Section II. Response and Patient Management

In the protocol for responding to potential hazardous materials incidents, the following primary considerations should be included: activities to undertake en route to the scene and upon arrival at the scene; guidelines for assessment, decontamination, and treatment of victims; and patient transport to the hospital.

En Route to a Hazardous Materials Scene

First responders need to be alert for hazardous materials when responding to every call. Hazardous materials can be obvious (i.e., noxious fumes, gasoline, or corrosive liquid spills) or they can be unnoticeable (odorless, but poisonous and/or flammable vapors and liquids, or radioactive). If a vehicle has a diamond-shaped placard or an orange-numbered panel on the side or rear, the cargo should be assumed to be hazardous. Unfortunately, not all hazardous materials carriers will be clearly marked. For example, delivery trucks regularly carry hazardous materials that can be released in a collision, yet rarely are marked. Therefore, first responders should use caution when attempting rescue at any incident scene. The hazard, or lack thereof, must be determined immediately — before first responders enter a chemically contaminated area.

The responder should pay attention to certain clues en route to an incident scene that could tip off the possibility of hazardous material involvement. Billowing smoke or clouds of vapor could give advanced warning that a dangerous substance may be involved. Senses are one of the best ways to detect chemicals, particularly the sense of smell. However, if you smell something you are too close and should remove yourself to a safe distance until you know more about the source of the odor. Failure to do so could cause injury. The nature of an incident should also be a key to identifying the possibility of a hazardous materials involvement. Tank trucks, train wrecks, and incidents at fixed facilities where chemicals are used could indicate hazardous materials involvement. The dispatcher may have clues that could indicate hazardous materials precautions are necessary. These could include the nature of an incident (e.g., leaking tank) and the nature of injuries (e.g., 25 workers with shortness of breath).

It is important that emergency responders pay attention to factors such as wind direction and topography when approaching a suspected hazardous materials incident. Responders should always approach upwind and upgrade from an incident, taking note that low lying areas such as stream beds and gulleys, or in urban areas, places such as courtyards or tall buildings, may contain vapor clouds that prevent dispersal by the wind.

Responders should also attempt to gather as much information as possible while en route to an incident. Using resources outlined in Section I under Hazard Recognition, they can relay this information to a predesignated information center (e.g., regional poison control center, ATSDR) to obtain information about definitive care procedures including:

- Possible health effects
- Treatment/antidote therapy
- PPE required
- Decontamination procedures.

Information that will be needed to determine appropriate care will include:

- Knowledge of whether a chemical may be involved
- Chemical name of substance involved
- State of material (solid, liquid, gas)
- Quantities involved
- Number of victims
- Signs or symptoms
- Nature of exposure (inhalation, dermal, etc.)
- Length of exposure.

If a hazardous substance is involved and has been identified, responders should locate information concerning that substance using appropriate references, such as Material Safety Data Sheets (MSDS), the Department of Transportation (DOT) Emergency Response Guidebook, and CHEMTREC, as outlined in Section I under Hazard Recognition. This information can also help responders identify possible health hazards, including the nature of possible injuries; routes of exposure; proper level of PPE required; and the appropriate safe distance from the hazard to protect EMS personnel, the public, and property from exposure or other dangers, such as explosion or fire. This information may be available from a command post if one has been established. Section I outlines these procedures for PPE, and Section III describes guidelines for planning.

Communications with other agencies or services involved should also begin en route to an incident. If an Incident Command System (ICS) is implemented, interactions with an incident commander will identify the best route of approach, the possible dangers involved, and the estimated number of injuries. Communications between on-site response personnel and receiving facilities should be kept open to relay as much advance information as possible. Communications with other services should include the fire department, police, and hazardous materials response team (if one exists).

Arrival at the Scene

Many first responders (police, fire-rescue, and EMS personnel, including physicians and nurses) are accustomed to immediately attending an injured victim; often they disregard the possibility of danger to themselves. Consequently, a rescuer entering a contaminated area also risks exposure and the potential

for becoming a victim. Even though rescue of any injured patient is important, it should only be attempted after it is certain that the responders, themselves, will not become injured. Responders must use judgement when assessing the dangers involved in a possible hazardous materials incident. Patient care should not be delayed unnecessarily when only minimal risk is involved, but many factors must be considered in determining the level of danger. Training and experience are essential for decision-making and those decisions, at best, are often a judgement call. As a rule, however, rescue should not be attempted by individuals who are not properly trained and equipped with appropriate PPE. Rescue should only be attempted by trained and equipped emergency personnel, fire department, or hazardous materials response team personnel. Exhibit II-1 represents a typical decision tree that may be used in making decisions about risk and response.

Upon arrival at a scene, an initial assessment of the situation and the size of the incident should be conducted. Additional support should be requested, if necessary. Sources of on-scene assistance may include:

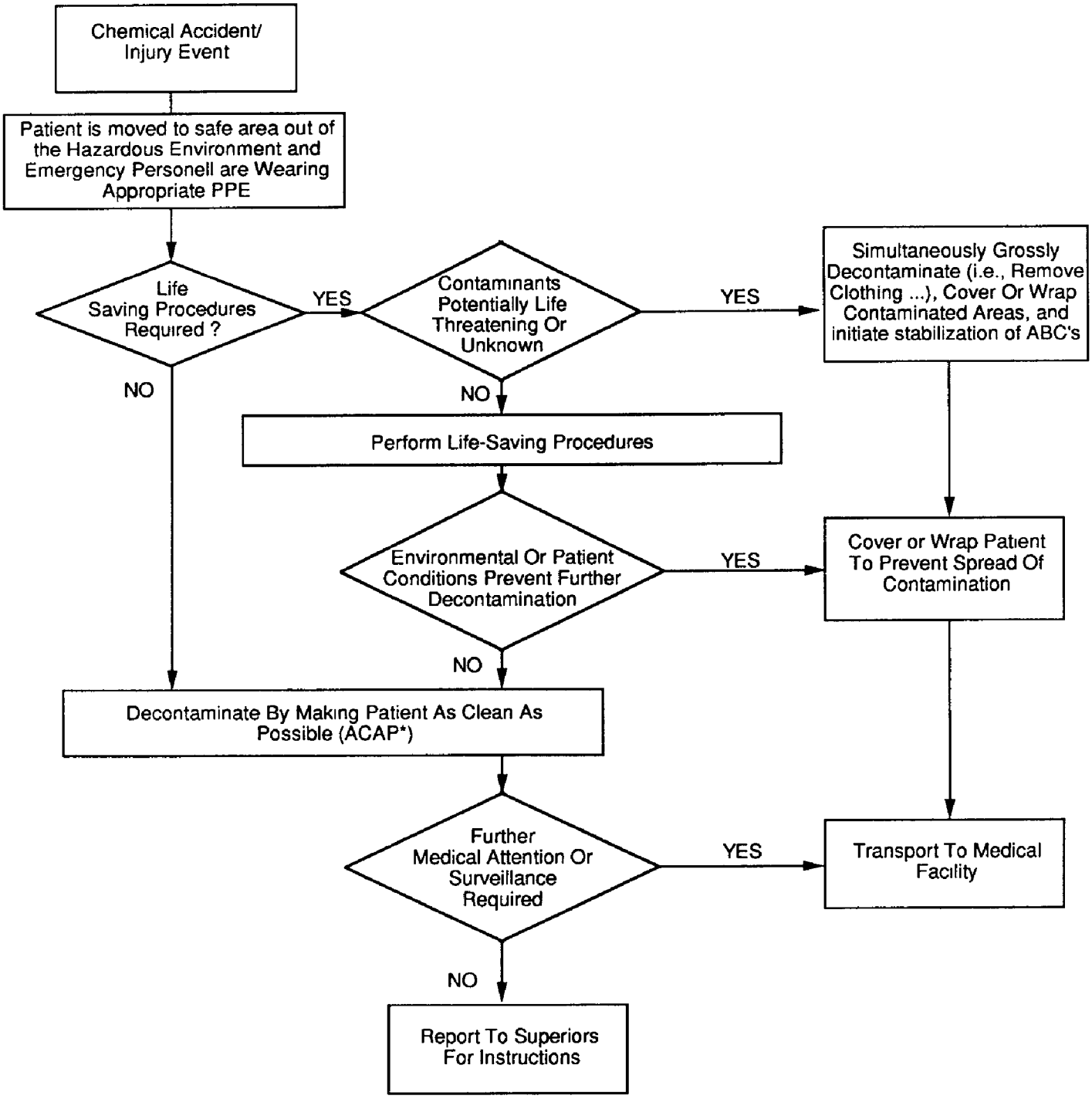
- Fire Departments
- Police Departments
- Health Departments
- Hazardous Materials Response Teams
- Local Industry Response Teams

Unless otherwise directed, responders should park upwind, upgrade, pointing away from, and a safe distance from any incident where hazardous materials are suspected. Safe distances for specific chemicals may be determined using the DOT Emergency *Response Guidebook*, by consulting CHEMTREC, or by using other response references. Responders should not drive or walk through any spilled or released materials (i.e., smoke and vapors as well as puddles). Also, a first-in responder should confirm that local authorities have been notified and are aware that hazardous materials might be involved.

Don't

- ***Don't drive or walk through any spilled materials.***
- ***Don't allow unnecessary contamination of equipment.***
- ***Don't attempt to recover shipping papers or manifests unless adequately protected.***
- ***Don't become exposed while approaching a scene.***
- ***Don't approach anyone coming from contaminated areas.***
- ***Don't attempt rescue unless trained and equipped with appropriate PPE for the situation.***

Exhibit II-1
Sample EMS Decision Tree For Chemical Incidents



** Contamination reduced to a level that is no longer a threat to patient or responder*

For first-in responders, the first priority is scene isolation. KEEP OTHERS AWAY! KEEP UNNECESSARY EQUIPMENT FROM BECOMING CONTAMINATED.

Immediately establish an Exclusion (Hot) Zone, but do not become exposed in doing so (see Exhibit I-11). The Exclusion Zone should encompass all contaminated areas, and no one should be allowed to cross into that zone. Assume that anyone leaving the Exclusion Zone is contaminated, and should be assessed and decontaminated if necessary. Additional zones, such as Contamination Reduction (Warm), Support/Clean (Cold), and Crowd Control, should be determined as soon as the opportunity becomes available. *Do not remove nonambulatory patients from the Exclusion Zone unless properly trained personnel with the appropriate PPE are available and decontamination has been accomplished.*

Not all hazardous substances have color or odor. Therefore, a responder with appropriate PPE may be required for rescue. If an incident commander has been identified, report to him or her and coordinate patient access and emergency care activities. **Unless appropriately trained and protected, responders must not attempt entry into the Exclusion Zone to rescue patients or to recover shipping papers or manifests.**

Do not approach any victims without first consulting with the incident commander. No rescue should be attempted unless the responder is trained and equipped with appropriate PPE for the situation. Likewise, response personnel should not approach anyone coming from contaminated areas (particularly those potentially contaminated) until given permission by the incident commander.

It must be emphasized that EMS responders who have not been trained should stay out of the hot zone and decontamination area. Sophisticated protective gear should only be used by those with proper knowledge and experience. If decontamination is carried out before the patient is transported to the EMS personnel at the perimeter, then no special gear may be needed.

Assessment, Decontamination, and Initial Treatment of Patients

Primary goals for emergency personnel in a hazardous materials incident include termination of exposure to the patient, removal of the patient from danger, and patient treatment — while not jeopardizing the safety of rescue personnel. Termination of exposure can best be accomplished by removing the patient from the exposure area and removing contaminants from the patient. If the patient is removed from the possibility of additional exposure or other dangers and the patient is no longer contaminated, the level of protection for personnel can be downgraded to a level that will better facilitate the provision of patient care. The potential for additional or increased danger to patient and responder prohibits any treatment inside the Exclusion Zone other than basic life support. The probability of contact

with hazardous substances either by subsequent release of materials still in the area, along with the dangers of fire or explosion, and the restriction of movement by necessary PPE outweighs the time saved by attempting patient care in a dangerous area. Gross management of Airway, Breathing, and Circulation (ABC) is all that should be undertaken while there is potential for further injury to patient or response personnel.

One of the most important steps in scene hazard assessment should be obtaining immediate assistance from a regional poison control center. The poison center can help determine the risk for secondary contamination, the need for special protective gear and decontamination procedures, and the toxic effects of the chemical.

Primary assessment can be undertaken while simultaneously performing decontamination in the Contamination Reduction Zone. **Priority should be given to the ABC: Airway, Breathing, and Circulation.** Once life-threatening matters have been addressed, rescue personnel can then direct attention to secondary patient assessment. It is important to remember that appropriate personal protective equipment and clothing must be worn until the threat of secondary exposure is no longer a danger. **Therefore, the sooner the patient becomes decontaminated the sooner response personnel may reduce protective measures or downgrade the level of protection.**

During initial patient stabilization, a gross decontamination should simultaneously be performed. This consists of cutting away or otherwise removing all suspected contaminated clothing, including jewelry and watches, and brushing or wiping off any obvious contamination. Care should be taken to protect any open wounds from contamination. Every effort should be made by personnel to avoid contact with any potentially hazardous substance.

Effective decontamination consists of making the patient As Clean As Possible (ACAP). This means that the contamination has been reduced to a level that is no longer a threat to the patient or the responder.

Decontamination

Directives for decontamination include the reduction of external contamination, containment of the contamination present, and prevention of the further spread of potentially dangerous substances. In other words, remove what you can and contain what you can't. With a few exceptions, intact skin is less absorptive than injured flesh, mucous membranes, or eyes. Therefore, decontamination should begin at the head of the patient and proceed downward with initial attention to contaminated eyes and open wounds. Once wounds have been cleaned, care should be exercised so as not to recontaminate them. This can be aided by covering the wounds with a waterproof dressing. For some chemicals, such as strong

alkali, it may be necessary to flush exposed eyes with water or normal saline for several hours. Exhibit II-2 outlines the minimum equipment that is required for decontamination of patients by emergency response personnel. These lists are not detailed; they are only provided to guide departments in developing their own equipment lists based on their community needs and requirements. Many chemical substances, even though highly toxic, carry no intrinsic risk for contamination to others. Most toxic gases, such as carbon monoxide or arsine, are highly poisonous, but once the victim has been brought out of the exposure area and into the fresh air, the amount of leftover gas in and around the patient simply *cannot* poison others. Even many chemicals that have the potential for spreading contamination can be made less hazardous by simply diluting them with copious amounts of water.

Exhibit II-2
Suggested Decontamination Equipment

At a minimum, the protective equipment listed is necessary to participate in decontamination procedures. Protective equipment used for decontamination should be no less than one level below that used for entry into the hazardous environment. Positive-pressure self-contained breathing apparatus (SCBA) and fully encapsulated suits may be necessary in extreme cases.

- Containment equipment
  - — Pool or tank
  - — Tarps
  - — 6-mil construction plastic
- Saw horses to support backboards
- Fiberglass backboards
- Supports for ambulatory patients
- Water supply
- Scissors for clothing removal
- Mild detergent (dishwashing liquid)
- Five-gallon buckets
- Sponges and soft brushes
- Large plastic bags for contaminated clothing
- Small plastic bags for patients' valuables
- Tags and waterproof pens to mark bags
- Disposable clothes and shoes for ambulatory patients
- Towels and blankets
- Clear, zip-front body bags to minimize contamination to transport personnel and ambulances
- Tape (duct, 4-inch)

External decontamination should be performed using the least aggressive methods. Limit mechanical or chemical irritation to the skin to prevent increased permeability. Wash contaminated areas gently under a gentle spray of water, and wash with a soft sponge using a mild soap such as dishwashing liquid. Use warm, never hot, water. The degree of decontamination should be completed based on the nature of the contaminant, the form of contaminant, the patient's condition, environmental conditions, and resources available. Care should be taken so that contaminants are not introduced into open wounds. Responders should try to contain all runoff from decontamination procedures for proper disposal. The patient should be isolated from the environment to prevent the spread of any remaining contaminants.

Ensure that all potentially contaminated patient clothing and belongings have been removed. Properly label bags that contain clothing or other potentially contaminated articles. Contaminated clothing and belongings should not be transported with the patient in the ambulance unless the incident commander approves, and the clothing and belongings have been adequately bagged.

Decontamination

- Decontaminate from the head down
  - — take care not to introduce contaminants into open wounds
  - — decontaminate exposed wounds and eyes before intact skin areas
  - — cover wounds with a waterproof dressing after decontamination
- For external contamination, begin with the least aggressive methods
  - — limit mechanical or chemical irritation of the skin
  - — wash contaminated area gently under a stream of water, and scrub with a soft brush or surgical sponge
  - — use warm, never hot, water
- Remove contaminants to the level that they are no longer a threat to patient or response personnel
- Isolate the patient from the environment to prevent the spread of any remaining contaminants
- If possible, contain all runoff from decontamination procedures for proper disposal
- Ensure that all potentially contaminated patient clothing and belongings have been removed
  - — properly label bags that contain clothing or other potentially contaminated articles

Considerations for Patient Treatment

Basically, a contaminated patient is like any other patient and may be treated as such except that responders must protect themselves and others from dangers due to contamination. Response personnel must first address life-threatening issues and then decontamination and supportive measures. Primary surveys will be accomplished simultaneously with decontamination; and secondary surveys should be completed as conditions allow. The chemical-specific information received from the hazardous materials response resources should be incorporated into the proper patient treatment procedures. In multiple patient situations, proper triage procedures should be implemented using local community emergency response plans (see Section III, SARA Title III). Treat presenting signs and symptoms as appropriate and when conditions allow. The sooner a patient has been decontaminated the sooner he or she can be treated like a "normal" patient. Administer orders of the designated poison control center when conditions allow. Unless required by life-threatening conditions prophylactic invasive procedures, such as intravenous injections (I.V.s) or intubation, should be performed only in fully decontaminated areas where conditions permit. These procedures may create a direct route for introducing the hazardous material into the patient. Oxygen should be given using a bag valve mask with reservoir device (rebreather) or manually triggered oxygen-powered breathing device. The contaminated atmosphere should not mix with the oxygen if possible. Reassess the patient frequently because many hazardous materials have latent physiological effects. While some cases may require treatment with antidotes, most cases will be handled with symptomatic care.

Patient Treatment

- Assign highest priorities to ABC and decontamination
- Complete primary and secondary surveys as conditions allow. Bear in mind the chemical-specific information received from the designated poison control or information center
- In multiple patient situations, begin proper triage procedures
- Treat presenting signs and symptoms as appropriate and when conditions allow
- Administer orders of the designated poison control center when conditions allow
- Perform invasive procedures only in uncontaminated areas
- Reassess the patient frequently because many chemicals have latent physiological effects
- Delay prophylactic measures until the patient is decontaminated

Patient Transport to Hospital

When transporting a *contaminated* patient by ambulance, special care should be exercised in preventing contamination of the ambulance and subsequent patients. Exposed surfaces that the contaminated patient is likely to come into contact with should be covered with plastic sheeting.

Fiberglass backboards and disposable sheeting are recommended. If a wood backboard is used, it should be covered with disposable sheeting or it may have to be discarded afterwards. Equipment that comes in contact with the patient should be segregated for disposal or decontamination. EMS personnel should wear protective clothing appropriate for conditions (e.g., surgical gloves, CPC, etc.), and respirators, if indicated (see Section I, PPE). Exhibit II-3 outlines suggested equipment required for care and transport of contaminated patients. Like other listings provided, it is only for guidance, and items may be added or deleted with experience.

The patient should be as clean as reasonably possible before transport, and further contact with contaminants should be avoided. Protective clothing should be worn by response personnel as appropriate. If decontamination cannot be performed adequately, responders should make every attempt to prevent the spread of contamination and at the very least remove patient clothing, wrap the patient in blankets, followed by body bags or plastic or rubber sheets to lessen the likelihood of contamination to equipment and others. Considerations should be made for chemicals that present the added danger of accelerated skin absorption due to heat. In these cases body bags and plastic or rubber sheets should not be used. Minimize contamination from shoes. The name of the involved chemicals, if identified, and any other data available, should be recorded before leaving the scene. Oxygen should be administered by rebreather mask for any victim with respiratory problems unless contraindicated (e.g., paraquat). Eyes that have been exposed should be irrigated with available saline or water, and such irrigation should be continued en route to the hospital. Personnel also should be alert for any respiratory distress.

In an ambulance during transport, personnel should use appropriate respiratory protection. Provide the maximum fresh air ventilation (e.g., open windows) that weather conditions permit to the patient and driver's compartment regardless of the presence or absence of odors.

Exhibit II-3
Supplies Needed to Prepare the Ambulance for Care of a Patient Contaminated with Hazardous Materials

- Enough 6-mil construction plastic* cut to size to:
  - — Cover floor of ambulance
  - — Cover squad seat
  - — Cover litter
- Disposable sheets
- One box of plastic trash bags to contain contaminated medical supply waste, gloves and the victim's clothes, and the like
- Personal protection:
  - — CVC disposable suits with built-in hoods and booty/boot covers
  - — Positive-pressure SCBA
  - — Full-face mask respirator with an orange- and purple-type cartridge (acid gas, organic vapor, highly toxic dust, mist and fumes, and radionuclides-rated cartridge)
  - — Poly Vinyl Chloride (PVC) or duct tape for taping closures
  - — Two-piece rainwear
  - — Rubber boots with steel toes
  - — Nitrile gloves with 14-inch cuffs
  - — Duct tape to seal suit seams if necessary

If the fire department's protective clothing is used, rainwear should be worn as an overgarment. Hydrocarbons and other chemicals may permeate the "bunker clothes."

NOTE: The protective equipment listed is to be used for patient care situations after initial decontamination. It is meant to be used when complete decontamination of the patients cannot be guaranteed or when assisting with decontamination procedures (in extreme cases positive-pressure SCBA and encapsulated suits may be required for decontamination procedures). **It is not meant to be used in rescue operations of victims found in a hazardous area.** Under no circumstances should this equipment be relied upon for entry into hazardous environments. Protective equipment for entry must be appropriate to and compatible with the products involved. This may include positive-pressure SCBA and fully encapsulated suits. Many factors must be taken into consideration when determining the appropriate level of protection. Consequently, selection of protective equipment must be done by a qualified individual.

**Wet plastic is slippery; stability is important.*

Re-contact the receiving hospital and provide an update on treatment provided or required and any other information received from the designated poison control center. Instructions for the procedure to enter the hospital with a contaminated patient should also be requested. Facilities receiving a potential hazardous material patient will need as much information as possible.

A checklist should be developed and made available for all vehicles and telephone or radio communication centers. Information that will aid in initiating appropriate actions includes:

- Type and nature of incident
- Number of patients
- Signs/symptoms being experienced by the patients
- Nature of injuries
- Name of chemical(s) involved
- Information available at the site concerning the chemical(s)
- Extent of patient decontamination in the field
- Estimated time of arrival

The ambulance should park in an area away from the emergency room or go directly to a pre-designated decontamination center or area, thereby limiting exposure to hospital facilities. In order to protect staff and other patients, the patient should not be brought into the emergency department before ambulance personnel receive permission from the hospital staff.

Upon the release of the patient to the hospital, any equipment that is believed to have become contaminated should be double bagged. The use of disposable equipment is recommended whenever possible. Contaminated articles should be kept sealed until the Incident Commander or his designee gives further instructions. If possible, send any material safety data sheets concerning the involved hazardous materials with the patient.

The ambulance should not go back into service unless the vehicle is clean. This again emphasizes the importance of thorough patient decontamination; if the patient is clean, then the vehicle (interior) is clean. After the patient is unloaded from the ambulance, a check should be made with the hospital to determine where the ambulance can be safely decontaminated, and whether equipment is available for this purpose. When decontamination is required, the most appropriate method should be identified using information resources. In most cases soap and water are adequate for decontaminating of the vehicle.

Transport to Hospital

- Re-contact the receiving hospital

  — update the hospital on treatment provided and any other information received from the designated poison control center, and
  — obtain instructions on approaching and entering the hospital.

- Avoid contact with contaminants; provide protection to the vehicle; wear protective clothing as appropriate.

- Get patient as clean as possible prior to transport.

- Administer oxygen by mask for any patient with respiratory problems (except as contraindicated).

- Before leaving the scene, write down the name of the involved chemicals, if identified, and any other data available.

- Provide fresh air ventilation to patient and driver's compartment.

- Continue to irrigate eyes that have been exposed with normal saline or water en route to the hospital and be alert for any respiratory distress.

- Park the ambulance in an area away from the emergency department or go directly to a predesignated decontamination area.

- Do not bring patients into the emergency department before ambulance personnel receive permission from the hospital staff.

- After unloading the patient, check with the hospital to determine where the ambulance can be safely decontaminated, and the availability of equipment for this purpose.

- **Decontaminate exposed personnel.**

Air Transportation of Chemically Exposed Patients

There is a potential danger in transporting patients in a helicopter from a hazardous materials incident. Often decontamination is not complete, and the flight crew could experience difficulty breathing or seeing. Also the area of the incident needs to be clearly communicated with the flight crew to avoid traveling through an unsafe area. Furthermore, the downdraft from the helicopter could affect vapors or fumes on the scene. Considerations should be made for each specific incident and chemical.

Critique

As soon as possible after each incident, all participating units should send personnel involved to review the measures that were taken by each unit or agency. The purpose of this review is to examine which activities succeeded and which did not, and to evaluate the overall coordination effort.

Patient Management Under Mass Casualty Conditions Involving Hazardous Chemicals

Basic medical procedures in a large-scale hazardous materials incident are not substantially different from life-saving measures in other mass casualty disasters. Primary attention to the ABC (i.e., Airway, Breathing, and Circulation) continues to have first priority.

There are, however, several important differences in disasters involving hazardous materials. A chemical mass casualty incident may also require setting up mass screening and decontamination centers. It may also be necessary to establish casualty collection points to provide stabilizing care in the field prior to transport. A major chemical disaster may accompany other disasters such as an earthquake. Such an event would drastically increase the number of casualties and the complexity of the medical care that must be provided (crushing and broken bones vs. gas inhalation, for example). This would require increased numbers of personnel, perhaps more sophisticated medical equipment, and a better transport system for taking stabilized victims out of the area. Training in the appropriate procedures to be followed is essential for potential responders to a hazardous materials incident involving mass casualties. Triage may be complicated for chemical exposure by delayed onset of signs and symptoms. The patient, injured or not, must be decontaminated before being transported to the emergency department to protect EMS and emergency department staff.

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