than one communication channel.
- The contact persons in the community can be used to foster cooperation across local, regional, and national agencies as well as among the responders and hospitals in the area.
- Inter-agency communication protocols and technical resources should be prepared beforehand and immediately activated during an incident to ensure sharing of the incident related information, the characteristics of the chemical, the causalities, the available resources, the expected fatalities etc
- One of the most difficult responsibilities during a chemical release disaster may be communicating adequately with the public, especially those who are affected by the event. Communicate clearly the concerns of the populations about danger signs and address the concerns of residual exposure so as to prevent the surge of people self-reporting to the hospital which will overburden the health facilities and deny attention to the real victims.
- Communicate clearly with the population about the response efforts and the actions taken to ensure better cooperation.
- The information that is communicated must be consistent
- The alerting mechanism must be periodically examined and upgraded.
- The responders may also need specific information on requirements for PPE/ type of PPE before entry to the scene, on decontamination and medical treatment guidelines, and on the outcome of the rapid assessment for each of the possible incident management strategies.

Information needed for Crisis Communication :

- The incident.
- Who is in charge.
- The measures being taken to contain the release and/or stop exposure.
- Who/who is not currently under threat.
- What the public can do to protect themselves.
- What the danger signs/ health effects from exposure might be
- How to get further information or treatment should symptoms arise
- When where and how these services will be made available
- The time at which an information update will be provided
- Important hotlines/ contact number for accessing health services/hospitals, missing persons

THE STARC PRINCIPLE - For effective Crisis communication

S imple	People want to hear words they understand
T imley	People want information as soon as possible
A ccurate	People want information that is to-the-point
R elevant	Responses to the public's questions should be factual
C redible	Openness is the key to credibility

CASE STUDY 1 :

SAN JUANICO DISASTER , MEXICO

On the morning of 19 November 1984 a huge fire and a series of catastrophic explosions occurred at the PEMEX Liquid Petroleum Gas (LPG) Terminal at San Juan Ixhuatepec, Mexico City. The catastrophe caused the deaths of 500 persons; 6400 were injured and the terminal was demolished. Two large spheres and 48 cylindrical vessels were filled to 90% capacity and four smaller spheres to 50% full. The sphere's support legs were not fireproofed. The tank got LPG through three underground pipelines from remote sites. The plant held about 12000 cu m of LPG which could produce energy of close to 5 times of that released at Hiroshima. An 8-inch pipe between a sphere and a series of cylinders ruptured. This caused a drop in pressure. The operators could not identify its cause. The LPG release continues and huge gas cloud of 200x150x2 metre was ignited by a flash fire. It led to a huge boiling liquid expanding vapor explosions (BLEVEs). The effects of which was felt close to 30 km away. It was followed by a chain of explosion in the pipes and storage tanks. A major rescue operation involving 4000 people participated in rescue and medical activities, including 985 medics, 1780 paramedics, and 1332 volunteers. 363 ambulances and five helicopters were involved.

Lessons Learned

- » The terminal's fire water system was disabled in the initial blast. Also the water spray systems were inadequate.
- » Not Formally reviewed Hazard and operability analysis (HAZOP)
- » The design of the plant was flawed leading to crowding of many tanks which increased the effect of the blasts.
- » The site emergency plan was inadequate to allow rapid entry of emergency services to help control the accident.







“Preparedness is not a one-time event, it’s an ongoing process”

PRE-HOSPITAL MANAGEMENT, TRIAGE AND STABILIZATION OF VICTIMS.

By the end of this chapter, you will be able to:

1. Understand the pre-hospital management of chemical victims
2. Learn the first aid steps for common chemical incidents
3. Triage at the event site and at hospital stage
4. Know the steps for initial stabilization of a victim of chemical incident

7.1 Pre Hospital Management of Chemical emergency

All Chemical hazards require decontamination, which comprises rapidly eliminating the unabsorbed contaminant from the victim's body and treating a sizable number of casualties while maintaining the responder's safety. The key to success is swiftness and correctness. Initial care should be administered at the accident site in order to give the injured the treatment necessary to ensure that they are in stable condition before being taken to a main treatment facility, if necessary. The most critical action is to remove the individual from further exposure to the hazardous substance(s). Physiological (clinical) and psychological effects may then be addressed.

- In addition to general first aid measures, it may be necessary to begin other treatment at the accident site.
- In a few cases, specific antidotes may be required. For this reason, special equipment and pharmaceutical supplies should be readily available at the site, as appropriate.
- Treatment of the injured should normally follow standard principles for the management of casualties, recognizing the need to take account of the special conditions following the accident.
- It should be noted that the majority of those exposed to hazardous only supportive therapy until their symptoms abate.

The Key steps in Pre hospital management include:

- Triage – Prioritization of patients based on clinical condition.
- Stabilize and treat patients as per triage.
- Decontaminate the victims so as to prevent the spread of contamination.
- Delay prophylactic measures until the patient is decontaminated.
- Administer antidotes and dosages as per local protocols and guidelines.
- Perform invasive procedures only in uncontaminated or clean areas.
- Transport victims to hospitals on priority as per triage classification.
- Reassess and Re-triage the patient frequently at all the phases of management because many chemicals have latent physiological effects.
- Only move the dead when it is affecting the response.
- Training, both theoretical and practical, with periodic refresher training



Fig 18 : On field medical post

7.1.1 Key points in On Site medical management

The first medical responders to an accident should have sufficient information, training and experience to be able to assess quickly whether they can deal with the situation, or whether additional equipment and/or persons with particular expertise should be summoned.

Mechanisms should be in place for the first medical responders to obtain whatever additional personnel and equipment are needed for responding to the accident.

1. The on-site coordinator should take measures to avoid the contamination of on site medical personals if there is a possibility of continuing exposure.
2. Medical/Paramedical personnel should not enter contaminated areas. They should work at casualty assembly points where accident victims are brought after decontamination. Only exceptionally should medical personnel need to enter the accident area, for example to carry out triage or give life-saving treatment.
3. Arrangements should be made for the provision of first aid and other medical treatment outside the contaminated area.
4. Hospitals and other treatment facilities should put their emergency plans into effect as soon as they are alerted that there is a possibility of patients arriving as a consequence of an accident involving hazardous substances.
5. Hospitals and other treatment facilities that may be involved in responding to an accident should be provided, as soon as possible.
6. Refer the patients who cannot be medically stabilized

SYMPTOMS IN A CHEMICAL INCIDENT

1. Difficulty breathing
2. Irritation of eyes
3. Sudden headaches
4. Tightness in the chest
5. Loss of coordination
6. Nausea , vomiting
7. Running nose
8. Burning sensation in the nose, throat, and/or lungs
9. Excessive salivation



7.2 First Aid for Chemical incident victims

The purpose of basic first aid is to protect life and to prevent or limit the deterioration in an injured person's condition. If accidents involves chemicals, it is essential that the casualty is decontaminated without delay in order to prevent further harm. The simple first aid for dealing with the majority of chemical contaminations can be performed without much experience.

For the majority of chemicals, the first aid treatment is very simple and involves clean water. Some substances which do not mix with water will require soap and water for removal. DO NOT use solvents or diluents for this purpose. DO NOT use any other lotion or medication to treat chemical contacts/injuries. Administer First aid according to the relevant and updated local guideline.

A First aid for chemical emergencies kit (FACE-kit) should be made available to all the hazardous sites/offices and small health establishments in the vicinity.

- The person should be stabilized physiologically
- Elimination of 90% of contamination is achieved by removal of clothing alone. Over-aggressive and over - zealous treatment should be avoided in order to prevent injury to the skin resulting in enhanced absorption.
- Measures like removal of contaminated clothing shower bath, administration of first aid for internal contamination should be done at the site before sending patient to site hospital.
- Measures to reduce absorption

Refer Annexure 2 for the ILO WHO Safety cards which contain the information for the basic first aid for common chemicals



Fig 19 : First aid in chemical emergencies

Refer Annexure 3 for General first aid measures in chemical emergencies 74

7.3 Triage

Triage should be modified according to the resources available at the local healthcare facility and the severity of the occurrence. It is a dynamic procedure, that frequently requires repeated assessments and categorisation. Initial aim of the approach is to ensure cessation of further exposure, victim stabilization, removal of the victim from immediate danger and containment of hazard.

- Immediate life threatening emergency interventions are provided in the **WARM** zone.
- All patients in **WARM** Zone are undressed, decontaminated, put on hospital clean clothes and transferred to **COLD** Zone .

Triage is again done in **COLD** Zone before designating their triage category

Triage designation of victims of chemical exposure are :

- IMMEDIATE** – Immediate casualties are those who are not likely to survive without instant decontamination, initial medical stabilization, and immediate antidote administration with available resources. Examples include -
 - Victims exposed to cyanide or nerve agents.
 - Impending airway compromise or respiratory distress
 - Casualties with suspicious liquid on the skin
- DELAYED** – Delayed casualties can wait up to several hours for medical care ,they need rapid local decontamination and prompt field decontamination. Typically, these victims cannot walk without assistance but they can obey commands, are not in respiratory distress, have peripheral pulses and have no major haemorrhage but they have injuries that are more than minor. Examples include -
 - Skin Irritation
 - Mild Respiratory irritation
 - External haemorrhages and injuries
- MINIMAL** – Victims who meet all criteria for delayed care and have only minor injuries are considered minimal once appropriately decontaminated. These patients are typically able to walk and talk.
- EXPECTANT/DEAD** – Expectant patients are those who are not likely to survive given available resources. They include patients who have experienced a respiratory or cardiac arrest, have continued seizures despite antidote therapy etc. These warrant withholding of medical resources if minimal resources are available and there are huge numbers of casualties requiring care and transport.

Few points to keep in mind include:

- When a culprit chemical agent has a long latent period, then victims for evacuation may be different than for medical treatment.
- Respiratory symptoms occurring less than four hours after exposure to a peripherally acting pulmonary agent or to a vesicant imply a high dose and a guarded prognosis. Although these patients would typically be triaged as delayed, the onset of symptoms so soon after exposure indicates a high dose capable of causing death.



Fig 20 : Triage tags



Fig 21 : Triage bands



7.4 Stabilization of the victim

Medical assessment and life-saving treatment after a chemical exposure frequently must occur during or prior to field or hospital decontamination to ensure patient survival. During this phase of care, key actions include the following:

A

AIRWAY

Maintain an open airway and, if the patient has traumatic injuries, perform cervical spine stabilization.

B

BREATHING

Give oxygen for respiratory distress and, if needed, support breathing with bag-mask ventilation followed by endotracheal intubation.

C

CIRCULATION

Establish intravenous access, obtain initial laboratory studies, and give intravenous antidotes

I

IMMEDIATE DECONTAMINATION

Stop exposure to the chemical agent; actions include application of a gas mask in the field if assisted breathing is not needed, local or spot decontamination of any suspicious liquid on the skin or in wounds, and removing the patient from the source of exposure.

D

DRUGS

Administer antidotes, including autoinjector administration of antidotes in the field prior to establishment of intravenous access; for chemical warfare agents, specific antidotes are only available against cyanide compounds, nerve agents.

E

EXPOSURE

Remove clothing and perform definitive decontamination while avoiding hypothermia, especially in infants, children, and older adults. These steps need not occur in strictly chronological order but should be accomplished nearly simultaneously if possible. Even in the absence of specific antidotes in the field, general stabilization measures as described may, in many cases, permit casualty survival until definitive treatment can begin.

D

DECONTAMINATION

Proper decontamination consists of local or spot decontamination of any liquids on the skin, removal of clothing, and copious irrigation of the skin with lukewarm water and, if available, mild soap. Although mass decontamination may be accomplished in the field, decontamination should also occur at receiving hospitals.

PATIENT ASSESSMENTS

Evaluate the patient through a comprehensive process that includes scene evaluation, identifying the chief complaint and medical history, and conducting a thorough secondary assessment.

Need of Patient assessment and management include:

- Achievement of an improvement in patients' acute health outcomes by reducing short-term morbidity and mortality.
- Achievement of an improvement in patients' long-term health outcomes by preventing delayed morbidity.
- Providing appropriate, timely care to patients requiring supportive/definitive medical care.
- Bypass medical evaluation for minimally exposed victims thereby preserving medical resources for those with the most urgent needs.
- Referral of patients needing immediate assistance.

Primary Assessment :Due to limited resources, paramedics must depend on their skills to accurately

- Gather patient history,
- Perform detailed physical examinations
- Utilize diagnostic tools.
- Ensuring scene safety,
- Assessing the mechanism of injury or illness

Secondary assessments for chemical conditions and regular reassessment.

- Look for the agent's type
- Toxicity
- Physical state
- Body exposure sites
- Severity of effects.

The specific treatment and management should follow the national or locally approved guidelines. The decision trees for the management of the specific conditions and specific routes of exposures are attached in the annexure.

7.4 Protection of Providers - PPE Kits

Providers responding to release of an unknown chemical should wear personal protective equipment (PPE) intended to protect against the maximum possible personal hazard. The effective use of PPE is dependent on availability, training and an understanding of the mechanisms of secondary exposure. Unfortunately, no one type of PPE will protect against all hazardous agents.

The appropriate personal protective equipment for a chemical emergency event is based on provider type, by the characteristics and amount of the hazardous agent present and site of care as follows:

- **First responders** – First responders who enter the site of an unknown chemical release (the “hot zone”) in order to extract casualties and provide field decontamination adjacent to the site of release. They should wear the Level A PPE which provide the highest degree of protection.
- **First receivers (hospital decontamination zone)** – For receivers performing care in the hospital decontamination zone can wear the level A, B, C PPE with respect to the type of chemical that has been identified and the type of safety needed.
- **ED receivers (hospital post-decontamination zone)** –is an area where you would not expect personnel or equipment to be contaminated. Hence, receivers carrying out care in this zone is expected to wear normal work clothes and PPE (level D) as desired for infection control like gowns, gloves, and/or surgical mask.

Personal protective equipment, or PPE, is designed to provide protection from serious injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other hazards. Careful selection and use of adequate PPE should protect individuals involved in chemical emergencies from hazards affecting the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing. No single combination of protective equipment and clothing can protect against all hazards. Thus, PPE should be used in conjunction with other protective methods, including exposure control procedures and equipment. PPE includes overalls, aprons, footwear, gloves, chemical resistant glasses, face shields and respirators. For first receivers and hospitals, PPE selection is based on the institution's chemical emergency procedures.



LEVELS OF PERSONAL PROTECTIVE EQUIPMENT



LEVEL A

Level A protection should be worn when the highest level of respiratory, skin, eye and mucous membrane protection is needed.

A typical level A ensemble includes:

- Fully encapsulating chemical protective suit.
- Gloves, inner and outer, chemical resistant and boots,
- Chemical resistant, steel toe and shank; (depending on suit)
- Boot construction, worn over or under suit boot.)
- Self contained breathing apparatus SCBA



LEVEL B

Selected when the highest level of respiratory protection is needed, but a lesser level of skin and eye protection is needed. Minimum level recommended on initial site entries until the hazards have been identified and defined.

A typical level B ensemble includes:

- Chemical resistant clothing (coveralls and long-sleeved jacket, coveralls, hooded two-piece chemical splash suit, Disposable chemical resistant coveralls.)
- Gloves, outer and inner, and boots, outer, steel toe
- SCBA / SAR - supplied air respiratory



LEVEL C

Level C protection should be selected when the type of airborne substance is known, concentration measured, criteria for using air – purifying respirators met, and skin and eye exposure is unlikely.

- Full-face or half-mask,
- Air-purifying respirator
- Chemical resistant clothing (one piece coverall, hooded two piece chemical splash suit, chemical resistant hood and apron, disposable chemical resistant coveralls.)
- Gloves, outer and inner
- Boots, steel toe and shank chemical resistant.
- Full face or half mask Air purifying respirator (APR) or Powered air purifying respirator (PAPR)



LEVEL D

Level D protection is primarily a work uniform and is used for nuisance contamination only. It should not be worn on any site where respiratory or skin hazards exist.

Level D assemble requires :

- Coveralls
- Safety shoes/boots.
- Other PPE is based upon the situation (types of gloves, etc.).

CASE STUDY 2 :

EXPLOSION OF CHEMICAL FACTORY – TOULOUSE, FRANCE

On 21 September 2001, a huge explosion ripped through AZF (Azote de France), a fertilizer factory located in the outskirts of the city of Toulouse, France killing Thirty-one people and injuring approximately 2500. Three hundred tons of ammonium nitrate was stored (the maximum capacity was 2,000 tons) in hangar #221. The plant held substantial amounts of ammonia and chlorine and was located in close proximity to facilities used for the storage of gunpowder and phosgene. The entire facility was obliterated, leaving behind a 40-meter-diameter crater with a depth of roughly 7 meters. The explosion had a Richter scale value of 3.4. The explosion severed telephone lines, and traffic immediately choked the highways, making this kind of evacuation very challenging. Particularly the health care services was faced with lack of information leading to inability to follow the general emergency plan. The warehouses containing ammonium nitrate had not been inspected for some time. Also the residential areas were located very close to the factories.

- o Prevention of chemical incidents necessitates a proper assessment of the health and environmental risks associated with the chemical (synthesis, storage, transport and utilization) of interest which was overlooked.
- o Absence of alternative communication systems when the phone lines were destroyed.
- o The preparedness plan should include public communication. A lack of information can lead to a population response that may interfere with the emergency response.
- o Lack of proper emergency response plans were absent for the first responders and the medical teams



Explosion at the AZF Factory in Toulouse, France, 2001



8

“Advocacy is about creating a sense of urgency and inspiring people to take action”

REFERRAL MECHANISM

By the end of this chapter, you will be able to understand:

1. Understand how to report a chemical incident
2. Learning how to transport chemical victims
3. How to designate hospitals for emergencies
4. How to maintain a registry and repository of chemical victims and responders

8.1 Reporting of the incident

The “METHANE” reporting format is a specific mnemonic used in emergency services, to report major incidents or emergencies, including chemical incidents.

M	MAJOR INCIDENT	Has a major incident or standby been declared? (Yes / No - if no, then complete ETHANE message)
E	EXACT LOCATION	What is the exact location or geographical area of the incident?
T	TYPE OF INCIDENT	What kind of incident is it?
H	HAZARDS	What hazard or potential hazards can be identified?
A	ACCESS	What are the best routes for access and egress?
N	NUMBER OF CASUALTIES	How many casualties are there, and what condition are they in ?
E	EMERGENCY SERVICE	Which and how many, emergency responder assets / personnel are required or are already on - scene ?

8.2 Transport of chemical emergency victims

The following steps have to be followed for the transportation of the victims of chemical emergency :

- Identify the type and severity of the hazardous material present at the scene.
- No victim should be transported without gross decontamination.
- When transporting a contaminated patient - by ambulance, special care must be exercised to prevent contamination of the vehicle and subsequent patients.
- Determine the level of PPE required for ambulance crews based on the hazardous material classification.
- Separate the driver compartment from the patient compartment (close door or use place plastic films)
- Use plastic to cover all equipment and cabinets in patient compartment and tape the seams
- Evaluate the distance from the scene to the nearest hospital or medical facility.
- Determine the availability of specialized ambulances equipped with advanced medical equipment and specialized PPE in the area.
- Evaluate the patient's medical history and current condition to determine the appropriate ambulance.
- Consider traffic conditions and their potential impact on ambulance transport times.
- Alert the receiving hospital on the status of the victim, what has been done to decontaminate the victim, what they were exposed to and any treatment that was given.
- Provide the hospital with as much information on the chemical as possible. i.e Safety data sheets.
- Park the ambulance away from ED.
- Do not bring the patient to the emergency department before receiving permission from the hospital staff.
- Safe decontamination of Ambulance after unloading the patient.

8.3 Hospital Designation

Designating hospitals for responding to chemical emergencies is an important step in emergency preparedness planning. Here are some key considerations for making hospital designations for responding to chemical emergencies:

1. **Capacity:** Hospitals designated for responding to chemical emergencies should have the capacity to handle a significant influx of patients with chemical exposure or contamination. This includes having adequate staff, equipment, and supplies to provide appropriate medical care.
2. **Expertise:** Hospitals designated for responding to chemical emergencies should have expertise in the management of chemical exposures and related medical conditions. This includes having trained staff with knowledge of chemical agents, their effects on the body, and appropriate treatment protocols.
3. **Isolation:** Hospitals designated for responding to chemical emergencies should have the ability to isolate patients with chemical exposure or contamination to prevent the spread of contamination to other patients and staff.
4. **Decontamination:** Hospitals designated for responding to chemical emergencies should have the ability to decontaminate patients, equipment, and supplies as necessary to prevent further exposure.
5. **Coordination:** Hospitals designated for responding to chemical emergencies should have a well-established communication and coordination plan with local emergency response agencies, such as fire departments and hazardous materials teams.
6. **Location:** Hospitals designated for responding to chemical emergencies should be strategically located to ensure timely access for patients and emergency response agencies.
7. **Accessibility:** Hospitals designated for responding to chemical emergencies should be accessible to patients with disabilities and have plans in place to accommodate their needs.

Based on the above considerations, the following steps can be taken to make hospital designations for responding to chemical emergencies:

1. Identify hospitals in the region with the capacity, expertise, and resources to respond to chemical emergencies.
2. Evaluate the hospitals' ability to isolate and decontaminate patients, and their communication and coordination plans with emergency response agencies.
3. Consider the hospitals' location and accessibility for patients and emergency response agencies.
4. Consult with local emergency response agencies and medical professionals to finalize the hospital designations.
5. Develop a communication plan to inform the public and emergency response agencies of the designated hospitals.



Fig 22. Bhagjan Gas And Oil Leak, 2020



8.4 Registration and Repository of victims and responders

8.4.1 Registration

Following an incident, it will be necessary to obtain information from the affected population regarding their involvement in the incident including exposures and any health effects that may have resulted from the exposures.

The objective of the register is to:

- Identify all those exposed, potentially exposed or otherwise affected individuals, as they are at risk of potential acute or chronic health effects. It will be vital to gather information from the impacted people after a chemical incident about the details, including exposures and any potential health repercussions from those exposures.
- Identify those who were unintentionally exposed and find out the best course of action with respect to treatment. Victims are defined as “exposed” to a chemical when they have inhaled, ingested, injected or come into surface contact with the chemical. The exposed involve the victims, volunteers, first responders etc.
- Identify those potentially exposed by a chemical incident include victims, emergency responders, onlookers, volunteers, employees from the site and nearby facilities, individuals passing by the area during the incident, including public transport passengers, visitors/ tourists to nearby events or attractions.
- Register the effect on the people with respect to acute exposure to chemicals, physical injuries. All these factors together determine the likely health outcomes for the victims and their nature and severity.
- Register those who might be impacted as quickly as possible; verification and exposure level may need to be ascertained later.

Rapid registration is critical for several reasons:

- Individuals' memories of their symptoms and locations can become muddled, due to memory deterioration and the influence of media coverage on the incident.
- The documentation of emergency response participants, including records from fire, police, and ambulance services, may not be comprehensive.
- Volunteers, who often rush to help during specific chemical emergencies, might face greater exposure than the broader population and can leave for remote areas afterward without any official record of their involvement.
- The tourists/visitors might leave the area and return to their home destinations and may not be traced.

REGISTER SHOULD CONTAIN:

- Demographic details of the person (e.g. name, age, sex, address)
- Medical history of the person
- How was the patient exposed – ingestion, injection, contact or inhalation.
- At what time the incident took place
- Duration of exposure
- Symptoms
- Samples collected
- Treatment received

8.4.2 Repository

A repository containing all the affected individuals both victims and responders should be maintained. The exposed persons should be assessed for long term impacts like functional, physical, morbidity and mortality outcomes that are related to either the exposure to the chemical.

The psychological, behavioral and mental status and stress associated with the chemical incident should also be maintained.

- All this information can then be used to provide follow-up advice on protection, individual treatment and population interventions.
- The primary goal of such a study is to identify potential chronic conditions related to the incident and offer treatment if necessary.
- Documentation of the effects of the particular chemical and its potential to cause intermediate and chronic health effects following an acute exposure
- Contribute to the database of public health and toxicological information.



Fig 23. District Disaster Management Authority personnel during a mock drill at Verka Milk Plant in Ludhiana.





Chemical Factory Blast, Ahmedabad, 2020

9

"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change."

HOSPITAL MANAGEMENT: IMMEDIATE

By the end of this chapter, you will be able to understand:

1. Understand the components of the Hospital Disaster Management Plan
2. Understand the components of Hospital Preparedness and Response plans for external disasters

9.1 Disaster Management Plan

INTRODUCTION

During a disaster involving chemical exposures, hospitals will be called upon to care for victims. Emergency department (ED) and hospital staff need sufficient training to provide safe and effective care. Several past chemical incidents have highlighted the need for hospital preparedness.

PLANNING AND RESPONSE RESOURCES

Electronic resources can be used in the clinical environment to help identify a chemical substance and guide the decontamination and initial treatments. Poison Control Centers also serve as valuable resources in providing guidance and elicit the expertise of a medical toxicologist to help identify chemical classes, recognize toxidromes, and assist with triage needs. Hospitals must also work with local and state emergency management and public health officials to coordinate preparedness and response efforts. Pre-planning for a large-scale response should involve emergency medical service and fire department first-responders as well. Chemical risks present in the local community, such as industrial sites or transportation routes, should be assessed in the hospital's hazard vulnerability analysis (HVA). The HVA can help to identify local risks before an incident occurs, but cannot assess for every possible emergency situation. Thus, it is important for hospitals to develop chemical-disaster response guidelines as a part of the hospital's emergency operations plan (EOP) and ensure adequate training of staff members.

TRAINING

Health care workers should be trained to effectively evaluate and treat chemically-exposed patients. Many hospitals maintain a decontamination team or utilize an agreement with a local hazardous materials (HAZMAT) response team to provide decontamination of chemically-contaminated patients.

The medical care module for the public health management of chemical emergencies can be used as the training material for the healthcare providers at the hospital

EVALUATION

When initially evaluating a chemically-contaminated patient, it is vitally important that the health care worker remains safe and does not contaminate him/herself. Although the type of chemical substance is often known at industrial facilities, or can be identified by labeling placards in transportation incidents, in many circumstances the substance released may be unknown.

The following steps are recommended to evaluate victims of chemical exposures:

1. Identify a Chemical Release
2. Identify Substance or try to identify using signs and symptoms
3. Toxidrome recognition

DECONTAMINATION

Current decontamination procedure recommendations involve the following steps:

1. Disrobe: Patients should be instructed to remove all potentially contaminated clothing.
2. Dry Decontamination: Once clothing is removed, dry decontamination can be performed as an initial emergency decontamination method with any available absorbent material.
3. Wet Decontamination: Involves using water and soap to remove caustic or harmful chemicals.

TREATMENT

An initial assessment of airway, breathing, and circulation is paramount in managing patients with chemical exposures. In a mass casualty incident, this initial "primary survey" assessment typically occurs rapidly along with the performance of triage. After stabilizing the patient, go for specific treatment protocols.

9.2 Disaster Management Plan dealing with External Disaster

Hospital preparedness and response plans are critical to ensure that healthcare facilities can continue to function effectively during and after a disaster especially chemical event. The following outlines some key elements of a hospital preparedness and response plan for a disaster happening in the vicinity:

- o **Emergency Management Team:** A hospital emergency management team should be established, and their roles and responsibilities should be clearly defined. This team should include key staff members from different departments, such as clinical, administrative, and support staff.
- o **Risk Assessment:** Conducting a risk assessment of the hospital and surrounding community is crucial to identify potential hazards that could affect the hospital during a disaster. This will help in preparing for specific types of disasters and their potential impacts.
- o **Evacuation Plans:** Evacuation plans should be in place for the hospital and should be reviewed regularly with staff. This includes the identification of evacuation routes, designated assembly points, and transportation to other facilities if needed.
- o **Communication Systems:** A communication system should be established that enables communication between the hospital and emergency management agencies, staff, patients, and the public. This can include phone trees, text alerts, and two-way radios.
- o **Surge Capacity Planning:** Hospitals must be prepared to handle a sudden influx of patients during a disaster. Surge capacity planning should be in place to ensure that additional staffing, equipment, and supplies can be quickly mobilized.
- o **Training and Education:** Staff should be trained and educated on emergency preparedness and response procedures, and regular drills should be conducted to test their readiness.
- o **Resource Management:** Hospitals must have a plan to manage resources such as medical supplies, equipment, and staff to ensure that they are utilized effectively and efficiently during a disaster.
- o **Continuity of Operations:** Hospitals must ensure continuity of operations during and after a disaster, such as ensuring that critical information technology infrastructure is protected and backups are available.
- o **Post-Disaster Recovery:** Hospitals should have a post-disaster recovery plan to ensure that normal operations can be resumed as quickly as possible. This includes restoring services, repairing damages, and supporting staff and patients who have been affected by the disaster.

In conclusion, hospitals must have a preparedness and response plan in place to ensure that they can continue to provide essential medical care during and after a disaster. By following the steps outlined above, hospitals can be better equipped to manage the situation, protect their staff and patients, and recover from the disaster as quickly as possible.





Fig 24.A blast victim being taken to the hospital



Fig 25 Ambulance Services transporting victims

CASE STUDY 3 :

THE GAIL GAS PIPELINE EXPLOSION: ANDHRA PRADESH

On June 27, 2014, at Nagaram, East Godavari district, Andhra Pradesh, India, when a massive fire erupted following a blast in Gas Authority of India Limited (GAIL) 18" size underground gas Pipeline. The tragedy occurred near the Tatipaka refinery of Oil and Natural Gas Corporation (ONGC), situated approximately 180 km from the state capital, Vijayawada.

The accident resulted in a grim toll, with 23 reported fatalities and about 40 individuals sustaining injuries. The injured were promptly transported to hospitals in Amalapuram and Kakinada.

The Petroleum and Natural Gas Regulatory Board's (PNGRB) investigation revealed that GAIL, the pipeline operator, failed to comply with various provisions related to design, maintenance, operation, inspection, integrity management, and gas quality standards. Notably, GAIL admitted to several lapses, such as the absence of a gas dehydration unit and the transportation of wet gas through a pipeline designed for dry gas.

Lessons learned

- Strict adherence to safety standards, proper design considerations, and continuous monitoring in the operation of critical infrastructure like gas pipelines.
- The urgency of strengthening regulatory oversight and implementing proactive measures to safeguard communities and the environment from industrial hazards.
- Lessons about the importance of prioritizing safety measures and following SOPs in handling chemicals





10

"An ounce of prevention is worth a pound of cure."

POISONS INFORMATION CENTER

By the end of this chapter, you will be able to understand:

1. Understand what is the roles of Poisons Information Centre
2. Know when and how to call a Poisons Information centre in case of a chemical incident
3. Learn how to communicate with the Poisons Information Centre (which questions to ask)

10.1 Introduction to Poisons Information Centre

India has one of the worst rates of poisoning in the world, and hazardous exposure claims the lives of more than 50,000 people annually.

A poison centre or a poison control centre is a specialized unit that advises on and assists in the prevention, diagnosis and management of poisoning. Its primary role is clinical: advising on and, in some cases, providing treatment for poisoning cases. The structure and function of poison centres varies around the world; however, at a minimum, a poison centre is an information service. Poison centres may also include a clinical treatment unit and/or a laboratory that can provide toxicological analyses.

IPCS INTOX program by WHO in 1988, is a global endeavor to promote chemical safety by the introduction and support of poisons information center. The program aimed to harmonize the collection of poisoning data, training and sharing of information related to poisoning within member countries.



Fig 26 : Poisons Information Center

11.2 Roles of PIC during Chemical Emergencies

Its main functions are provision of toxicological information and advice, management of poisoning cases, provision of laboratory analytical services, toxicovigilance activities, research, and education and training in the prevention and treatment of poisoning. PICs play important roles in chemical safety and public health, which include: characterizing the epidemiology of poisoning to prioritize preventive efforts; advising on the management of the health impacts of chemical incidents; surveillance of chemical exposures; and acting as sentinels to detect chemical release etc. Through these roles poisons centres contribute to national capacities for implementation of the International Health Regulations (2005). It may work as nodal point for connecting between first hand informants and rapid response team, hospitals and authorities responsible for handling the chemical emergencies. It may drastically reduce the response time of rapid response teams to get engaged in handling the chemical emergencies by conveying authentic information on any incidence of reporting of first case in such emergencies.

The various roles of PIC during chemical emergencies could be summarised as follows;

1. Provision of creditable Information and Advice

The PIC provides information and advice on management of poisoning 24 hours a day, 7 days a week. On receiving an enquiry on telephone/fax or in person, details about the patient and poisoning are noted on the present proforma and immediately Poisindex Database is consulted for all the relevant details by a trained poisons information specialist. The advice to the inquirer is given by a follow-up call.

This advice is provided to the hospitals and private practitioners. In case the caller is from a community, general advice on first-aid management is given or if the incident does not warrant any treatment, reassurance is given with follow-up. Similarly, inquiries from various government agencies and parliament regarding the acute or long-term effects of chemicals on population are answered accordingly. If needed, poisons centres abroad or IPCS/WHO are consulted on such issues. The individual enquiries in the form(s) of letter from public/professionals about dyes, colours, food adulterants and additives etc. are also answered accordingly.

2. Patient Management

The clinical treatment unit of a poison control center is involved in the management of patients with poisoning. The centre provides information and advice about the first-aid measures and transport of the patient to the hospital. The trained poisons information specialist inquiries about all the necessary demographic and clinical questions to understand fully, the consequences of an exposure and follows-up the poisoning cases. The NPIC also informs about the availability of antidotes. It provides information on dosing schedule, indications, contraindications and monitoring of side effects of antidotes.

3. Laboratory Services

The laboratory service of a poisons control programme provides the identification and characterization of the toxic substances in both biological and non-biological samples, to assist in the diagnosis and treatment of the patients. Two levels of laboratory service may be envisaged, the first based mainly on simple qualitative tests, and the second, more advanced providing confirmation. Such an advanced laboratory can act as a reference laboratory. The service is also needed for monitoring populations exposed to occupational hazards.

4. Teaching and Training and Research

The experience gained in a poison information centre can be an important source of human and animal toxicological data. Centres thus have educational responsibilities that extend to the training of medical practitioners and other professional health workers likely to encounter cases of poisoning, and to communication with the local population and the mass media. Alongwith this the PIC may conduct research on specific chemicals, their probable adverse effects with possible management in case of disaster.

5. Toxicovigilance

Toxicovigilance is an essential function of poison information centres. It is the active process of identifying and evaluating the toxic risks existing in a community, and evaluating the measures taken to reduce or eliminate them. Analysis of inquiries helps in developing national database by identification of circumstances, possible toxic agents and populations involved. The centre plays a vital role in alerting the health and other authorities so that necessary preventive and regulatory steps are taken.

6. Prevention

The Poisons Information Centre plays an important role in the prevention of poisoning through toxicovigilance by identifying high-risk circumstances of poisoning in community and through calling alerts to potential emergency situations. In addition, it has the responsibility to inform the general public about the risks with respect to use, transport, storage and disposal of chemicals, advise about the safe use of pesticides and other chemicals at home and at work place through brochures, leaflets, posters, educational programmes and media.

7. Environmental Toxicology

The toxic effects of chemicals in the environment on human health has become a cause of growing concern. The public is uncertain whether pollution (air, water, soil) is responsible for chronic poisoning in the exposed population and if it has cumulative long-term sequelae. Poison information centres could play an important role in quantifying the relationship between exposure to toxic chemicals and observed clinical features of poisoning, including long-term sequelae.

8. Contingency planning for chemical incidents and disasters

Poison information centres can contribute to the handling of major chemical incidents and disasters by providing appropriate information in the event of an emergency and by taking an active part in contingency planning and in education and training. They should also take part in epidemiological follow-up studies and other research initiatives, where appropriate, collaborating and acting in concert with other bodies involved in accident prevention



10.3 What to ask when you call a poison center?

Sample set of questions to be asked for effectively communicating with a PIC

1. What is the name of the chemical or product involved in the event according to the smell or visual colour and location of the event?
2. What are the potential health effects or symptoms associated with exposure to the chemical?
3. What is the proper way to handle and dispose of the chemical or product?
4. What are the first aid measures that should be taken if someone has been exposed to the chemical?
5. What are the long-term health effects that may result from exposure to the chemical?
6. What are the recommended medical treatments for someone who has been exposed to the chemical?
7. Is there any additional information or resources available regarding the chemical or product involved in the event?
8. Whom to contact next for further course of actions?

10.3.1 Scenarios

Case study highlighting the Role of PICs in case of Chemical Emergencies:

Example:

A large industrial plant that produced a variety of chemicals experienced an explosion in one of its units. The explosion caused a massive fire that resulted in the release of toxic chemicals into the environment. The local emergency response team was immediately called to the scene. The team was composed of firefighters, police officers, and medical personnel.

As soon as the emergency response team arrived on the scene, they contacted the local Poison Information Center to obtain information about the chemicals involved in the explosion. The PIC was able to provide detailed information about the chemicals that were released into the environment. The information included the toxicity of the chemicals, the route of exposure, the symptoms of exposure, and the appropriate treatment options.

The information provided by the PIC was critical in helping the emergency response team to manage the situation effectively. The information helped the team to:

- o **Establish an evacuation zone:** Based on the information provided by the PIC, the emergency response team was able to establish a safe zone around the explosion site. The safe zone was designed to keep the public away from the toxic chemicals and prevent further exposure.
- o **Provide medical treatment:** The information provided by the PIC was also critical in helping medical personnel to provide appropriate treatment to those who were exposed to the chemicals. The symptoms of exposure were identified early, and appropriate treatment was administered.
- o **Protect emergency responders:** The information provided by the PIC was also critical in protecting emergency responders. The responders were equipped with the appropriate personal protective equipment (PPE) based on the toxicity of the chemicals involved.

In conclusion, the case study highlights the critical role of Poison Information Centers in chemical emergencies. The information provided by PICs is crucial in managing chemical emergencies effectively. The prompt and accurate information provided by PICs can help emergency responders to protect the public, provide appropriate medical treatment, and protect themselves from exposure to toxic chemicals.

10.3.2 Conclusion

- o To reduce the chemical induced morbidity and mortality PIC may play a very important role right from early detection, convey and dissemination of information, coordination, management and rehabilitation.
- o In association with other responsible bodies, it also plays an important role in developing contingency plans for, and responding to chemical emergencies.
- o We have to further strengthen the resources and references used in quick response and need to equip and upgrade the existing Poison Information Centre as Poison Control Centre with antidote banks.

CASE STUDY 4: NEISHAPUR TRAIN DISASTER, IRAN

18 February 2004, 51 train cars containing various flammable chemicals and materials including fertilizers, Sulphur, Petrol and cotton wool separated from the main train and rolled back for close to 20 km and derailed at the station near Khayyam.

The first responders and local rescue services were able to put out the fire for some time. A chemical leak occurred during the cleaning up and fire extinguishing process followed by a large explosion which killed 295 people injuring 460 people including the rescue workers and high ranking state officials and destroying the town of Khayyam and neighboring towns. The explosion was caused by the pooling and mixing of incompatible chemicals that had leaked following the derailment and were exposed to heat from the subsequent fire.

Lesson learned

- o Although none of the materials in the wagons had been designated as “dangerous” by the Iranian railway authority prior to the incident, they were all extremely flammable or explosive.
- o The trains carrying explosives should be adequately marked or labelled
- o The people should be made aware of crowding in rescue areas especially when chemical or other hazardous cargo is involved.





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"Medical management is not just about treating illness or injury, it's about restoring health and well-being."

OVERVIEW OF MEDICAL MANAGEMENT MODULE

By the end of this chapter, you will be able to understand:

1. Overview of medical management module



Fig 27 : Temporary wards for maintaing chemical emergencies



Fig 28 : Victim transportation during chemical emergencies

11. Overview of medical management of chemical emergencies

The medical management of victims of chemical emergencies is critical in preventing further harm to the affected individuals and mitigating the overall impact of the incident. The first step in the medical management of victims of chemical emergencies is to identify the type of exposure. This includes determining the type and quantity of the hazardous substance, the duration of exposure, and the route of exposure. This information will help healthcare professionals determine the appropriate medical treatment. The medical treatment of victims of chemical emergencies varies depending on the type of exposure. There are three main routes of exposure: inhalation, ingestion, and skin contact. Inhalation exposure occurs when a person breathes in a hazardous substance, ingestion exposure occurs when a person swallows a hazardous substance, and skin contact exposure occurs when a person's skin comes into contact with a hazardous substance.

INHALATION EXPOSURE

Inhalation exposure to hazardous substances can cause respiratory distress, including coughing, wheezing, and shortness of breath. The medical management of inhalation exposure involves the administration of oxygen, bronchodilators, and other medications, as needed. Patients may require intubation and mechanical ventilation in severe cases.

INGESTION EXPOSURE

Ingestion exposure to hazardous substances can cause gastrointestinal distress, including nausea, vomiting, and abdominal pain. The medical management of ingestion exposure involves the administration of activated charcoal, which can help absorb the hazardous substance and prevent further absorption. Patients may also require intravenous fluids and other supportive care.

SKIN CONTACT EXPOSURE

Skin contact exposure to hazardous substances can cause chemical burns, irritation, and other dermatological problems.

The medical management of skin contact exposure involves the removal of contaminated clothing and decontamination of the skin.

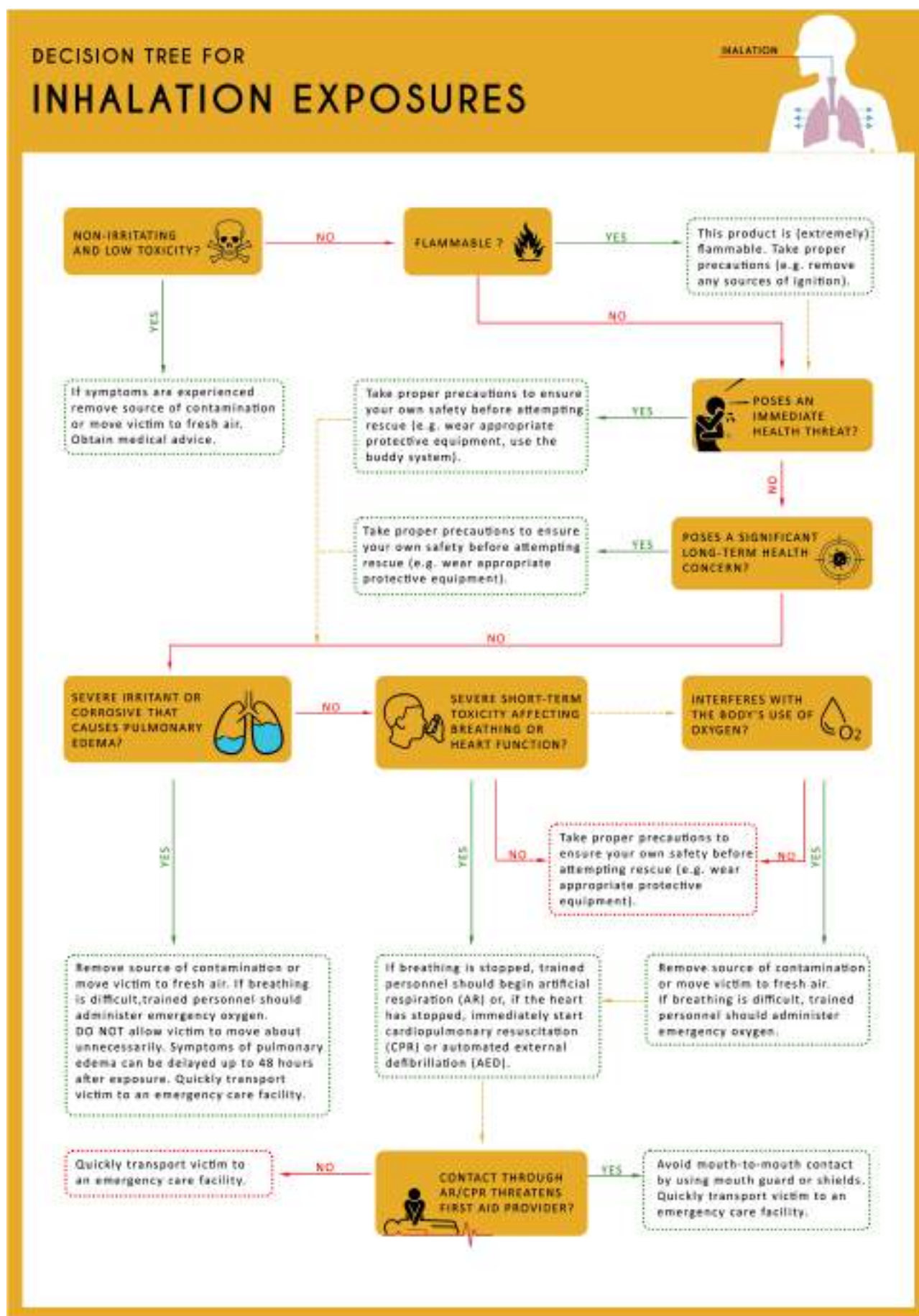
Patients may require topical treatments, including ointments, creams, and dressings, as well as pain management and other supportive care.

In addition to the specific medical treatments for each type of exposure, victims of chemical emergencies may require psychological support. The traumatic nature of chemical emergencies can cause significant psychological distress for those affected. Healthcare professionals may provide counseling and other support services to help victims cope with the emotional impact of the incident.

Medical management of victims of chemical emergencies also involves the monitoring of long-term health effects. Some hazardous substances can cause long-term health effects, including cancer, respiratory problems, and neurological disorders. Healthcare professionals may provide follow-up care and monitoring to ensure that victims receive appropriate medical care and support.

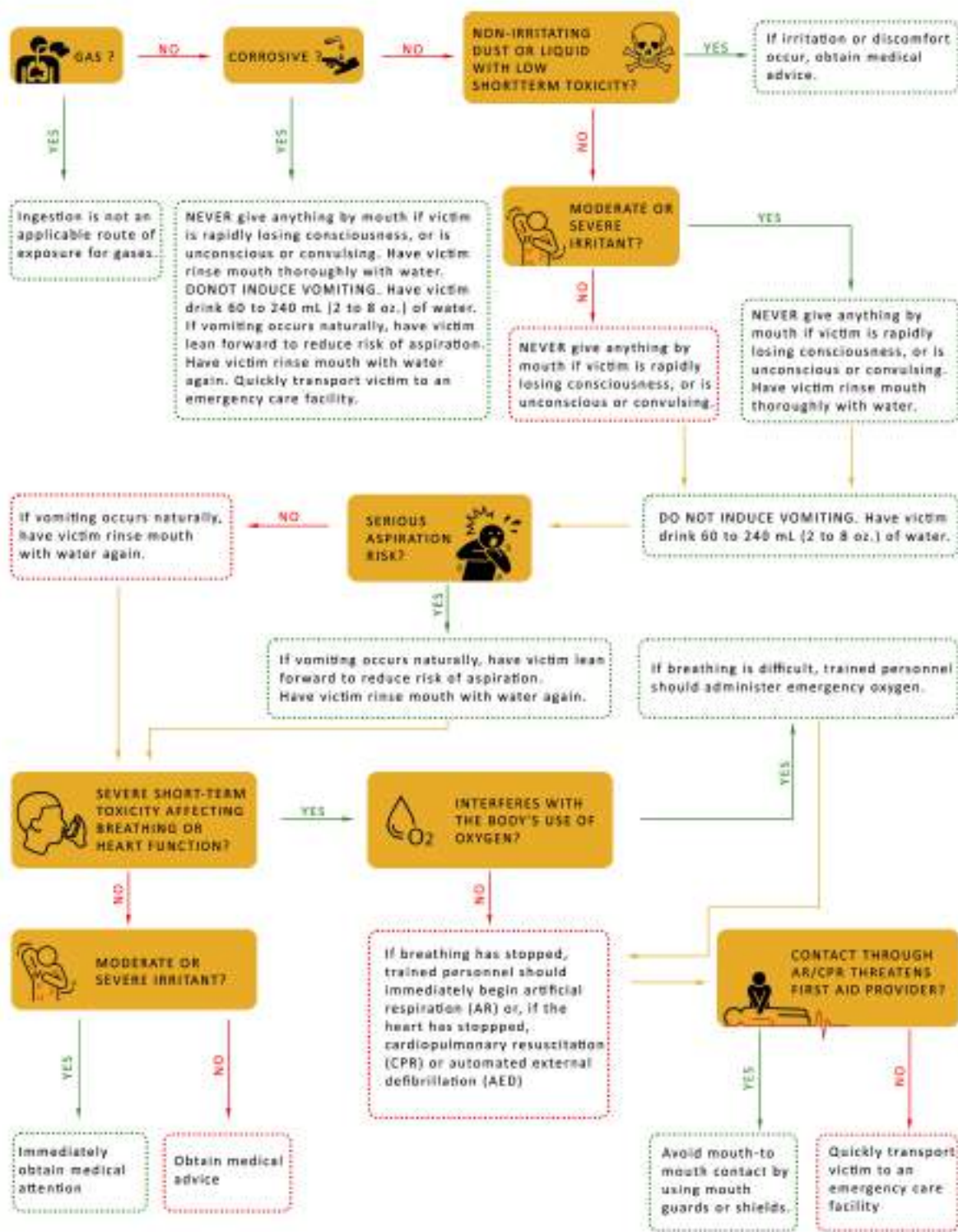
ANNEXURE

Follow the algorithm in case of Inhalation exposures, skin exposures, eye exposure, ingestion exposure.



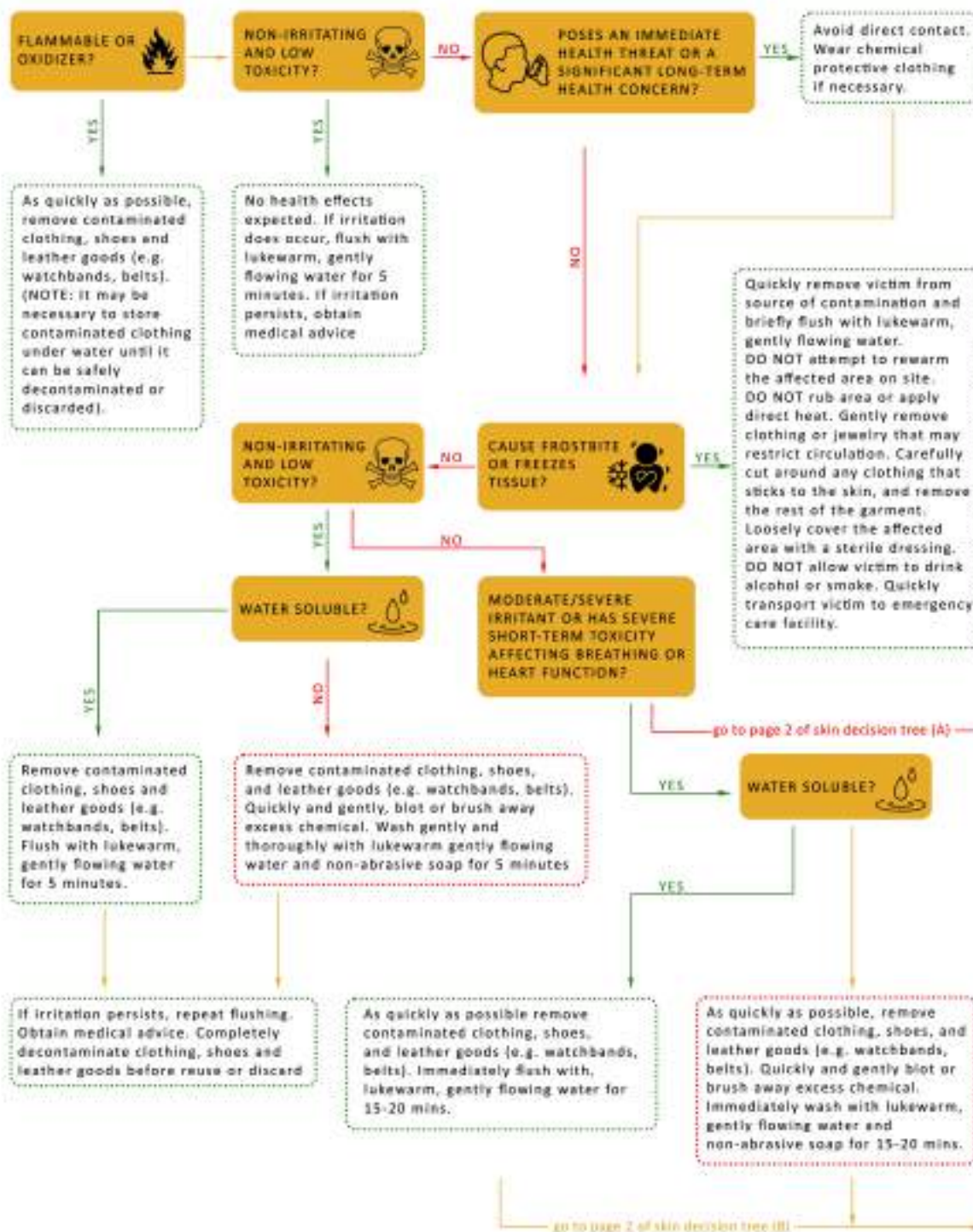
DECISION TREE FOR INGESTION EXPOSURES

INGESTION



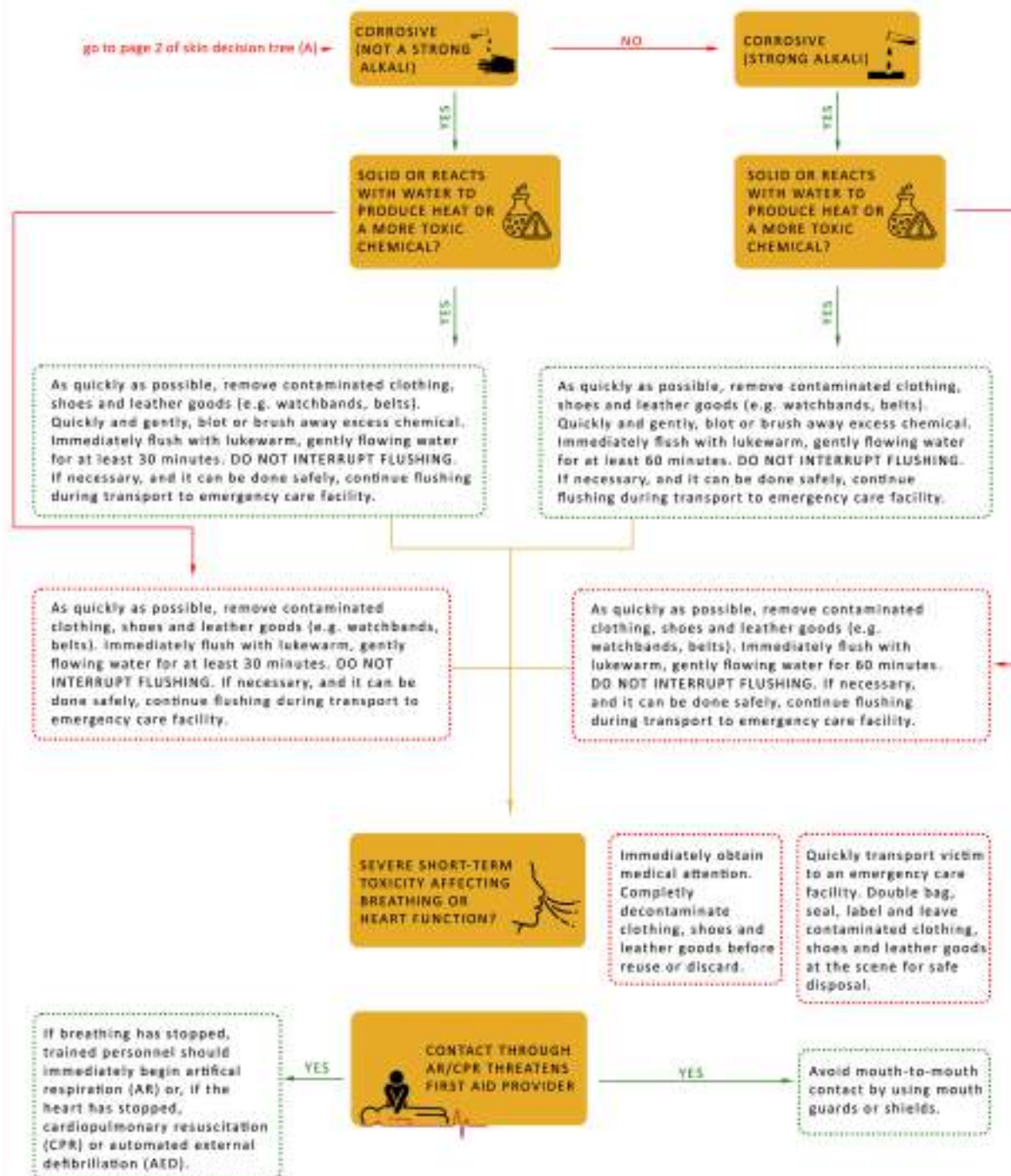
DECISION TREE FOR SKIN EXPOSURES

DERMAL PENETRATION



DECISION TREE FOR SKIN EXPOSURES

DERMAL PENETRATION



ANNEXURES

ANNEXURE 1: Patient Decontamination Procedure (to be done only by trained professionals and Specialized teams)

Ambulatory Victims

- o Direct the patient to the Decontamination Sector. Whenever possible, children should stay with their parents. If no parent or older sibling is available, a Decontamination Team member should assist the child.
- o Instruct the patient to promptly remove all clothing, placing valuables in the clear plastic bag and clothing in the larger bag. Both bags should then be placed into the third bag and securely sealed with the numbered tag provided in the kit.
- o Place the sealed clothing bag in a secure holding area and record the patient's name and tag number in Record. The patient should then proceed into the Decontamination Sector.
- o Begin with a quick head-to-toe rinse. Instruct the patient to wash using soap and a washcloth or brush, starting with any open wounds, and then continuing from head to toe in a systematic manner.
 - Wash for 5 minutes if the contaminant is known to be non-persistent, or for 8 minutes if the agent is persistent or unknown.
 - Do not scrub too vigorously.
 - If eye irritation is present, apply a topical anesthetic before irrigation.
- o Decontamination Team members must carefully observe each patient to ensure thorough cleansing, paying close attention to the axillae, body folds, creases, and hair. Assistance should be provided as needed.
- o Following the wash, the patient should perform a final rinse
- o All used soap, washcloths, brushes, and sponges must be discarded in a designated trash receptacle and must not enter the Cold Zone.
- o After rinsing, the patient should move to the drying area, dry off completely, and discard the towel in the designated contaminated waste bin.
- o Once dry, the patient should wear a clean patient gown and proceed to the Triage Area.
- o Additional medical interventions should be limited to those considered lifesaving by the Decontamination Officer and Antidotes should only be administered intramuscularly (IM) after the affected area has been cleaned.
- o Decontamination Team members should remain vigilant for signs of clinical deterioration among ambulatory patients. Any patient who becomes non-ambulatory should be immediately transferred to the Non-Ambulatory Sector using a backboard, stretcher, or wheelchair.

Non Ambulatory Victims

- o The patient should be brought to the Decontamination Sector and attended to by at least four Decontamination Team members. Two members will be responsible for turning the patient on the backboard, and one will maintain cervical spine precautions, if needed.
- o Position the patient on a backboard, ensuring that any padding is removed.
- o Carefully remove all clothing. Valuables should be placed in the clear plastic bag and clothing in the larger bag. Both bags should then be sealed within a third bag using the numbered tag provided in the kit. Clothing may be cut away if necessary.
- o To reduce the aerosolization of particulate contaminants, clothing should be turned inside out during removal. The skin should be gently dabbed with sticky tape or vacuumed to eliminate any surface particles.
- o Attach the numbered clothing bag tag around the patient's neck. This tag should remain in place throughout the decontamination and subsequent treatment process.
- o Store clothing bags securely. If staff are available, record the patient's name and tag number in the Patient Decontamination Record.
- o Position the patient on a backboard with support. Perform an initial rinse from head to toe using a handheld sprayer, garden hose, or showerhead. Take precautions to prevent aspiration of the rinse water.
- o Clean the patient with soap and a washcloth or brush, beginning with the airway, then any open wounds, followed by a systematic head-to-toe wash.
 - Wash for 5 minutes if the agent is non-persistent, or for 8 minutes if the agent is persistent or unknown and Avoid vigorous scrubbing or rubbing of the skin.
- o To cleanse posterior surfaces—such as the back of the head and neck, back, buttocks, and legs—gently roll the patient onto their side with the assistance of 2–4 team members, while maintaining spinal precautions when necessary.

Steps to put on personal protective equipment (PPE) including coverall

- 1 Remove all personal items** (jewelry, watches, cell phones, pens, etc.)



- 2 Put on scrub suit and rubber boots¹** in the changing room.



- 3 Move to the clean area at the entrance of the isolation unit.**

- 4 By visual inspection, ensure that all sizes of the PPE set are correct and the quality is appropriate.**

- 5 Undertake the procedure of putting on PPE under the guidance and supervision of a trained observer (colleague).**

- 6 Perform hand hygiene.**



- 7 Put on gloves** (examination, nitrile gloves).



- 8 Put on coverall.²**



- 9 Put on face mask.**



- 10 Put on face shield OR goggles.**



- 11 Put on head and neck covering** surgical bonnet covering neck and sides of the head (preferable with face shield) OR hood.



- 12 Put on disposable waterproof apron** (if not available, use heavy duty, reusable waterproof apron).



- 13 Put on second pair of (preferably long cuff)² gloves over the cuff.**



¹ If boots are not available, use closed shoes (slip-ons without shoelaces and fully covering the dorsum of the foot and ankles) and shoe covers (non-slip and preferably impermeable).

² Do not use adhesive tape to attach the gloves. If the gloves or the coverall sleeves are not long enough, make a thumb (or middle finger) hole in the coverall sleeve to ensure that your forearm is not exposed when making wide movements. Some coverall models have finger loops attached to sleeves.



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WHO/2019-nCoV/2020-02-02
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Steps to take off personal protective equipment (PPE) including coverall

1 Always remove PPE under the **guidance and supervision of a trained observer** (colleague). Ensure that infectious waste containers are available in the doffing area for safe disposal of PPE. Separate containers should be available for reusable items.

2 Perform **hand hygiene** on gloved hands.¹

3 Remove **apron** leaning forward and taking care to avoid contaminating your hands. When removing disposable apron, tear it off at the neck and roll it down without touching the front area. Then untie the back and roll the apron forward.



5 Remove **head and neck covering** taking care to avoid contaminating your face by starting from the bottom of the hood in the back and rolling from back to front and from inside to outside, and dispose of it safely.

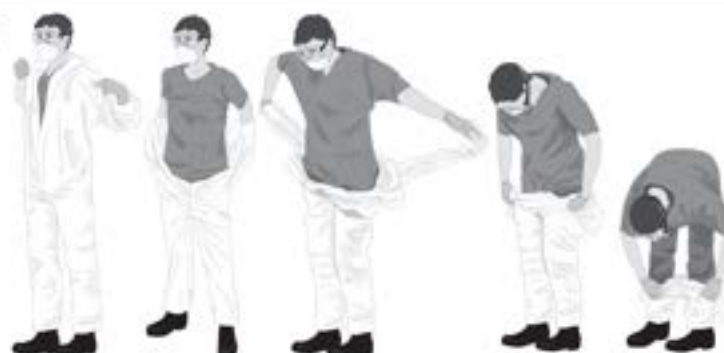


4 Perform **hand hygiene** on gloved hands.

6 Perform **hand hygiene** on gloved hands.

7 Remove **coverall and outer pair of gloves**:

Ideally, in front of a mirror, tilt head back to reach zipper, unzip completely without touching any skin or scrubs, and start removing coverall from top to bottom. After freeing shoulders, remove the outer gloves² while pulling the arms out of the sleeves. With inner gloves roll the coverall, from the waist down and from the inside of the coverall, down to the top of the boots. Use one boot to pull off coverall from other boot and vice versa, then step away from the coverall and dispose of it safely.



8 Perform **hand hygiene** on gloved hands.

9 Remove **eye protection** by pulling the string from behind the head and dispose of it safely.



11 Remove the **mask** from behind the head by first untying the bottom string above the head and leaving it hanging in front; and then the top string next from behind head and dispose of it safely.



12 Perform **hand hygiene** on gloved hands.

10 Perform **hand hygiene** on gloved hands.

13 Remove rubber **boots** without touching them (or overshoes if wearing shoes). If the same boots are to be used outside of the high-risk zone, keep them on but clean and decontaminate appropriately before leaving the doffing area.³

14 Perform **hand hygiene** on gloved hands.

15 Remove **gloves** carefully with appropriate technique and dispose of them safely.



16 Perform **hand hygiene**.

¹ While working in the patient care area, outer gloves should be changed between patients and prior to exiting (change after seeing the last patient)

² This technique requires properly fitted gloves. When outer gloves are too tight or inner gloves are too loose and/or hands are sweaty, the outer gloves may need to be removed separately, after removing the apron.

³ Appropriate decontamination of boots includes stepping into a footbath with 0.5% chlorine solution (and removing dirt with toilet brush if heavily soiled with mud and/or organic materials) and then wiping all sides with 0.5% chlorine solution. At least once a day boots should be disinfected by soaking in a 0.5% chlorine solution for 30 min, then rinsed and dried.

ANNEXURE 2: ILO WHO Safety cards for the basic first aid for common chemicals

AMMONIA (ANHYDROUS)	ICSC: 0414 (October 2013)
R717 Refrigerant gas 717	
CAS #: 7664-41-7	
UN #: 1005	
EC Number: 231-635-3	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Flammable. Cylinder may explode in heat of fire. Gas/air mixtures are explosive.	NO open flames, NO sparks and NO smoking. Closed system, ventilation, explosion-proof electrical equipment and lighting.	In case of fire in the surroundings, use appropriate extinguishing media. In case of fire: keep cylinder cool by spraying with water.

AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!			
	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Burning sensation. Cough. Laboured breathing. Shortness of breath. Sore throat.	Use ventilation, local exhaust or breathing protection.	Fresh air, rest. Half-upright position. Administration of oxygen may be needed. Refer immediately for medical attention.
Skin	Redness, Pain, Blisters, Skin burns. ON CONTACT WITH LIQUID: FROSTBITE.	Cold-insulating gloves. Protective clothing.	Rinse skin with plenty of water or shower for at least 15 minutes. ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer immediately for medical attention.
Eyes	Redness, Pain, Severe burns. ON CONTACT WITH LIQUID: FROSTBITE.	Wear face shield or eye protection in combination with breathing protection.	Rinse with plenty of water for several minutes (remove contact lenses if easily possible). Refer immediately for medical attention.
Ingestion			

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Evacuate danger area! Consult an expert! Personal protection: gas-tight chemical protection suit including self-contained breathing apparatus. Ventilation. Shut off cylinder if possible. Isolate the area until the gas has dispersed. Remove gas with fine water spray. NEVER direct water jet on liquid.	According to UN GHS Criteria  DANGER Flammable gas Contains gas under pressure; may explode if heated Toxic if inhaled Causes severe skin burns and eye damage Very toxic to aquatic life Transportation UN Classification UN Hazard Class: 2.3; UN Subsidiary Risks: 8
STORAGE	
Fireproof. Separated from oxidants, acids and halogens. Cool. Keep in a well-ventilated room.	
PACKAGING	
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AMMONIA (ANHYDROUS)**ICSC: 0414****PHYSICAL & CHEMICAL INFORMATION****Physical State; Appearance**

COLOURLESS GAS OR COMPRESSED LIQUEFIED GAS WITH PUNGENT ODOUR.

Physical dangers

The gas is lighter than air.

Chemical dangers

Mixtures with mercury, silver and gold oxides are shock-sensitive. The substance is a strong base. It reacts violently with acid and is corrosive. Reacts violently with strong oxidants, halogens and many other substances. Attacks copper, aluminium, zinc and their alloys. Dissolves in water evolving heat. The substance reacts with most organic and inorganic compounds, causing fire and explosion hazard.

Formula: NH_3

Molecular mass: 17.0

Boiling point: -33°C Melting point: -78°C Relative density (water = 1): 0.7 (-33°C)Solubility in water, g/100ml at 20°C : 54Vapour pressure, kPa at 26°C : 1013

Relative vapour density (air = 1): 0.60

Auto-ignition temperature: 630°C

Explosive limits, vol% in air: 15-33.6

EXPOSURE & HEALTH EFFECTS**Routes of exposure**

The substance can be absorbed into the body by inhalation.

Effects of short-term exposure

Rapid evaporation of the liquid may cause frostbite. The substance is corrosive to the eyes, skin and respiratory tract. Exposure could cause asphyxiation due to swelling in the throat. Inhalation may cause lung oedema, but only after initial corrosive effects on eyes and/or airways have become manifest.

Inhalation risk

A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

Effects of long-term or repeated exposure

Repeated or chronic inhalation of the vapour may cause chronic inflammation of the upper respiratory tract. Lungs may be affected by repeated or prolonged exposure. This may result in chronic obstructive pulmonary disorders (COPD).

OCCUPATIONAL EXPOSURE LIMITS

TLV: 25 ppm as TWA; 35 ppm as STEL.

EU-OEL: 14 mg/m^3 , 20 ppm as TWA; 36 mg/m^3 , 50 ppm as STEL.MAK: 14 mg/m^3 , 20 ppm; peak limitation category: I(2); pregnancy risk group: C**ENVIRONMENT**

The substance is very toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment.

NOTES

Ammonia is normally supplied in compressed liquified form in cylinders.

See ICSC 0215.

Turn leaking cylinder with the leak up to prevent escape of gas in liquid state.

ADDITIONAL INFORMATION**EC Classification**

Symbol: T, N; R: 10-23-34-50; S: (1/2)-9-16-26-36/37/39-45-61; Note: U

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CHLORINE

ICSC: 0126 (March 2009)

CAS #: 7782-50-5

UN #: 1017

EC Number: 231-959-5

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible but enhances combustion of other substances. Many reactions may cause fire or explosion. Risk of fire and explosion. See Chemical Dangers.	NO contact with incompatible materials. See Chemical Dangers	In case of fire in the surroundings, use appropriate extinguishing media. In case of fire: keep cylinder cool by spraying with water. NO direct contact with water.

AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!			
	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough. Sore throat. Shortness of breath. Wheezing. Laboured breathing. Symptoms may be delayed. See Notes.	Use breathing protection, closed system or ventilation.	Fresh air, rest. Half-upright position. Refer immediately for medical attention. Artificial respiration may be needed. See Notes.
Skin	ON CONTACT WITH LIQUID: FROSTBITE. Redness. Burning sensation. Pain. Skin burns.	Cold-insulating gloves. Protective clothing.	First rinse with plenty of water for at least 15 minutes, then remove contaminated clothes and rinse again. Refer immediately for medical attention.
Eyes	Watering of the eyes. Redness. Pain. Burns.	Wear face shield or eye protection in combination with breathing protection.	Rinse with plenty of water for several minutes (remove contact lenses if easily possible). Refer immediately for medical attention.
Ingestion		Do not eat, drink, or smoke during work.	

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Evacuate danger area! Consult an expert! Personal protection: gas-tight chemical protection suit including self-contained breathing apparatus. Ventilation. Shut off cylinder if possible. Isolate the area until the gas has dispersed. NEVER direct water jet on liquid. Remove gas with fine water spray. Do NOT let this chemical enter the environment.	According to UN GHS Criteria 
STORAGE	DANGER May cause or intensify fire; oxidizer Contains gas under pressure; may explode if heated Fatal if inhaled Causes severe skin burns and eye damage May cause respiratory irritation May cause damage to lungs through prolonged or repeated exposure if inhaled Very toxic to aquatic life
PACKAGING	Transportation UN Classification UN Hazard Class: 2.3; UN Subsidiary Risks: 5.1 and 8
Fireproof if in building. Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs. See Chemical Dangers. Cool. Dry. Keep in a well-ventilated room. Store in an area without drain or sewer access.	
Special insulated cylinder. Marine pollutant.	



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CHLORINE**ICSC: 0126****PHYSICAL & CHEMICAL INFORMATION****Physical State; Appearance**

GREENISH-YELLOW COMPRESSED LIQUEFIED GAS WITH PUNGENT ODOUR.

Physical dangers

The gas is heavier than air.

Chemical dangers

The solution in water is a strong acid. It reacts violently with bases and is corrosive. The substance is a strong oxidant. Reacts violently with combustible substances and reducing agents. The substance reacts with most organic and inorganic compounds, causing fire and explosion hazard. Attacks metals, some forms of plastic, rubber and coatings.

Formula: Cl₂

Molecular mass: 70.9

Boiling point: -34°C

Melting point: -101°C

Solubility in water, g/100ml at 20°C: 0.7

Vapour pressure, kPa at 20°C: 673

Relative vapour density (air = 1): 2.5

EXPOSURE & HEALTH EFFECTS**Routes of exposure**

Serious by all routes of exposure.

Effects of short-term exposure

Lachrymation. The substance is corrosive to the eyes, skin and respiratory tract. Rapid evaporation of the liquid may cause frostbite. Inhalation may cause asthma-like reactions. Inhalation may cause pneumonitis. Inhalation may cause lung oedema, but only after initial corrosive effects on eyes and/or airways have become manifest. See Notes. Exposure could cause death.

Inhalation risk

On loss of containment, a harmful concentration of this gas in the air will be reached very quickly.

Effects of long-term or repeated exposure

The substance may have effects on the respiratory tract and lungs. This may result in chronic inflammation and impaired functions. The substance may have effects on the teeth. This may result in erosion.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.1 ppm as TWA; 0.4 ppm as STEL; A4 (not classifiable as a human carcinogen).

MAK: peak limitation category: I(1); pregnancy risk group: C.

EU-OEL: 1.5 mg/m³, 0.5 ppm as STEL

ENVIRONMENT

The substance is very toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment.

NOTES

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.

Immediate administration of an appropriate inhalation therapy by a doctor, or by an authorized person, should be considered.

The odour warning when the exposure limit value is exceeded is insufficient.

Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Do NOT spray water on a leaking cylinder (to prevent corrosion of the cylinder).

Turn leaking cylinder with the leak up to prevent escape of gas in liquid state.

ADDITIONAL INFORMATION**EC Classification**

Symbol: T, N; R: 23-36/37/38-50; S: (1/2)-9-45-61

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METHYL ISOCYANATE

ICSC: 0004 (November 2003)

Isocyanatomethane
Isocyanic acid, methyl ester

CAS #: 624-83-9

UN #: 2480

EC Number: 210-866-3

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Extremely flammable. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire. Vapour/air mixtures are explosive.	NO open flames, NO sparks and NO smoking. NO contact with water, acids, bases or oxidizing agents. Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling.	Use alcohol-resistant foam, dry sand, powder, carbon dioxide. NO hydrous agents. In case of fire: keep drums, etc., cool by spraying with water. NO direct contact with water. Combat fire from a sheltered position.

AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough. Laboured breathing. Shortness of breath. Sore throat. Vomiting.	Use ventilation, local exhaust or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration may be needed. Refer for medical attention.
Skin	MAY BE ABSORBED! Redness. Pain. Burning sensation.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Pain. Redness. Loss of vision.	Wear face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Abdominal pain. Burning sensation. Shock or collapse.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give one or two glasses of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Evacuate danger area! Consult an expert! Personal protection: chemical protection suit including self-contained breathing apparatus. Ventilation. Remove all ignition sources. Do NOT let this chemical enter the environment. Collect leaking and spilled liquid in sealable containers as far as possible. Cautiously neutralize spilled liquid with caustic soda. Absorb remaining liquid in dry sand or inert absorbent. Then store and dispose of according to local regulations.	According to UN GHS Criteria
STORAGE	Transportation
Fireproof. See Chemical Dangers. Cool. Dry. Store only if stabilized. Store in an area without drain or sewer access.	UN Classification
PACKAGING	UN Hazard Class: 6.1, UN Subsidiary Risks: 3, UN Pack Group: I
Special material.	
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METHYL ISOCYANATE**ICSC: 0004****PHYSICAL & CHEMICAL INFORMATION****Physical State; Appearance**

VOLATILE COLOURLESS LIQUID WITH PUNGENT ODOUR.

Physical dangers

The vapour is heavier than air and may travel along the ground; distant ignition possible. The vapour mixes well with air, explosive mixtures are easily formed.

Chemical dangers

The substance polymerizes when pure. The substance may polymerize due to heating and under the influence of metals and catalysts. Decomposes on contact with water. Decomposes rapidly on contact with acids or bases. This produces toxic gases of hydrogen cyanide, nitrogen oxides and carbon monoxide. Attacks some forms of plastic, rubber and coatings.

Formula: CH_3NCO

Molecular mass: 57.1

Boiling point: 39°C

Melting point: -80°C

Relative density (water = 1): 0.96

Solubility in water at 20°C: reaction

Vapour pressure, kPa at 20°C: 54

Relative vapour density (air = 1): 2

Relative density of the vapour/air-mixture at 20°C (air = 1): 1.44

Flash point: -7°C c.c.

Auto-ignition temperature: 535°C

Explosive limits, vol% in air: 5.3-26

EXPOSURE & HEALTH EFFECTS**Routes of exposure**

The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Effects of short-term exposure

The substance is severely irritating to the eyes, skin and respiratory tract. Corrosive on ingestion. Inhalation of the vapour may cause lung oedema. See Notes. Inhalation may cause asthma-like reactions. Exposure could cause death. The effects may be delayed. Medical observation is indicated.

Inhalation risk

A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

Effects of long-term or repeated exposure

Repeated or prolonged contact may cause skin sensitization. The substance may have effects on the respiratory tract. Causes toxicity to human reproduction or development.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.02 ppm as TWA; 0.06 ppm as STEL; (skin); (SEN).

MAK: 0.024 mg/m³, 0.01 ppm; peak limitation category: I(1); pregnancy risk group: D.

EU-OEL: 0.02 ppm as STEL

ENVIRONMENT

This substance may be hazardous to the environment. Special attention should be given to aquatic organisms.

NOTES

Reacts violently with fire extinguishing agents such as water.

Depending on the degree of exposure, periodic medical examination is suggested.

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.

Anyone who has shown symptoms of asthma due to this substance should avoid all further contact.

The symptoms of asthma often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.

The odour warning when the exposure limit value is exceeded is insufficient.

Do NOT take working clothes home.

ADDITIONAL INFORMATION**EC Classification**

Symbol: F+, T+; R: 12-24/25-26-37/38-41-42/43-63; S: (1/2)-26-27/28-36/37/39-45-63

PHOSGENE

Carbonyl chloride
Chloroformyl chloride

CAS #: 75-44-5

UN #: 1076

EC Number: 200-870-3

ICSC: 0007 (October 2013)

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible.		In case of fire in the surroundings, use appropriate extinguishing media. In case of fire: keep cylinder cool by spraying with water. NO direct contact with water. Combat fire from a sheltered position.

AVOID ALL CONTACT! FIRST AID: USE PERSONAL PROTECTION. IN ALL CASES CONSULT A DOCTOR!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough. Sore throat. Chest tightness. Shortness of breath. Nausea. Vomiting. Symptoms may be delayed. See Notes.	Use closed system or ventilation.	Fresh air, rest. Half-upright position. Administration of oxygen may be needed. Refer immediately for medical attention.
Skin	Redness. ON CONTACT WITH LIQUID: FROSTBITE.	Cold-insulating gloves. Protective clothing.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Rinse skin with plenty of water or shower. Refer immediately for medical attention.
Eyes	Redness. Watering of the eyes. ON CONTACT WITH LIQUID: FROSTBITE.	Wear face shield or eye protection in combination with breathing protection.	Rinse with plenty of water for several minutes (remove contact lenses if easily possible). Refer immediately for medical attention.
Ingestion			

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Evacuate danger area! Consult an expert! Personal protection: chemical protection suit including self-contained breathing apparatus. Ventilation. Shut off cylinder if possible. Remove gas with fine water spray. Isolate the area until the gas has dispersed.	According to UN GHS Criteria  DANGER Contains gas under pressure; may explode if heated Fatal if inhaled Causes serious eye irritation May cause respiratory irritation Causes damage to lungs Causes damage to the lungs through prolonged or repeated exposure
STORAGE	
Fireproof if in building. Isolated from work area. Separated from incompatible materials. See Chemical Dangers. Cool. Dry. Ventilation along the floor.	
PACKAGING	
	Transportation UN Classification UN Hazard Class: 2.3; UN Subsidiary Risks: 8



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PHOSGENE

ICSC: 0007

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance

COLOURLESS COMPRESSED LIQUEFIED GAS WITH CHARACTERISTIC ODOUR.

Physical dangers

The gas is heavier than air.

Chemical dangers

Decomposes above 300°C. Decomposes on contact with water or moisture. This produces corrosive hydrogen chloride (see ICSC 0163). Reacts violently with ethanol, strong oxidants, ammonia, amines and aluminium. Attacks many metals in the presence of water.

Formula: COCl_2

Molecular mass: 98.9

Boiling point: 8°C

Melting point: -128°C

Relative density (water = 1): 1.4

Solubility in water: reaction

Vapour pressure, kPa at 20°C: 161.6

Relative vapour density (air = 1): 3.4

EXPOSURE & HEALTH EFFECTS

Routes of exposure

The substance can be absorbed into the body by inhalation.

Effects of short-term exposure

Rapid evaporation of the liquid may cause frostbite. The substance is irritating to the eyes and respiratory tract. Inhalation of the gas may cause lung oedema and chemical pneumonitis. The effects may be delayed. Medical observation is indicated. See Notes. Exposure at high levels could cause death.

Inhalation risk

A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

Effects of long-term or repeated exposure

Lungs may be affected by repeated or prolonged exposure. This may result in impaired functions and decreased resistance to infection.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.1 ppm as TWA.

MAK: 0.41 mg/m³, 0.1 ppm; peak limitation category: I(2); pregnancy risk group: C.EU-OEL: 0.08 mg/m³, 0.02 ppm as TWA; 0.4 mg/m³, 0.1 ppm as STEL

ENVIRONMENT

NOTES

A serious intoxication may develop even without experiencing symptoms of irritation or detecting the characteristic odour (grass or hay).

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.

Do NOT spray water on a leaking cylinder (to prevent corrosion of the cylinder).

Turn leaking cylinder with the leak up to prevent escape of gas in liquid state.

The information in this ICSC would also apply to phosgene generated by chemical reactions or by decomposition of organic compounds containing chlorine.

ADDITIONAL INFORMATION

EC Classification

Symbol: T+; R: 26-34; S: (1/2)-9-26-36/37/39-45; Note: U

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STYRENE

ICSC: 0073 (April 2006)

Vinylbenzene
Phenylethylene
Ethanylbenzene

CAS #: 100-42-5

UN #: 2055

EC Number: 202-851-5

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Flammable. Gives off irritating or toxic fumes (or gases) in a fire. Above 31°C explosive vapour/air mixtures may be formed. See Notes.	NO open flames, NO sparks and NO smoking. Above 31°C use a closed system, ventilation and explosion-proof electrical equipment.	Use dry powder. Use foam. Use carbon dioxide. In case of fire: keep drums, etc., cool by spraying with water.

STRICT HYGIENE!			
	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Dizziness. Drowsiness. Headache. Nausea. Vomiting. Weakness. Unconsciousness.	Use ventilation, local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Redness. Pain.	Protective clothing. Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Wear safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give one or two glasses of water to drink. Rest.

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Personal protection: chemical protection suit including self-contained breathing apparatus. Remove all ignition sources. Do NOT let this chemical enter the environment. Do NOT wash away into sewer. Collect leaking and spilled liquid in covered containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations.	According to UN GHS Criteria  DANGER Flammable liquid and vapour Harmful if inhaled Causes skin and eye irritation Suspected of causing cancer Causes damage to the central nervous system and the liver through prolonged or repeated exposure Toxic to aquatic life
STORAGE	
Fireproof. Separated from incompatible materials. See Chemical Dangers. Cool. Keep in the dark. Store only if stabilized. Store in an area without drain or sewer access.	
PACKAGING	
Airtight. Marine pollutant.	Transportation UN Classification UN Hazard Class: 3; UN Pack Group: III



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STYRENE**ICSC: 0073****PHYSICAL & CHEMICAL INFORMATION****Physical State; Appearance**

COLOURLESS-TO-YELLOW OILY LIQUID.

Physical dangers**Chemical dangers**

The substance can form explosive peroxides. The substance may polymerize due to warming, under the influence of light, oxidants, oxygen and peroxides. This generates fire and explosion hazard. Reacts violently with strong acids and strong oxidants. This generates fire and explosion hazard. Attacks rubber, copper and copper alloys.

Formula: C_6H_6 / $C_6H_5CHCH_2$

Molecular mass: 104.2

Boiling point: 145°C

Melting point: -30.6°C

Relative density (water = 1): 0.91

Solubility in water, g/100ml at 20°C: 0.03

Vapour pressure, kPa at 20°C: 0.67

Relative vapour density (air = 1): 3.6

Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02

Flash point: 31°C c.c.

Auto-ignition temperature: 490°C

Explosive limits, vol% in air: 0.9-6.8

Octanol/water partition coefficient as log Pow: 3.0

EXPOSURE & HEALTH EFFECTS**Routes of exposure**

The substance can be absorbed into the body by inhalation of its vapour.

Effects of short-term exposure

The substance is irritating to the eyes, skin and respiratory tract. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure at high levels could cause unconsciousness.

Inhalation risk

A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

Effects of long-term or repeated exposure

The substance defats the skin, which may cause dryness or cracking. The substance may have effects on the central nervous system. Exposure to the substance may increase noise-induced hearing loss. This substance is possibly carcinogenic to humans. See Notes.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 10 ppm as TWA; 20 ppm as STEL; (OTO); A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued.

MAK: 86 mg/m³, 20 ppm; peak limitation category: II(2); carcinogen category: 5; pregnancy risk group: C

ENVIRONMENT

The substance is toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested.

Check for peroxides prior to distillation; eliminate if found.

Styrene monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.

Do NOT take working clothes home.

ADDITIONAL INFORMATION**EC Classification**

Symbol: Xn; R: 10-20-36/38; S: (2)-23; Note: D

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ANNEXURE 3: General First Aid Measures in Chemical Emergencies

- Call emergency medical service. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and avoid contamination.
- Move victim to fresh air if it can be done safely.
- Administer oxygen if breathing is difficult.
- If victim is not breathing:
 - DO NOT perform mouth-to-mouth resuscitation; the victim may have ingested or inhaled the substance.
 - If equipped and pulse detected, wash face and mouth, then give artificial respiration using a proper respiratory medical device (bag- valve mask, pocket mask equipped with a one-way valve or other device).
 - If no pulse detected or no respiratory medical device available, provide continuous compressions. Conduct a pulse check every two minutes or monitor for any signs of spontaneous respirations.
- Remove and isolate contaminated clothing and shoes.
- For minor skin contact, avoid spreading material on unaffected skin.
- In case of contact with substance, remove immediately by flushing skin or eyes with running water for at least 20 minutes.
- For severe burns, immediate medical attention is required.
- Effects of exposure (inhalation, ingestion, or skin contact) to substance may be delayed.
- Keep victim calm and warm.
- Keep victim under observation.
- For further assistance, contact your local Poison Control Center.
- Note: Basic Life Support (BLS) and Advanced Life Support (ALS) should be only be done by trained professionals

(Reference: Emergency response guidebook -USDT 2024 , Transport Canada)



CHEMICAL EMERGENCY

What to do?



Precut plastic sheets should be ready for covering doors and windows



Close all doors and window-cover and seal gaps or drafts with duct tape or similar



Do not go outside until its safe to do so



Block chimneys, fans, etc.



Turn off all ventilation in the home, especially those systems which allow outside air to enter



Room designated as a shelter, ideally with water supply. Should be as high in a structure as possible to avoid vapors sink to low levels.

Ensure that your change of cloth is uncontaminated- if from a drawer or cupboard they should be suitable



Do not pull clothing over your head; it should be cut off instead



Dispose off any affected clothing in a black bin bag and then seal inside another bag



Eyes if affected should be rinsed in clean water for 15 minutes. Spectacles should also be washed.



Wash thoroughly any skin areas that has been in contact with chemical with large amounts of water



IF OUTSIDE:



Immediately move as far away as possible, and seek shelter



Don't shelter in car unless you have a choice



Breathing faster will increase the intake of any agent

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Exercise Scenarios :

BHOPAL GAS TRAGEDY

- What are the potential health hazards of the gas leak, and what symptoms would you expect to see in affected individuals?
- What actions would you take immediately following a report of a gas leak in a populated area?
- How would you coordinate with local hospitals to ensure that they are prepared to receive and treat the affected individuals?
- Analyze the role of human error, technical failures, or organizational shortcomings in the Bhopal Gas tragedy?
- Simulate a communication breakdown between the response team and the government officials. This inject will test how well the participants can communicate under pressure and how they can solve communication challenges.
- Conduct a root cause analysis to identify the underlying causes of the Bhopal Gas Tragedy.



TUGLAKABAD

- What equipment and supplies would you need to respond to the gas leak, and how would you ensure that those resources are secured?
- How would you provide training and education to personnel who will be involved in the response to the gas leak?
- What crisis communication strategies would you use to keep the public informed about the gas leak and the response?
- Elucidate the difference in management of the Tuglakabad gas leak compared to Bhopal
- What personal protective equipment advice would you give to anyone who would be involved in providing prehospital care to the victims?
- What equipment and supplies would you need to respond to the gas leak, and how would you ensure that those resources are secured?
- How will you transport the patients to designated facility/ hospital ?

LIST OF CONTRIBUTORS

NAME

DESIGNATION

Program Steering Committee and Editors

Dr. Meera Dhuria	Joint Director & Head (Public Health Preparedness and NCD), NCDC
Dr. Saurabh Dalal	NPO (Emergency Preparedness & Risk Management) WHO India

EXPERTS

Dr. Senthil Nathan	CMO (SAG-IH) , MoHFW
Shri Jayant Raushan	Consultant- Chemical Disaster, Department of Chemicals (DCPC)
Dr. P Sivaperumal	Head - Chemical Science Division, ICMR-NIOH
Shri Abhishek Sharma	Senior Research Officer, NDMA
Dr. Vimlesh Bind	Adviser-NACWC
Dr. Amit Murari	CMO(SG), NDRF
Shri Nisarg Dave	Director, GIDM
Ms. Anusha Vyas	Research Associate cum Program Coordinator, GIDM
Shri BN Acharya	Scientist F, DRDE
Dr. Surya Prakash	Head CBRN, NIDM
Dr. Asit K Patra	Deputy Director, Disaster management Institute, Bhopal
Dr. Sujata Arya	ADG -IH, MoHFW
Dr. Raghvendra Kumar Vidua	Associate Professor, Forensic Medicine & Toxicology, AIIMS Bhopal
Dr. Meehir Palit	Scientist E, DRDE
Dr. Krupa George	Associate Professor and In-Charge CTU and PCC, CMC Vellore
Dr. Nishanth Hiremath	HOD - Emergency, Bhagwan Mahaveer Jain Hospital, Bangalore
Dr. Narendra Nath Jena	Director, Dept. of A & EM, Meenakshi Mission Hospital, Madurai
Dr. S Senthilkumaran	Emergency & Critical care Physician, Manian Medical Center, Erode

NCDC

Dr. (Prof) Ranjan Das	Director, NCDC
Dr. Atul Goel	Former DGHS and Director NCDC
Dr. Sujeet Kumar Singh	Former Director, NCDC
Dr. S Venkatesh	Former DGHS and Ex Director, NCDC
Dr. Himanshu Chauhan	Joint Director, HOD-IDSP, NCDC
Dr. Navin Verma	Joint Director Dte.GHS, EMR

WHO - India

Ms. Payden	WHO Representative to India (Acting)
Dr. Badri Thapa	Team Lead, WHE & CDS
Dr. George Joseph Kodickal	Health Emergencies and Disaster Risk Management Officer
Dr. Vidhya Chandramohan	Health Emergencies and Disaster Risk Management Officer
Dr. Anisur Rahman	NPO, Infection Prevention and Control, WHO India
Dr. Girish Chandra Dash	Consultant, Emergency Preparedness and Response
Mr. Amit Alok	Consultant, Emergency Preparedness and Response



National Centre for Disease Control

22 - Sham Nath Marg, Delhi - 110 054

Phone: +91-11-23971272, +91-11-23971060,

e-mail: dirncd@nic.in

Website: www.ncdc.gov.in

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