# Patients management in chemical Disaster

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# ILOs

1-Introduction to chemical warefare agent

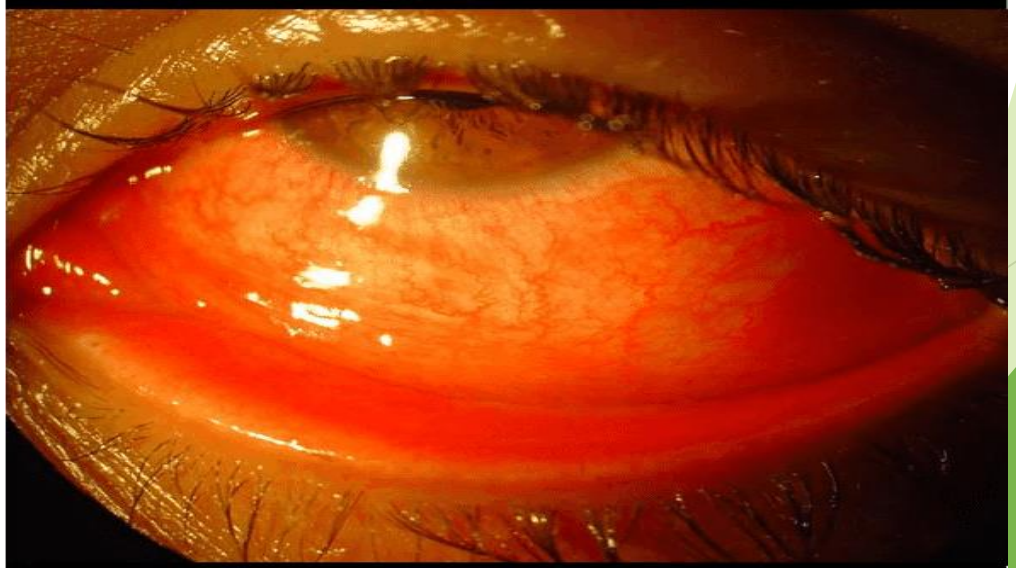
2-Response at the scene

3-Transport to the hospital

4-Hospital response

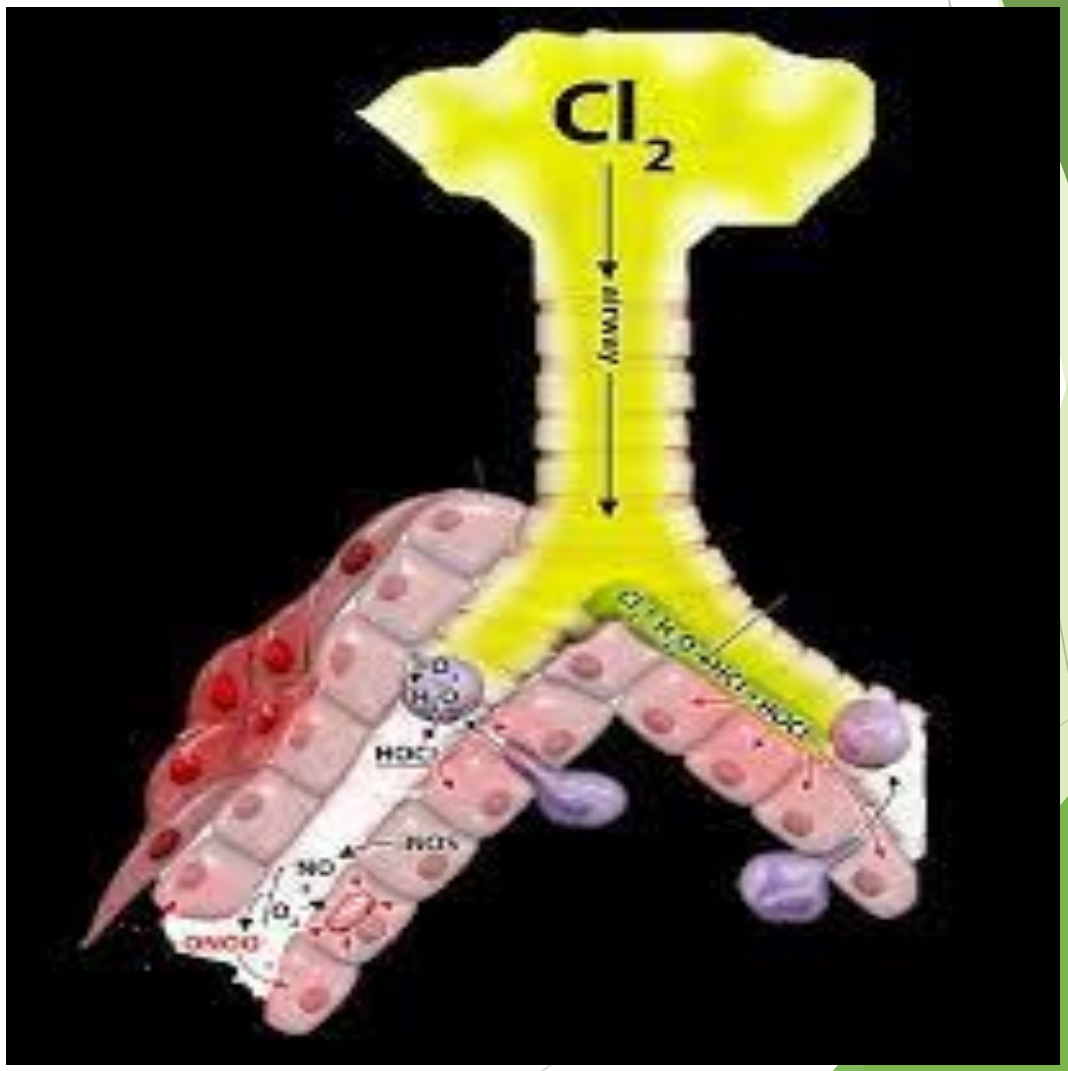
# 1-Irritant Agents (Tear Gases)

4.a. Left eye tear gas injury



4.b. Left eye toxic keratoconjunctivitis

# 2- Pulmonary Agents



# 3- Vesicant Agents

# 4- Nerve Agents

They are  Organophosphorus compounds that are used in production of pesticides, herbicides, solvents and many other industries.

## SARIN GAS USED IN SYRIA – UN REPORT

The UN has released details of its investigation into the chemical attack in Syria.

*An image released by the Local Committee of Arbeen shows the bodies of children after Syrian rebels claim they were killed in a toxic gas attack by pro-government forces in eastern Ghouta. Picture: AFP/Local Committee of Arbee*

# 5- Cyanides

Toxicity results from prevention of oxygen uptake at the cellular level.

# Modern Chemical Warfare Agents

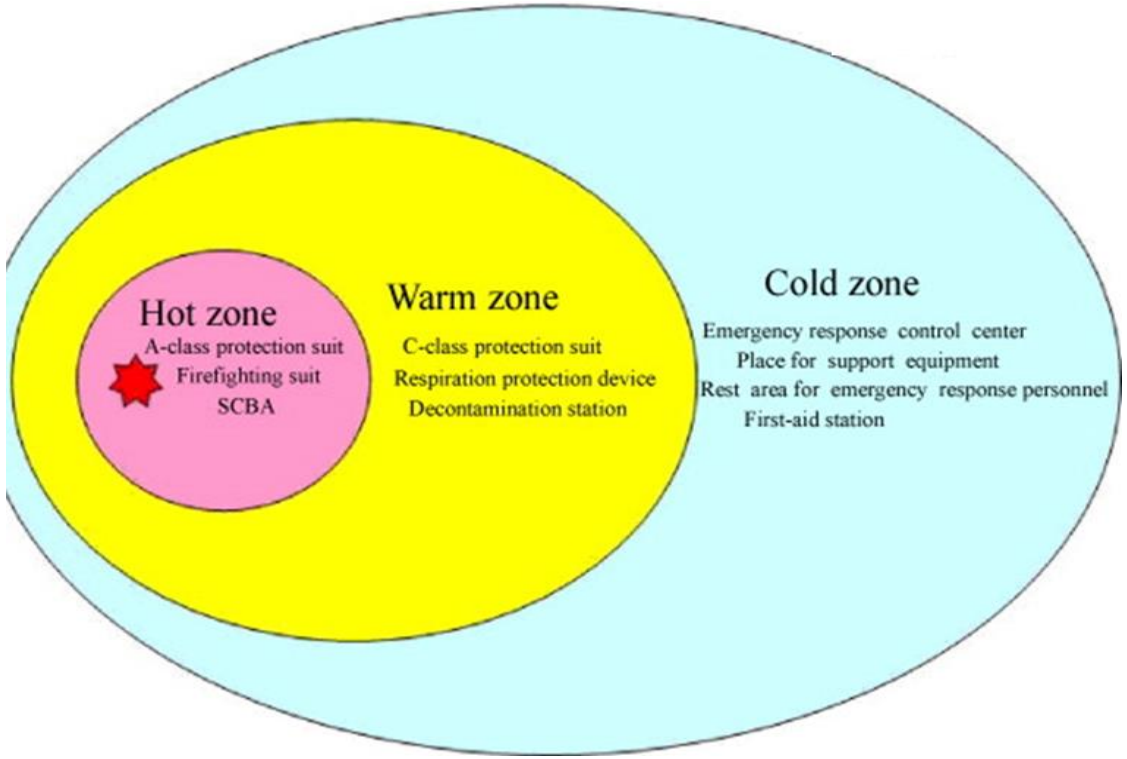
# 1- White Phosphorous

US forces used phosphorus bombs in Fallujah in Iraq in 2004, while the Israeli forces used it during Gazza siege in 2009

USA used it in mortar shells and missiles loaded in Vietnam

# 2-Dense Inert Metal Explosives (DIME)

# Response at the scene



# The Hot Zone (Exclusion Zone)

It is the area that contains the source of contamination.

No one should be allowed to pass to hot zone except after wearing appropriate personal protective equipment (PPE).

The actions of personnel in this zone include:

- Rescue
- Assessment
- Incident control .
- Sampling: for diagnosis of the agent

- **Warm Zone (Contamination Reduction Zone)**
- Decontamination is done in this zone. hence it is a transitional zone between the hot **(contaminated) and the cold (clean) zones** It is specially designed to prevent the spread of chemical contamination, thus it is large enough to accommodate the steps of decontamination.
- The boundaries of this zone are demarcated by yellow warning tapes.
- Cold Zone (Support Zone)

It present immediately next to the warm zone It is characterized by being free from any contamination , and therefore *it is the only region that does not require personal protective equipment during working*.

## Hot Zone:

Triage&

Evacuation to warm zone

## Warm Zone:

Decontamination

Antidotes if available

BLS only

## Cold Zone:

Safe zone(Free frome any contamination)

ALCS

Treatment and Transport.

**Safe distance from unknown Hazards sources**

1- Minor Incident .....50 Meters

2- Minor industrial .....100Meters

3- Major industrial .....200 Meters

## Agent Identification

- The chemical agent must be identified, either through clinical manifestation  or using special detection devices.

## Diagnosis of a chemical injury are:

- Strong odors
- Unknown liquids on the body
- Respiratory complaints
- Eye and mucous membranes complains
- Chemical burns
- Neurological complaints

# Respiratory protection devices
# 1-Self-contained Breathing Apparatus (SCBA)

Consists of a **full face-piece connected by a hose to a portable source of compressed air**.

Positive-pressure SCBA is the most common type.

Provides clean air under positive pressure from a cylinder the air then is exhaled into the environment.

Negative-pressure SCBAs are prohibited by Occupational Safety and Health Administration**(OSHA)** regulations for hazardous materials(HAZMAT} incidents.

SCBA provides the highest level of respiratory protection.

# 2- Supplied-Air Respirator (SAR)

Consists of a full face-piece connected to **an air source away from the contaminated area via an airline.**

Because SARs are less bulky than SCBA, they can be used for longer periods.

Although negative-pressure SARs are available, positive-pressure SARs are recommended for HAZMAT incidents.

SARs, like SCBA, provide the highest level of respiratory protection

# 3- Air-Purifying  Respirator(APR)


Consists of a face-piece worn over the mouth and nose with a filter element that filters ambient air before inhalation.
Three basic types of APRs are available **powered disposable  and chemical cartridge or canister .**
Powered air-purifying respirators (PAPRs), deliver filtered air under positive pressure to a face piece mask, helmet, or hood, which provides respiratory and ocular protection

# Personal Protective Equipment

Multilayerd garments
Aluminum –lined to increase level of protection also vapour impermeable

-Gown and gloves

Footwear covers

Level of protection acc to mission with Resp. protection devices

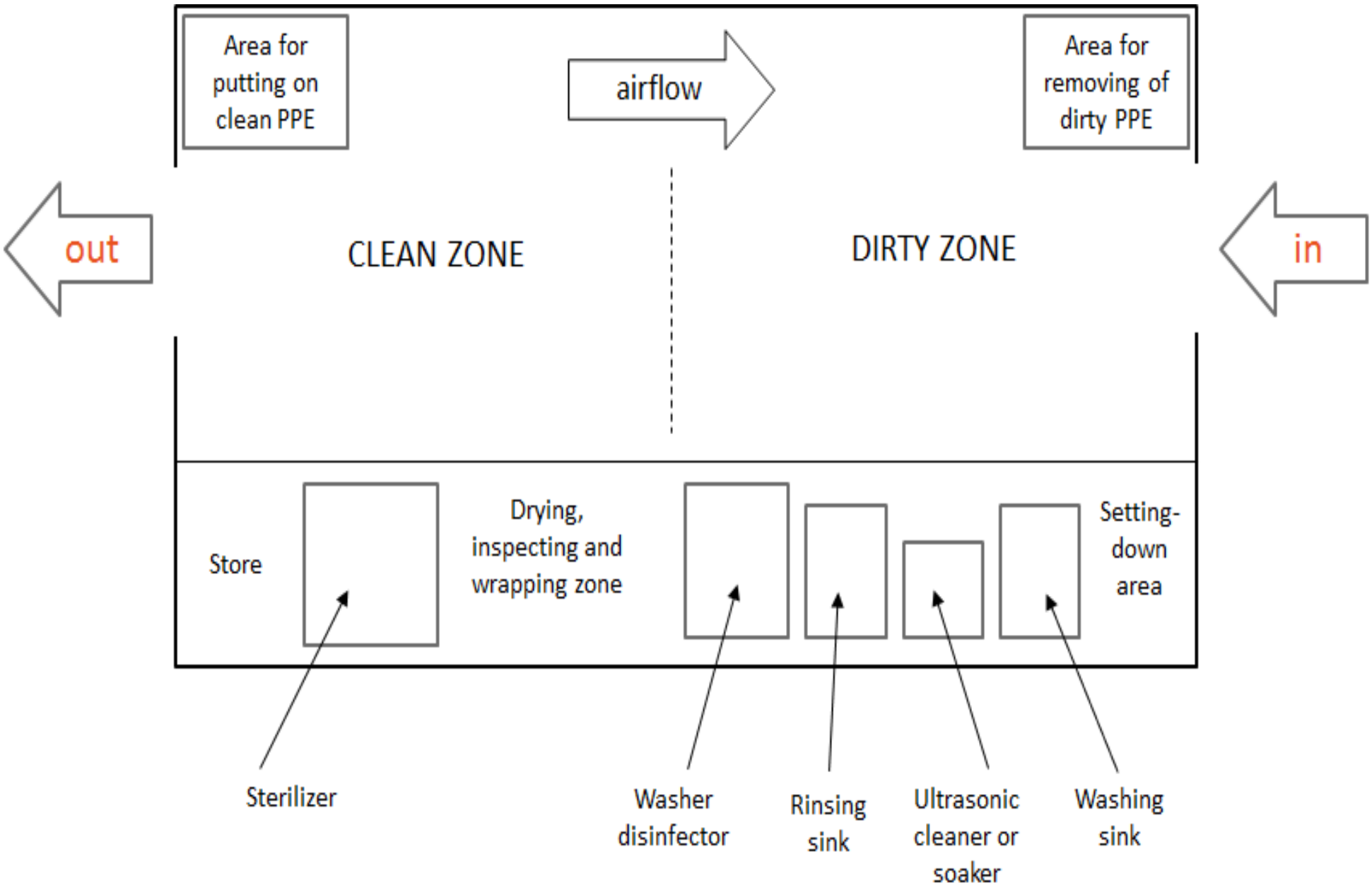
| | MOPP 0 | MOPP 1 | MOPP 2 | MOPP 3 | MOPP 4 |
|---|---|---|---|---|---|
| FIELD GEAR | WORN | WORN | WORN | WORN | WORN |
| OVERGARMENT | CARRIED | WORN | WORN | WORN | WORN |
| FOOTWEAR | CARRIED | CARRIED | WORN | WORN | WORN |
| MASK/HOOD | CARRIED | CARRIED | CARRIED | WORN | WORN |
| HANDWEAR | CARRIED | CARRIED | CARRIED | CARRIED | WORN |

- Reduction of Contamination

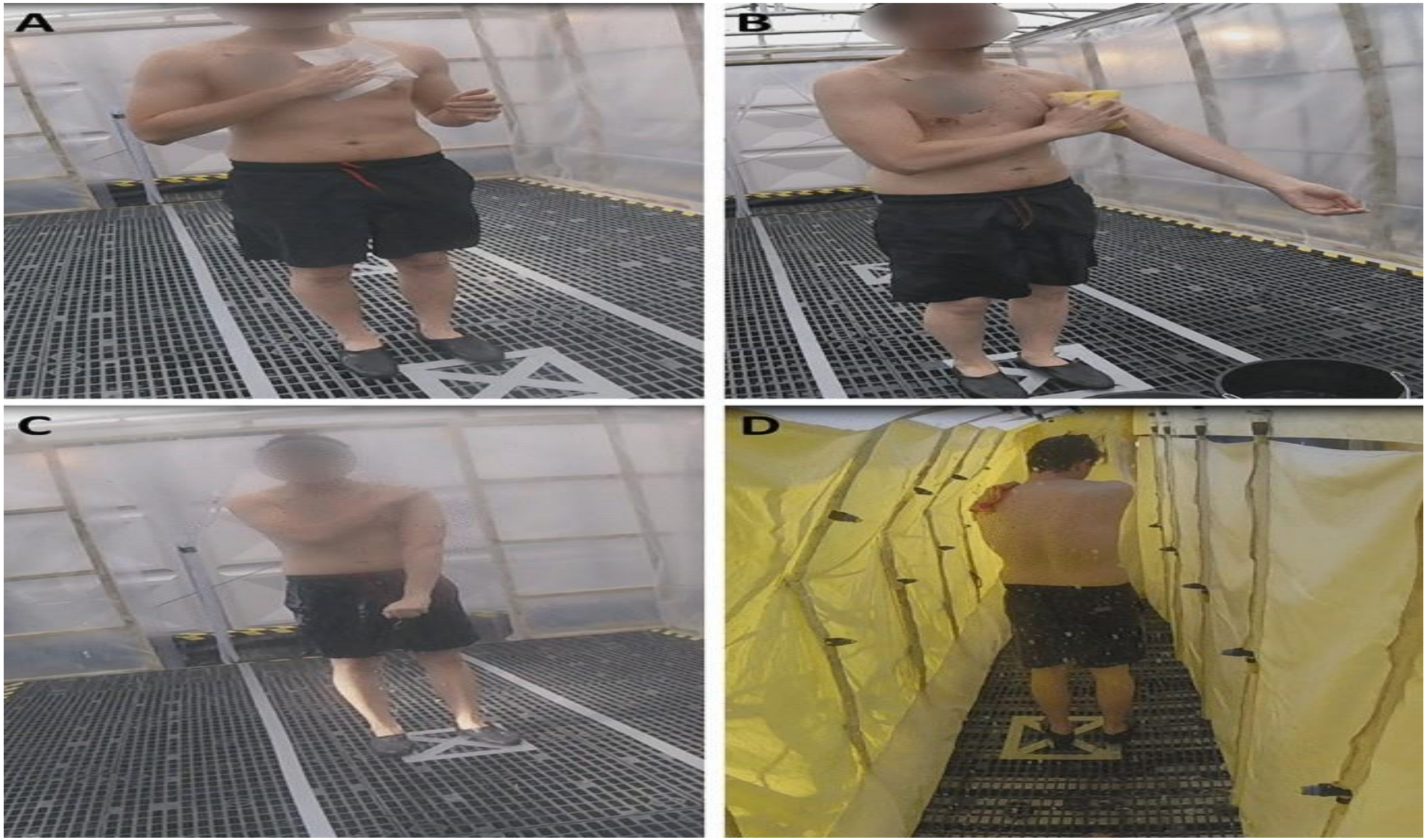
The following rules should be respected in order to prevent spread of contamination zone

- No one should leave the warm zone unless assessed for contamination.
- No one should be allowed to enter the warm  or hot zone except after appropriate personal protective equipment determined by the safety officer
- No one should be allowed to enter the hot zone before the establishment decontamination area
- If anyone enters the hot zone, he is not allowed to pass through warm to cold zone except after being decontaminated and checked to. Ensure that he is completely free from contamination..

# Mobile Decontamination Units


Area for putting on clean PPE
airflow
Area for removing of dirty PPE
out
CLEAN ZONE
DIRTY ZONE
in
Store
Drying, inspecting and wrapping zone
Setting-down area
Sterilizer
Washer disinfector
Rinsing sink
Ultrasonic cleaner or soaker
Washing sink

# 1- Soap and water decontamination



# 2-Dry contamination

## 3- Chemical  Decontaminants

Oxidation of decontamants using chlorine solution is the most important methods of chemical decontamination..

The hypochlorite solution is effective **against nerve gases compounds and mustard gas**

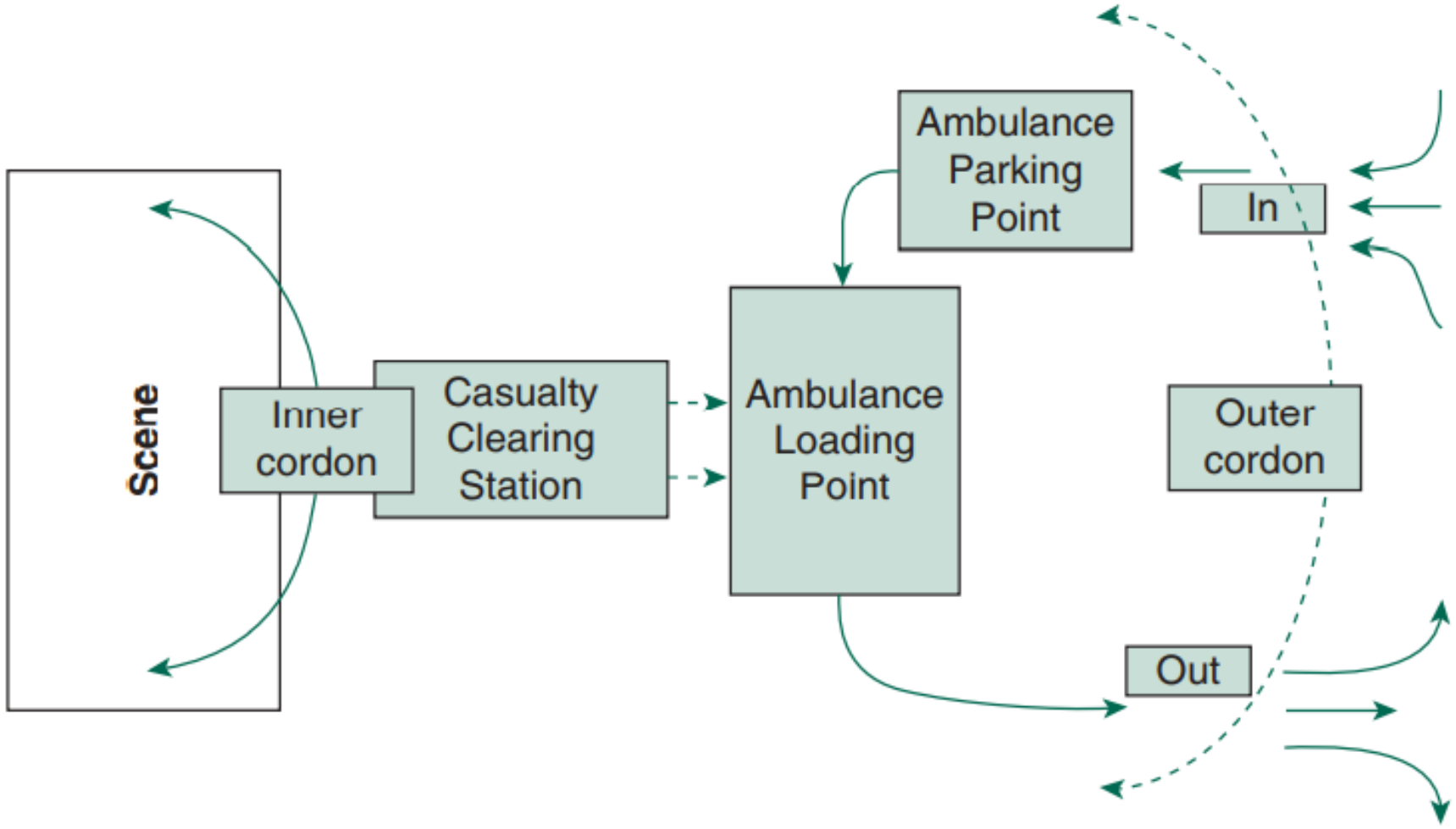
# Wound Decontamination

## Command Hierarchy

- The structure of management system in the scene is revolves around five major tasks:
- Command of response as a whole
- Operations
- Planning
- Logistics
- Finance and administration

- **Safety**
- How to determine the safety officer at the scene and the safety officer for hazardous materials.
- How to ensure complete decontamination before moving between different zones.
- The maximum time limit allowed for responders entering the hot zone .
- Deciding the establishment an emergency line of decontamination
- Determining the site of the staff and equipment at the scene.
- **Communication**
- **Triage**
- **Treatment**
- Treatment is a continuum that may begin in the hot zone in some extreme conditions, but usually begins in the warm zone at the scene.
- In the cold zone, treatment is continued until the victim is safe for transport to hospital, where definitive treatment can take place.
- **Transport**

# The cordons at a major incident



# Transport To the Hospital

**Ambulance Circuit**

Establish clean & contaminated transport tracks in the vicinity of the hospital that ensures that protection of clean vehicles from being contaminated.

**Transfer Inside Hospital**

No patient should be allowed entrance to the ED before being decontaminated.

Once the patient is clean and inside hospital, further transfer of non ambulatory patients is carried out with transfer teams composed of triad of doctor, nurse a porter.

**Inter-Hospital Transfer**

Every effort should be made to avoid secondary transfer of critically ill patients indicated due to the lack of necessary resources needed for patient care.

Transfer decision should be taken jointly between the receiving and dispatching hospitals.

# Response in Hospital

1-Reception phase

2-Definitive care phase

3-Recovery phase

Discharge &Enquiry Area

Press &VIP

P1

P2

P3

E.R

Internal Medicine Building

Bereavement area

Hospital Coordination & Information center

Surgical Building O.R & ICU

# 1- Reception phase

## Command and Control CSCATTT

- Medical coordinator
- Senior nurse
- Senior emergency physician
- Senior manager
- HazMat assessment Team(hazardous materials"): responsible for the safety and assessment of hazards and level of protection needed.
- Decontamination Team: responsible for process of decontamination.

## Surge Capacity

- Stable patients must be treated as soon as possible and released.
- Elective operation and outpatient appointments and diagnostic procedures may be cancelled.
- Establishing Main Areas.
- The hospital needs special areas to deal with the disaster, such as:
- **Primary triage area**: which is vulnerable to contamination, it is present outside emergency department.
- **Decontamination area**: it is always present outside the emergency department
- Access Control point: to limit and control access to the emergency department
- Secondary Triage area: which is not exposed to danger of contaminate present inside the emergency department.

# How to control Contamination

- Ambulance circuit system must be designed with care to limit contamination Idea victims should reach hospital decontaminated, but this is not always the case. Her decontamination corridor must be established outside the ED.
- The hospital should be locked, and ED should have a HVAC system separate from the rest of the hospital. It also should have two negative-pressure rooms. The air in these rooms should be replaced 6 times per minutes and, with the air directly exhausted to the external environment

- **Staff Needs**
- Hospital must have reliable methods to call personnel in, but difficulties in the communication or arrival to hospital should be expected.
- Data collected should include the patient's name or number, site and type of injury, treatment provided, and the path of the patient while receiving various services within the hospital.

**Relatives and Families**

Families of victims will need a waiting area.

Services provided to them should include counseling, access to doctors, social services, and relief agencies. Also. basic needs such as food, drinks, lavatories, and televisions should be provided in waiting area .

**Volunteers**

There must be a system to direct unknown volunteers to a separate area, where the needs for their help s assessed , their identities are checked, and then are allowed to perform the appropriate tasks.

As a rule, no volunteers should be tasked with direct patient care.

**Early Recovery**

It is estimated that there will be between 4 to 20 psychological injuries for every physical injury.

**Definitive Care Phase**

Definitive care takes place in almost every part of the hospital. This includes the decontamination corridor, emergency department, wards, ICU and surgical theaters.

## 2-Definitive care phase

- **Treatment**

Decontamination in hospital should be done through decontamination teams

- members should be closely monitored to provide immediate support & help when needed of PPE for a period of 30 minutes can lead to manifestations of Heat Exhaustion, such as nausea. dizziness and headache
- Personnel wearing PPE should be physically fit. Any body who suffered from upper respiratory tract infections , vomiting or diarrhea during the three days prior to the incident should be excluded from taking a role in decontamination teams
- Recovery Phase

The beginning of recovery stage occurs as soon as the event ends and no more casualties are there in the scene

- **Treatment priority for chemical victims**

| Priority | |
|---|---|
| Airway | Secure patent  airway |
| Breathing | Effective breathing |
| Circulation | Stabilize the circulation |
| Decontamination & Disability | Assessment of neurological deficit |
| Exposure & Evacuation | Final assessment of further injuries and transport for evacuation |

# Commonly used-antidotes in chemical incidents

| gent | Antidote | Dose |
|---|---|---|
| - Nerve Agent (Organophosphorus compounds) | Atropine | 2-8 mg IM/IV Full atropinization maintained at 2mg doses every 3-5 min.for several hours |
| | Pralidoxine | 1-2 g IV in saline |
| | Pyridostigmine bromate | 30 mg/8h |
| 2- Vesicant agent (Lewisite) | British Anti-Lewis (BAL) | 3 to 5 mg/kg IM every 4 hours for 4 doses. |
| 3- Hydrogen cyanide | Amyl nitite | Inhalation for 30s/m and maintained until initiation of Na nitrite |
| | Na nitrite | IV infusion of 10 ml over 3-5 min |
| | Na thiosulphate | IV infusion of 50ml |
| | DMAP | 3mg/kg IV injection |
| 4- BZ(incapacitant) | Physiostigmine | 2mg in 10 ml saline IV over 5 minute |

# Treatment of Vesicant Agents

No specific antidotes exist for sulfur mustard or phosgene oxime exposure.
Antidote: Only Lewisite has specific antidote, the British Anti-Lewis (BAL)

Dimercaprol component of BAL competes with the thiol groups for binding the metal ion which is then excreted in the urine.

It is available for deep IM, which itself may be painful and has significant systemic toxicity.

The standard dosing regimen 1s 3 to 5 mg/kg IM every 4 hours for 4 doses.

**Table 1**. Treatment for Nerve Agent Exposure

| Severity | Vapor exposure | Liquid exposure |
|---|---|---|
| Mild | Observation only | 2 mg atropine, 600 mg 2-PAM Cl, and observation |
| Moderate | 2 mg atropine, 600 mg 2-PAM Cl, and observation | 2–4 mg atropine, 600–1200 mg 2-PAM Cl, and observation |
| Severe | 6 mg atropine, 1800 mg 2-PAM Cl, and 10 mg diazepam | 6 mg atropine, 1800 mg 2-PAM Cl, and 10 mg diazepam |

**Table 2.** Treatment Options for Cyanide Poisoning

| Therapy | Mechanism | Dose | Adverse effects | Comments |
|---|---|---|---|---|
| Amyl nitrite perles | Methemoglobin generator; MetHgb binds cyanide as cyanomethemoglobin | Crush and inhale perle for 30 s of each minute; Replace perle every 3–4 min | Methemoglobinemia (levels of up to 5%); vasodilation; headache | Can be used in mask of spontaneously breathing or ventilatory tubing reservoir in intubated patients; use until sodium nitrite available |
| Sodium nitrite (3% solution) | Methemoglobin generator, MetHgb binds cyanide as cyanomethemoglobin | *Adult: 300 mg (10 ml) over 4 min; *Pediatric: 0.33 ml/kg at 2.5 ml/min (max 10 ml) | Hypotension; syncope; methemoglobinemia; headache; nausea/vomiting; use with caution with severe cardiovascular or cerebral vascular disease | For moderate to severe poisoning; goal methemoglobin level of 20%; methylene blue causes further release of cyanide, crucial to prevent excessive methemoglobinemia; use caution with smoke inhalation and associated elevated carboxyhemoglobin level |
| Sodium thiosulfate 25% solution) | Binds cyanide to form thiocyanate, which is renally excreted | *Adult: 12.5 g (50 ml) IV over 10 min; *Pediatric: 1.65 ml/kg (max 50 ml) | Nausea; vomiting; arthralgia; muscle cramps | Only used for known exposure; detoxification rate is slow; thiocyanate toxicity common with renal insufficiency |
| Hydroxycobalamin | Binds cyanide to form cyanocobalamin, which is renally excreted | *Adult: 4 g IV administered as 1-time dose; *pediatric: unknown | Volume overload | Main limitation: large volume required for treatment; not FDA approved for treatment of cyanide poisoning |
| Dicobalt EDTA<br><br>mon | Chelates cyanide | Adult or pediatric: 4 mg/kg over 1 min, foll.<br><br>by dextrose infusion | Hypotension; vomiting; anaphylaxis; face/neck edema;<br><br>chest pain; arrhythmias | For moderate to severe poisoning; acts more rapidly than nitrites; anaphylaxis more com-<br><br>w/o cyanide poisoning, so only use in known exposure |

# Uses of OXYGEN

## Use of Oxygen .

- Oxygen is vital factor in treatment of chemical contamination victims, either in first aid or resuscitation. Considered superior to antidotes in importance.
- **Oxygen Stock**

Unlike hospitals that have plenty of oxygen sources in the form of outlets and cylinder scenes of chemical incident usually have limited oxygen supplies, and special arrangements must be done in advance to facilitate its provision and use.

- Oxygen is usually supplied to scene in the liquid form, either in special containers for the cold zone. **or in smaller cylinders for hot and warm zones**. Although provision of oxygen supplies is commonly a part of medical response at the scene, other emergency services might have limited numbers of oxygen cylinders that are commonly smaller in some countries.

# Management of the Dead

There are no specific global guidelines on management of contaminated fatalities.

**Factors proposed that define best practice in this area, including:**

1. Ensuring an organized multi-agency response
2. Identifying the chemical agent to take precautions needed
3. Safe management of the fatality to reduce secondary contamination
4. Safe transportation, storage, and disposal of the fatality so that there is little or no impact on others and the environment
5. Ensuring that the religious and cultural beliefs appropriate to the fatality are considered, where possible

# 3- Recovery phase

The decision about the time of "standing down" is critical one that must be done wisely.

## 1- NERVE AGENT:

Ideally, he should be kept under medical observation for a week or longer and not returned until recovery of cholinesterase activity.

However, the tactical situation may lead to modification of these guidelines

**2-Chocking Agents:**

If the patient presented initially with symptoms and a'" abnormal physical examination, chest x-ray, or arterial blood gas, he requires close supervision but can be returned to duty at 48 hours if physical examination, chest x-ray, and arterial blood gases are all normal at that time.

## 3- Vesicant agent

## 1. Mustard

Casualties with minor skin, eye, or pulmonary injuries might be returned to duty as soon as they are given symptomatic therapy at a medical facility.

Those with eye injuries should recover in one to three weeks, except for the low percentage of casualties with severe injures or complications.

Casualties **with mild to moderate pulmonary injuries should return in a week to a m**onth.

Healing of mild skin lesions will enable the casualty to return within several wee but patients with large skin lesions will require hospitalization for many months.

## 2. Lewisite

Casualties with minor skin lesions who receive symptomatic therapy can be returnee - duty quickly.

## *4- Cyanides*

Full recovery is usually relatively fast after cyanide intoxication .

Those with mild - moderate effects from the agent can usually return to duty within hours, and those success treated after severe effects can return within a day.

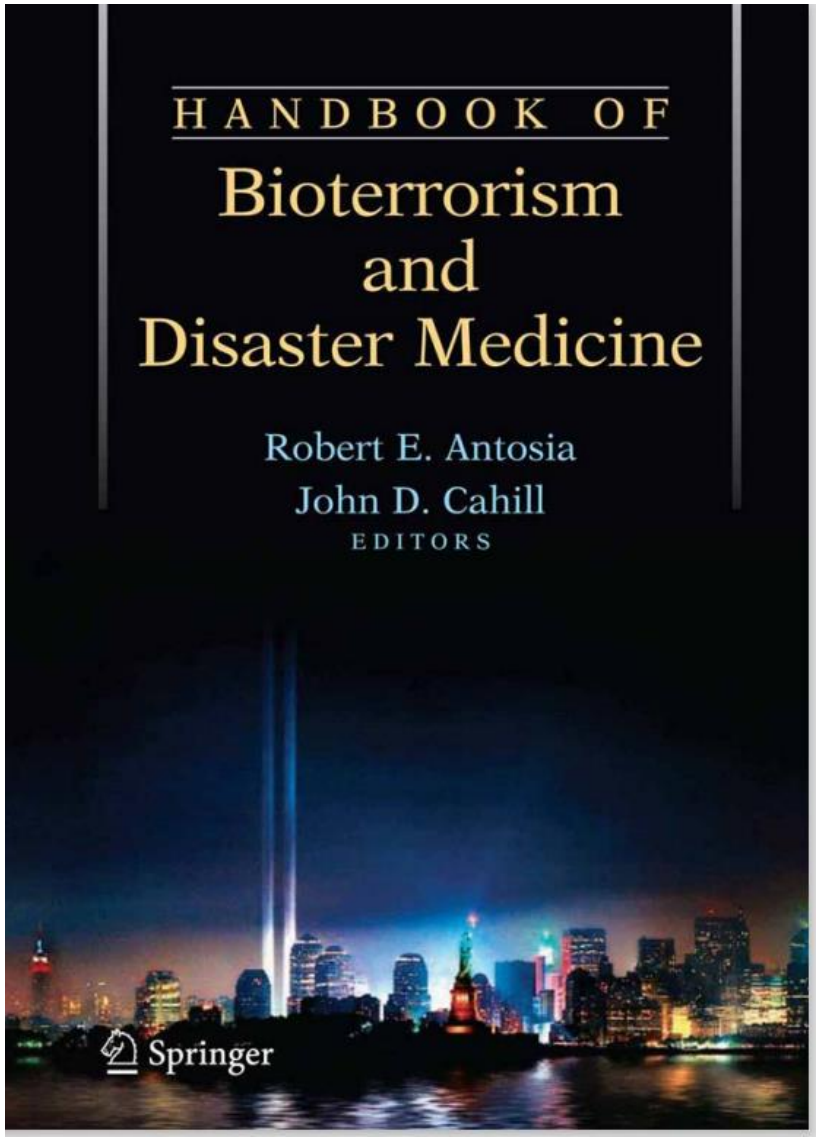
- 

## ***5- Riot Control Agents***

- Because the effects of field concentrations clear within minutes, the casualty should returned to duty as soon as possible. Casualties with complications may require evacuation further medical treatment before returning to duty.

- PSYCHOLOGICAL SUPPORT

# References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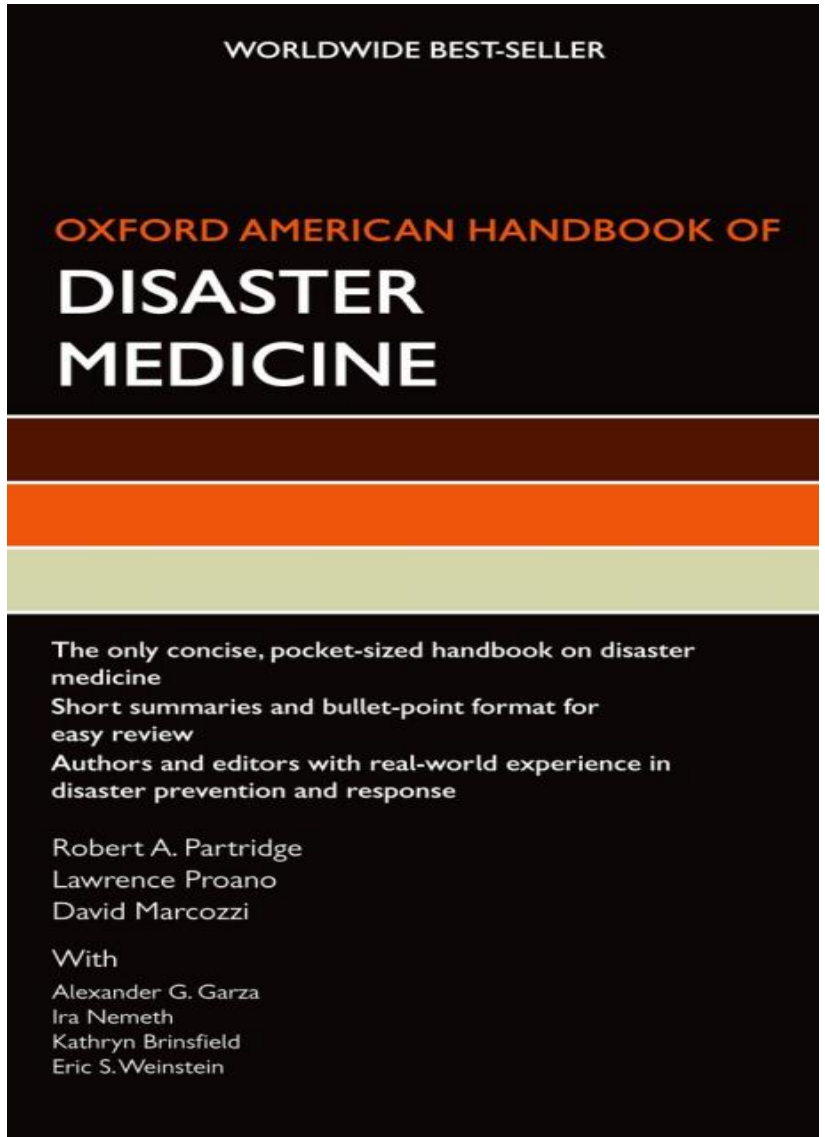
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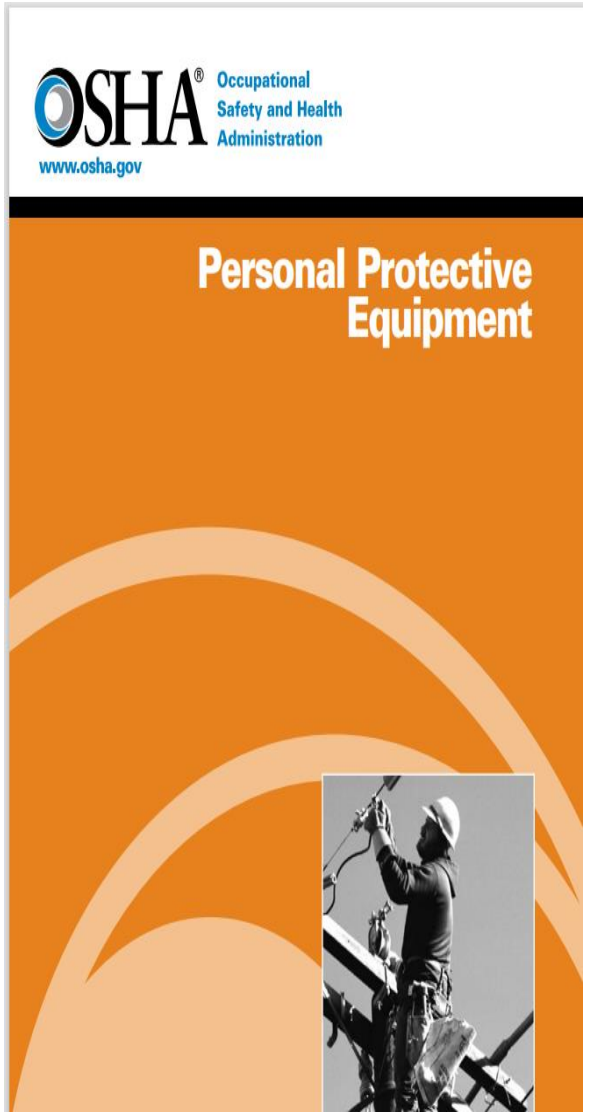
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