Growing concern about the proper treatment of chemically contaminated patients has outpaced adequate guidance on the subject. However, definitive work has been done on cases that bear similar characteristics (e.g., radioactive exposure), and some of the same principles apply. Many of these principles are outlined in the article Emergency Department Radiation Accident Protocol by R.B. Leonard and R.C. Ricks, published in the September 1980 issue of *Annals of Emergency Medicine.* Further information on radiation response procedures is contained in *Hospital Emergency Department Management of Radiation Accidents* by R.C. Ricks, prepared for the Federal Emergency Management Agency.

When a hospital receives a call that a patient exposed to hazardous materials is being transported to its facility, a planned course of action should be implemented. Steps in the protocol must be practiced before a hazardous materials emergency occurs. Emergency department personnel should know their responsibilities and how to perform them, and all required equipment should be immediately accessible.

Individuals receiving a potential hazardous materials call should obtain as much information as possible. A checklist should be developed and made available for all telephone or radio communication centers. Information that will aid in initiating appropriate actions includes:

- Type and nature of incident
- Caller s telephone number
- Number and ages of patients
- Signs and symptoms being experienced by the patients
- Nature of injuries
- Name of chemical(s) involved, including correct spelling
- Extent of patient decontamination in the field
- Estimated time of arrival

After the above information is received, a predesignated resource center (e.g., regional Poison Control Center, ATSDR) should be contacted for information regarding definitive care procedures. This should include the need for decontamination and what methods should be used. Communications should be kept open with onsite response personnel to obtain as much advance information as possible.

If incident notification comes through other than usual emergency communication channels, the call should be verified before a hazardous materials response plan is initiated. Ambulance personnel should be notified of any special approach or entrance to the emergency department and also advised

not to bring the patient into the emergency department until he or she has been assessed by appropriate emergency department staff.

Often patients contaminated by hazardous materials are brought into the emergency department unannounced or not through regular EMS channels. This could be an ambulatory patient or an individual transported by private vehicle. The ideal response to this situation is to call the fire department or a hazmat team that is properly trained and equipped to come to the hospital and set up a decontamination area outside the ambulance entrance. In any event, these individuals should be isolated from other patients and assessed and decontaminated as soon as possible. Preplanning with the fire department and/or hazmat team should determine the location, equipment needs, and logistics for decontamination outside of the hospital during all weather conditions.

Emergency Department Preparation

Every member of the emergency department should be familiar with the hospital s hazardous materials response plan and be required to participate in scheduled drills. A written copy of the plan should also be kept in a central location in the emergency department for quick reference. Preparation for arrival of a contaminated patient should include notification of all services involved, preparation of a decontamination area, and suiting up of the decontamination team.

Emergency Department Mobilization

The person receiving a call of an incoming victim(s) should notify the Nursing Supervisor or other designated individual, who will in turn notify the appropriate personnel according to the hospital s response plan. The hospital operator should be instructed to notify security and maintenance, and the nurse on duty should contact the predesignated resource center.

Decontamination Area Preparation

Any victim of a hazardous materials incident must be considered to be contaminated until demonstrated otherwise. Therefore, the route from the emergency entrance to the Decontamination Area may also become contaminated and all persons along that route should be removed by security personnel prior to the arrival of the contaminated patient. Ideally, this area should be protected with a barrier of plastic or paper sheeting taped securely to the floor. Care should be exercised in walking on plastic sheeting because it can become very slippery when wet.

Security personnel should be stationed at the main entrance to the emergency department, close to the Decontamination Area, to prevent unauthorized entry, to control the entry of contaminated patients into the department, and to direct the vehicle(s) transporting the patient(s) to the appropriate area. A reception station should be set up just outside the emergency department entrance, where arriving patients can be screened for adequate decontamination before entering.

A decontamination area should be large enough to facilitate decontamination of more than one patient and to accommodate the many personnel involved in patient treatment and contamination reduction. The ventilation system should either be separate from the rest of the hospital or turned off to prevent the spread of airborne contaminants through heating and air conditioning ducts to other

parts of the facility. If the ventilation system is shut off during the handling of a contaminated victim in an enclosed area, the emergency department staff could be endangered. To address this, OSHA regulations on atmospheric monitoring (29 CFR (1910.120)(q)(3)(iv)) should be followed, especially if air-purifying respirators are used.

Weather permitting, the best place to evaluate and initially treat contaminated patients is outside, where ambient ventilation will keep airborne cross-exposure low. Some hospitals have radiation decontamination facilities that can be used with minor changes. An outside or portable decontamination system is a viable substitute and would aid in preventing contamination of the emergency department and other patients. A practical alternative for facilities with limited resources is to have a warm shower nozzle, soap, a wading pool, and plastic garbage bags in a predesignated area outside the back door to the emergency department. The patient may be able to remove his or her own contaminated clothing, place it in a double bag, and do his or her own soap and water decontamination. A partial tent or curtain can provide for patient privacy. Under most circumstances, ordinary hospital gowns, plastic goggles, and plain latex gloves will adequately protect hospital staff if they have to assist the patient in removing soaked clothing, washing exposed skin and hair, or performing eye irrigation. With large amounts of concentrated corrosives or very oily materials, such as pesticides, disposable chemical protective clothing and unmilled nitrile gloves offer additional protection. If it is anticipated that your facility is likely to receive heavily contaminated patients who have not received prior decontamination, then it may be advisable to purchase appropriate protective gear and to fit and train emergency department staff in its use. However, no person should wear and use specialized PPE, especially respiratory protective gear, without prior training.

To prevent unnecessary contamination, all nonessential and nondisposable equipment should be removed from the decontamination area. Door knobs, cabinet handles, light switches, and other surfaces that have contact with hands should be taped, and the floors should be covered with plastic or paper sheeting. The floor covering should be securely taped to prevent slippage, and the entrance to the room marked with a wide strip of colored tape to indicate a contaminated area. Personnel should not enter the area unless properly protected, and no personnel or equipment should leave the area until properly decontaminated. A clean member of the staff should stand on the clean side of the entrance to hand in supplies and receive medical specimens.

The essential requirements for any decontamination task are:

- A safe area to keep a patient while undergoing decontamination
- A method for washing contaminants off a patient
- A means of containing the rinsate
- Adequate protection for personnel treating the patient
- Disposable or cleanable medical equipment to treat the patient

Decontamination Team Preparation

A decontamination team should be predesignated and trained in appropriate personal protection equipment and procedures. The team should consist of:

- Emergency department physicians
- Emergency department nurses and aides
- A trauma surgeon, if injuries are present
- Support personnel
  - Nursing Supervisor
  - Occupational Health and Safety Officer
  - Security
  - Maintenance
  - Recorder

The decontamination team should be equipped with personal protective clothing (as discussed in Section II) for whatever level is deemed appropriate for the substance(s) involved. This may be determined by consulting reference guidebooks, websites, database networks, telephone hotlines, or a predesignated resource center (e.g., the regional Poison Control Center).

Appropriate dress for the decontamination team should include:

- A scrub suit.
- Plastic shoe covers.
- Disposable chemical protective clothing with built-in hood and booties, and with hood taped at the neck.
- Polyvinyl chloride (PVC) gloves taped to sleeves.
- Respiratory protection, as appropriate (see Section II).
- Multiple layers of surgical gloves, neoprene or disposable nitrile gloves, with the bottom layer taped; should be changed whenever torn.
- Protective eyewear.

A 2-inch-wide piece of masking tape with the team member s name written on it, and placed on the back of the protective suit, will assist team members in communicating.

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Patient Arrival

The emergency physician-in-charge or an emergency department nurse should meet the ambulance upon arrival and assess the condition of the patient(s) as well as the degree of contamination. The recorder should note on a diagram of the body the areas found by the physician to be contaminated. Personnel should keep in mind that the actual contamination may be (or become) a life-threatening condition, and triage procedures should be initiated at this point, if necessary. During initial patient assessment and stabilization, contamination reduction 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 contamination. Care should be taken to protect any open wounds from contamination. Emergency department personnel should make every effort to avoid contact with any potentially hazardous substance(s).

Ideally, decontamination should be performed before patient transport; however, field decontamination facilities are limited and emergency department personnel should consider that all hazardous materials patients need decontamination unless information has been received indicating that it is not necessary (e.g., in cases of carbon monoxide exposure). If a patient s clothing was not removed at the incident site, it should be removed outside the ambulance but before entry into the emergency department. This will reduce further exposure to the patient and lessen the extent of contamination introduced into the emergency department. Contaminated clothing should be double-bagged in plastic bags, sealed, and labeled. The decontamination team should bring the prepared stretcher to the ambulance, transfer the patient, and take him or her directly to the Decontamination Area along the predesignated route.

Priority should be given to the fundamentals of emergency treatment airway, breathing, and circulation simultaneous with contamination reduction. Once life-threatening matters have been addressed, emergency department personnel can then direct their attention to thorough decontamination and secondary patient assessment. Identification of the hazardous materials involved can be simultaneously performed by other personnel. It is important to remember that appropriate personal protective clothing must be worn until personnel are no longer in danger.

Patient Decontamination

The basic purpose of decontamination is to reduce external contamination, contain the contamination present, and prevent the further spread of potentially dangerous substances. In other words, remove what you can and contain what you can t. **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 to the responder.**

With a few exceptions, intact skin is more resistant to hazardous materials than injured flesh, mucous membranes, or eyes. Therefore, decontamination should begin at the head of the patient and proceed downward with initial attention paid to contaminated eyes and open wounds. Once wounds have been cleaned, care should be exercised so that they are not recontaminated. This can be aided by covering the wounds with a waterproof dressing. For some chemicals, such as strongly alkaline substances, it may be necessary to flush exposed skin and eyes with water or normal saline for an extended period of time.

External decontamination should be performed using the least aggressive methods. Mechanical or chemical irritation to the skin should be limited to prevent damage to the epidermal layer, which results in increased permeability. The skin of young children is particularly sensitive and should be treated accordingly. Contaminated areas should be gently washed under a spray of warm (never hot) tap water, using a sponge and a mild soap. If decontamination is performed outside, care must be taken to avoid hypothermia; young children are particularly sensitive to cold stress. All run-off from decontamination procedures should be collected for proper disposal.

The first priority in the decontamination process should be treatment of contaminated open wounds. These areas allow for rapid absorption of hazardous materials. Wounds should be irrigated with copious amounts of normal saline. Deep debridement and excision should be performed only when particles or pieces of material have been embedded in the tissues. Decontamination of eyes should also take high priority. Gentle irrigation of the eyes should be performed with the stream of normal saline diverted away from the medial canthus so that it does not force material into the lacrimal duct. Contaminated nares and ear canals should also be gently irrigated, with frequent suction to prevent any material being forced deeper into those cavities. Washing with soap and tepid water, including the hair, is usually all that is needed to remove contamination. Hot water, stiff brushes, or vigorous scrubbing should seldom be used because they cause vasodilation and abrasion. This increases the chances for absorption of hazardous materials through the skin.

Decontamination of young children poses particular problems because they are usually frightened and may not understand what is happening. If a parent is available and can accompany the child through decontamination, this may be desirable. If not, a nurse should be assigned to stay with the child.

Considerations for Patient Treatment

The primary goals for emergency department personnel in handling a contaminated individual include cessation of patient exposure, patient stabilization, and patient treatment all without jeopardizing their own safety. Termination of exposure can best be accomplished by removing the patient from the incident area and by removing contaminants from the patient.

In treating patients, personnel should consider the chemical-specific information received from the hazardous materials response resources. In multiple patient situations, proper triage procedures should be implemented. Symptoms and signs being experienced by patients should be treated as appropriate and when conditions allow. The sooner a patient becomes decontaminated the sooner he or she can be treated as a normal patient and protective measures reduced or downgraded. Recommendations from the designated Poison Control Center and orders from the attending physician should be carefully followed. Invasive procedures, such as IVs or intubation, should be used only for life-threatening conditions until decontamination is performed. Patients should be frequently reassessed and monitored because many hazardous materials have latent physiological effects.

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Information on Materials Involved

Identification of the material(s) involved in a hazardous materials incident should be determined as early in the process as possible. Using resources outlined elsewhere in this section, and in Section II under Hazard Recognition, personnel should identify and obtain detailed information involving treatment, decontamination procedures, and possible adverse health effects of the specific chemical(s) involved. Needed information includes:

- Chemical name of substance(s) involved
- Form of the material (solid, liquid, gas)
- Length of exposure
- Route(s) of exposure
- Possible adverse health effects
- Recommended treatment or antidote therapy
- PPE required
- Decontamination procedures

The importance of getting a rapid but comprehensive overview on an unknown substance cannot be overemphasized. Based on past hazmat incidents, NIOSH and EPA recommend that Level B protection is the minimum level to be worn when entering an area containing unknown substances. However, if the substance in question is suspected to involve the skin as a route of exposure or is otherwise noted to be dangerous by absorption, corrosion, and the like, Level A protection should be worn because it provides additional skin protection.

Removal of Patient from Decontamination Room

After the patient has been decontaminated, place a clean piece of plastic on the floor for the patient and staff to use when exiting the clean area. If the patient is not ambulatory, a clean stretcher or wheelchair should be brought to the doorway by an individual who has not been exposed. After the patient is transferred to the clean area, the physician can perform a physical examination and initiate routine patient management. The patient can be discharged home or admitted to the hospital, depending on his or her clinical condition. The attending staff must remember that since exposure to some substances can result in serious delayed effects, sustained observation and monitoring may be required.

Community Education and Briefing

During a hazardous materials incident, the emergency department will be used as a source of information by the community and the media. A plan must be in place to deal with information requests, whether received by phone or by onsite media representatives. It is essential that all information be delivered by a knowledgeable person and be coordinated with the agency handling the event in the field. In the absence of such coordination, misleading or inaccurate information may be released which may worsen public reaction to an incident. Above all, it is essential that patient confidentiality be respected. The emergency department may opt to defer all information requests to other involved agencies, such as the regional Poison Control Center.

Critique

As soon as possible following a hazardous materials incident, all participating units should send knowledgeable representatives 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 with an aim toward making necessary improvements.

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 should focus on the ABC fundamentals of emergency care, with decontamination performed at the same time. A chemical disaster may overwhelm any one hospital, particularly if it occurs along with another disaster such as an earthquake. Hospitals need to preplan what steps to take if they are unable to handle the number of hazmat patients.

Critical Incident Stress Management

Situations involving large numbers of ill or injured individuals, and risks of harm to the responder(s), are sources of critical incident stress. To minimize the occurrence of acute or long-term psychological consequences in response personnel, stress debriefing sessions should be held shortly after the incident is terminated. Acute stress reactions recognized during the incident should be immediately addressed by qualified peer debriefers or other qualified mental health professionals.

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