

## Prehospital response to Hazmat incidents

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Hazmat incidents rarely occur, but when they do they may cause tremendous casualties and terror among the community. The chemical leakage in Bhopal of India in 1984 resulted in 2500 deaths and injured more than 150,000.<sup>1</sup> The Sarin attack in Tokyo subway station caused more than 10 deaths and 5,000 people were affected.<sup>2</sup> Therefore, both industrial chemical leakage and terrorist attack using chemical agents is a major concern to any cosmopolitan city. To best manage these incidents, we need a well written contingency response plan involving local government departments, the Police Department, the Fire Service Department and the receiving hospitals. (*Hong Kong j.emerg.med.* 2002;9:90-94)

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### Prehospital response planning

A properly written Hazmat contingency plan is the key to a safe and effective response. This plan should include important definitions; Incident Command practices; operational policies and procedures; medical practices and transportation guidelines.<sup>3</sup> The plan should be developed jointly by all involved agencies and reviewed regularly. Training sessions should be held for all medical personnel involved so as to familiarise them with the plan. Finally Hazmat disaster drill should be held at least annually to test the response of different agencies.

### Important definitions

A Hazmat incident can involve a single individual, multiple casualties or mass casualties. Local health

authorities should have their definitions for a major Hazmat Incident. For example, 20 casualties of a chemical accident may well be handled by a major hospital, but it can be disastrous if all the victims are sent to a small rural hospital. Therefore, health authorities should define the receiving capability of each individual hospital and what constitute a Hazmat Disaster. There may also be separate plans for handling industrial chemical incidents and incidents involving weapons of mass destruction (WMD).

### Incident command

The Fire Services Department and the Police Department should work out a unified command approach to handle the Incident. Usually the Incident Officer is the most senior officer from the Fire Services Department. Medical Emergency Team (MET) and a Medical Control Officer (MCO) may need to be dispatched to the incident site.<sup>4</sup>

### Operational procedures

For any Hazmat incident, it is the responsibility of the Police to cordon off the area. The Fire Service Department will be responsible for the Save and

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Rescue procedures. There should be Triage operational guidelines to prioritise the decontamination and transport of multiple patients.<sup>3</sup> There should also be plans for decontamination of ambulatory and non-ambulatory patients and as well as mass decontamination of mass casualties.

### **Medical management protocols**

Medical Management Protocols for common industrial chemical and for vesicant, nerve agent and cyanide should be written up. A Poison Control Centre should be available to provide advice on antidote treatment.

### **Patient destination**

Each emergency department should be equipped to handle victims of Hazmat incident. However, some hospitals may have expertise in handling specific chemical exposures and victims would best be sent to these hospitals for evaluation and treatment.<sup>5</sup>

### **Documentation**

Documentation is very important as some Hazmat incidents may be acts of terrorist attacks and clues are important for law enforcement agencies to investigate.

### **Coordination with other specialty centres**

There may be needs for patients to be sent to other specialty centres for treatment such as Trauma Centre, Burns Unit, Hyperbaric chamber; so these centres should be notified in advance.<sup>4</sup>

### **Media relations**

A designated person should be appointed to handle media requests for information.

## **Communication**

Good communications are central to the efficient management of a major disaster.<sup>3</sup> Communications between the Ambulance Incident Officer, the Ambulance and the Police must be established early and arrangements made for regular liaison.

Communication equipment must be tested regularly amongst the departments involved to ensure that they are functionally properly.

## **Response at the scene**

When responding to a potential hazardous materials scene, the first responders should use their senses to confirm if it is a Hazmat incident. It can be obvious in case where there is noxious fume with pungent smell and eye irritation. But others may not be that obvious if it involved odourless but poisonous vapours and liquids or radioactive materials.<sup>6</sup>

The first responders should use other clues such as location of incident, container shape, markings, placards/labels, and other senses to determine whether a Hazmat incident has occurred.<sup>7</sup>

If a hazardous material leakage is suspected, the first responders should move away to a safe distance before the source can be identified. They should not walk or drive through spilled materials. Rescue of victims should only be done by those who have been properly trained and geared in proper personal protective equipment (PPE).<sup>8</sup>

The first responders at the scene should immediately report to the headquarters regarding the type and nature of incident; name of the possible chemical (including trade name) involved if this is known or suspected; number of victims; signs and symptoms of victims; nature of injuries; state of the materials (solid, liquid or vapour); and routes of exposure (inhalation or dermal).<sup>9</sup> The following information will be very useful for the command post to plan their subsequent

actions:

- (1) the nature of possible injuries
- (2) potential risk of exposure
- (3) risk of secondary contamination
- (4) required PPE
- (5) the need for decontamination
- (6) decontamination procedures
- (7) the appropriate safe distance to cordon off the area<sup>8</sup>

Other agencies that will be involved and also the receiving hospital should be notified at this stage and frequent communication among all parties should be established.

## Arrival at the scene

The most important task on arrival at the incident site is scene isolation and keeping all people and bystanders away.<sup>9</sup> The Police and Fire Services Department should establish the Hot Zone, Warm Zone and Cold Zone as quickly as possible while making sure that they are not contaminated during this process. (Figure 1)

The Hot Zone (or called Exclusion zone) should cover all contaminated areas, and no unauthorized personnel can enter this Zone. Anyone leaving the Hot zone

should be considered to be contaminated and require medical assessment and decontamination.<sup>10</sup>

The Warm Zone (or called contamination reduction zone) is where decontamination and doffing of PPE takes place.<sup>10</sup>

The Cold Zone (or called Support Zone) is the clean zone.<sup>10</sup>

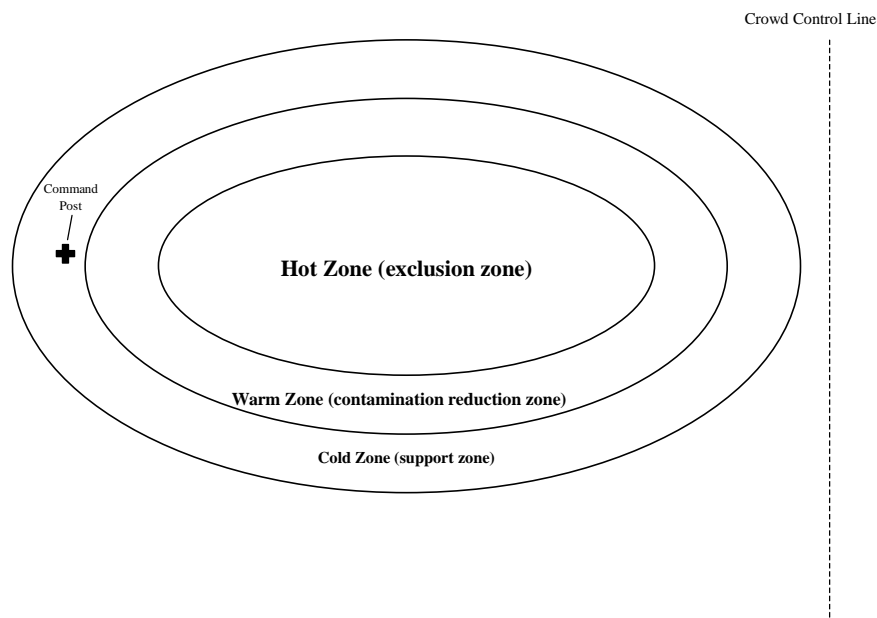
For any medical personnel who has not been properly trained or dressed in proper PPE, they should only stay in the Cold Zone.<sup>10</sup>

## Triage

Triage of patients is very important in mass casualties Hazmat incidents involving mass casualties. The triage principles are to identify life-threatening problems, to sort out casualties according to their severity and to use the decontamination resources appropriately.<sup>11</sup>

## Triage in Hot Zone

The triage principle is based on ABC (airway, breathing and circulation).



**Figure 1.** The set up at incident site.

If patient has an insecure airway, insert an oropharyngeal airway or insert a laryngeal mask airway. This patient has extrication priority from the Hot Zone.<sup>6</sup>

If patient has abnormal breathing (respiratory rate <10 or >30 per minute), then he has extrication priority. If patient has abnormal circulation (weak or absent carotid pulse), he will also has extrication priority.<sup>6</sup>

In the case where the Hazmat incident is the result of a potential terrorist attack, there should be a quick evaluation as to whether it is due to nerve agent, vesicant or cyanide attack. In suspected nerve agents poisoning, look for features of DUMBELS (Diarrhoea, Urination, Miosis, Bronchorrhea, Emesis, Lachrymation, Salivation). The treatment is to give victim antidote by autoinjection of atropine and pralidoxime.<sup>3</sup> In suspected vesicant attacks, look for any redness of eyes and skin in victims. The treatment is early decontamination. If there are features of cyanide poisoning, treatment priority is to give antidote such as intranasal amyl nitrate.<sup>3</sup>

## Decontamination

To prevent further exposure of victims to hazardous materials, the best way is to remove the victims from the Hot Zone and perform decontamination.

The decontamination facilities are usually set up at the outer edge of Hot Zone or in the Warm zone. The sooner the victim is decontaminated, the sooner he can be transferred to the Cold zone for further evaluation and treatment.

The decontamination procedures begin with the removal all contaminated clothing, including jewellery and watches. All removed items should be double-bagged in plastic bags, sealed and labelled. The patient should then be rinsed thoroughly from head to toe with large amount of water. All obvious contaminants should be brushed off. The medical personnel present should be dressed in appropriate personal protective equipment (PPE) and avoid secondary contamination.<sup>6</sup>

An effective decontamination can be achieved by removing the patient's clothing and washing with soap

and water. This step, if performed properly, can reduce the contamination to a level that is not a threat to the patient and the medical personnel. However, determining the adequacy of decontamination can be difficult. It is often based on clinical judgement by the responders at the scene rather than by using detection devices.<sup>6</sup>

Washing should be done using warm water, soft brushes and mild soap. Hot water, stiff brushes and vigorous scrubbing are not recommended as this will cause vasodilatation, abrasion and increase the risk of entry of hazardous materials into the skin. Ambulatory patients should be advised to undergo the decontamination procedures themselves under supervision. The run-off from the decontamination process can be collected by a proper container that allow for safe disposal and further analysis if necessary.<sup>5</sup>

Decontamination of non-ambulatory patients is more difficult. The medical personnel will need to assist the patient with this process. Care must be taken to clean the back, axilla, buttocks and hair. Any equipment such as neck collar and spinal board that accompany the patient will need to be decontaminated or exchanged before entering the Cold zone.

For those victims who have inhaled toxic gases, after they have been removed from the exposure area and undergone decontamination and brought into an area with fresh air, the amount of leftover gas is minimal and unlikely to poison others.<sup>6</sup>

## Mass decontamination

In some Hazmat incidents, there may be a large number of victims being exposed to a chemical agent, or believe that they have been exposed. In this case, a system for quick decontamination of many patients simultaneously is needed in order to control the escaping crowd, to minimize secondary contamination and to prevent panic. There should be contingency plan by the Fire Services Department or the Hazmat Response team to supply large volume of water through specially-mounted nozzles on fire engines or other methods to rinse large number of individuals

quickly.<sup>10</sup> Once the patients have undergone the decontamination process, they should be given temporary clothing to wear before being directed to the Cold Zone for evaluation.

### **Patient treatment at Cold Zone**

In the cold zone, the medical personnel must address the patients' ABC first. Unless in life threatening conditions, intubation or intravenous injections should not be done, otherwise it may introduce hazardous materials into the patient. If it is required, it has to be done in fully decontaminated area.<sup>10</sup> Some patients may need antidote treatment but most will need only supportive treatment at the site.

### **Patient transfer**

When transporting patients exposed to hazardous materials, care should be taken not to contaminate the ambulance. The patient should be as clean as possible before the transfer. No patient should be transported to hospital without undergoing decontamination at the incident site.<sup>10</sup> During transport, ambulance personnel should use appropriate respiratory protection such as open window to allow circulation of fresh air.

The receiving hospital should be contacted prior to the ambulance arrival. The ambulance should be parked away from the emergency room or in a predesignated decontamination location to limit the risk of contaminating hospital facilities.<sup>10</sup> The patient should not be allowed to enter the hospital until permission is granted.

### **Conclusion**

Hazmat Incidents may occur in any part of the world. It can range from a single victim being contaminated in his workplace to a large scale incident involving mass casualties due to massive chemical leak or

terrorist attacks. Also the toxic substance involved may vary from place to place. Multiple agencies are involved and it is hard to imagine that without a carefully written well-designed plan and protocols, how a effective and efficient response can be achieved. The role of first responders to the scene are crucial. As their response will determine whether contingency plan should be activated, the type of PPE required and the method to control secondary contamination. Therefore they should be adequately trained on these issues. Drill involving all agencies should be conducted regularly to test communication and coordination. This is the only way to ensure that we are better prepared to handle incidents due to hazardous materials.

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