be taken into account to perform an appropriate triage. The decision process of triage becomes even more complex in disasters in which factors such as the change of patient's condition, the effect of treatment, the number of casualties, hostile environmental conditions, time, resources in manpower, material, means of transport and the treatment capacities of the receiving medical facilities must be taken into consideration. Sorting is thus a dynamic and continuous process and must be repeated throughout the chain of emergency medical care taken into account all factors of the triage process (10). Triage for chemical disaster victims should follow the rules that apply generally to other disaster situations. Triage may be complicated in chemical exposure by delayed onset of signs and symptoms. Exposure may be followed by a variable latent period during which casualties who have received potentially lethal doses will have little or no clinical signs or symptoms of poisoning. Furthermore, even apparently trivial exposure may result in delayed development of severe injuries (25). Triage is only correct at the time it is performed and triage in chemical disasters is even more than in other disasters a continuous process and should involve regular and repeated assessment of the clinical condition of the victim.

As a general rule, children are more sensitive to toxic substances and therefore normally should be given higher priority for medical care (32). If in a chemical disaster the nature of the injury will be the same, this can simplify the triage procedure as only the degree of severity of injury will vary and categorization can more easily be standardized (25). To achieve the objective of providing the greatest benefit to the largest number of patients, casualties should be triaged into following categories :

(a) Immediate treatment group T1

Casualties with disorders of vital functions that require immediate treatment or in need of emergency lifesaving surgery but with high chance of survival. The treatment procedures may not be time-consuming. Casualties with blocked airway, intense irritant induced cough, respiratory failure with systemic effects, coma or severe alteration of consciousness due to systemic toxicity, burns with a lethal risk (2050%TBSA).

(b) Delayed treatment group T2

Casualties requiring hospitalization, but their clinical condition allows a delay of treatment without endangering life. Sustaining measures (stabilization) will be administered in order to mitigate the effects of delayed treatment. Casualties with strong irritant induced cough, respiratory difficulties but no systemic effects, moderate alteration of consciousness due to systemic toxicity, burns requiring specialized burn care.

© Minimal treatment group T3

Slightly injured and/or ambulatory casualties who need care which can be given after an unspecified delay and often by non specialized personnel. Casualties with moderate or slight irritant induced cough, minor eye symptoms, headache, rapidly resolvent disorder of consciousness, minor superficial burns, psychological reactions.

(d) **Expectant treatment group T4**

Severely injured casualties, often with multiple injuries and with very poor or no chance of survival and whose treatment would be so time-consuming and complex that it would entail the inappropriate use of limited resources to the detriment of other casualties. They may not be abandoned to their lot, but a so-called comfort treatment will be administered. This category will only be used in mass casualty situations. In other accidents these casualties will be categorized in the immediate treatment group. As some casualties may have a minimal chance of survival, definitive treatment will be given as soon as the mass casualty situation is under control. Casualties with : cardiopulmonary arrest, extensive burns (> 50 % TBSA) or both burns with lethal risk and major respiratory failure.

Casualties on the scene of a chemical disaster will be divided into these four groups according to the chemical and/or other injuries. All persons who have been exposed to hazardous materials and who are asymptomatic at the time of triage should be labeled with a capital C on the triage tag or casualty form and evacuated to a medical facility.

It is inappropriate to assume that all casualties in a hazardous materials disaster require immediate treatment. It is easier to assess priorities for those who have been exposed to high concentrations of a chemical agent as symptoms will be obvious.

Triage during transport and at the medical facility will again be based on the same principles. It is more likely, however, that by the time the casualties reach the hospital, enough time would have elapsed to permit the appearance of the signs and symptoms indicative for poisoning.

(5) **Stabilization and conditioning of casualties**

Stabilization and conditioning for transport may be necessary in view of the important impact on the outcome of the casualties. Stabilization prevents numerous premature deaths, can prolong the time available for primary care and can result in a change of priority group.

The care at the scene of the disaster must however be restricted in order to not delay the transfer and hence the definitive treatment in medical facilities. Stabilization and conditioning at the scene of the disaster must remain simple in order to allow an easy adaptation to unexpected situations. The treatment procedures must be similar to those used in the everyday emergency medical system in order to achieve an immediate and efficient response.

Stabilization and conditioning will be restricted to the preservation of cardiorespiratory functions without the mobilization of too important resources in manpower and equipment, restricted to the control of bleeding and the prevention of shock, to splinting of fractures, dressing wounds, to analgesia and to prevention of hypothermia.

Exposure to hazardous materials can involve just a single toxin as with an industrial spill or a variety of combustion products as with a fire. About thirty toxic products of combustion have been identified including carbon monoxide, carbon dioxide, chlorine, hydrogen chloride, ammonia, hydrogen cyanide, phosgene, nitrogen and sulfur oxides and aldehydes (6,26). The use of a variety of chemical warfare agents, particularly sulfur mustard and organophosphates also referred to as "nerve gases" may be an additional potential source of mass destruction by inhalation or skin absorption (22,26).

Hazardous materials disasters are mainly caused by toxic inhalants, because large volumes of gas can spread rapidly over very large geographic areas (22). The eyes and skin are other likely routes of exposure in this context. Specific medical information about toxicity of the gase(s) present probably will not be known at the time EMS personnel start to treat the casualties (19,22). For many chemicals, the effects following acute exposure to high concentrations can be quite different from those produced by low level chronic exposure.

The treatment of acute poisoning should be based on four main principles that may be utilised to varying degrees depending on the circumstances of the exposure and the characteristics of the toxic agent. These principles are : (a) the removal of the toxic agent to prevent further local damage or absorption into the body; (b) symptomatic and supportive therapy; © specific "antidotal" therapy although antidotes will have little role in most disasters; (d) enhancement of poison elimination (17).

The diverse and non specific symptoms of toxic gas inhalation do not facilitate the identification of the offending agent by clinical presentation, particularly in cases of systemic toxicity in which failure to make diagnosis may result in serious injury or death (6,22,26). Fortunately the management of the majority of toxic inhalations is only supportive and is effective if only the category of the offending toxic inhalant is known. Exceptions to this rule are some systemic toxicants (chemical asphyxiants and organophosphates) for which rapid identification and specific antidotes are essential for casualties survival (6,19,22,26). Only with a high level of suspicion, rapid identification and appropriate medical logistics will the accurate assessment, management and regulation of the casualties be possible (26).

Similarly, burn, blast and other traumatic injuries need to be identified and stabilized. Pneumothorax or other pulmonary barotrauma may present as chest pain and dyspnea mimicking inhalation injuries but requiring quite different treatment (2,6). Invasive procedures should only be performed in uncontaminated areas.

Mass casualties in toxic inhalation accidents occur by three basic mechanisms : by inhalation of air deficient in oxygen (physical asphyxiants), through damage of upper and/or lower airway (respiratory irritants) or by systemic absorption (systemic toxicants). Factors affecting the morbidity and mortality of the inhaled substance include beside the chemical activity, the intensity and the duration of the exposure.

The concentration of the toxic inhalant depends on the nature and the quantity of the emitted gas and on the dispersion space. In open air, the dispersion space is determined by the meteorological conditions such as temperature, atmospheric pressure, humidity and speed of wind and the local geography. Other factors affecting the inhalational toxicity are physicochemical properties of the substances such as water solubility and particle size. In general toxic agents with high water solubility and of large particle size (> 5 µ) cause upper airway injuries. Inhalation of compounds of lower water solubility and of a smaller (< 5 µ) particle size cause more likely alveolar injuries.

These properties will determine the level in the respiratory tract where the inhaled compound will have its main harmful effect and the degree of systemic absorption. Also muscular exertion, respiratory rate, preexisting respiratory disease and associated thermal injury will influence morbidity and mortality of a toxic inhalation (6,26,27). Some exposures to toxic inhalants can result in both direct pulmonary damage and systemic toxicity such as smoke and hydrogen sulphide inhalation (26,27). Toxic inhalants can be divided into three main categories according to their pathophysiologic mechanisms : simple or physical asphyxiants, respiratory irritants and systemic toxicants most commonly chemical asphyxiants, organophosphates and volatile hydrocarbons. Limited space only allows for a discussion of some representative compounds from each category.

(a) Physical asphyxiants

Physical asphyxiants are biologically inert gases that produce hypoxemia and asphyxia by displacing oxygen from air (6,22,26). Casualties usually result when individuals are inside or enter an enclosed space (mine, silos, ship holds) where oxygen has been either displaced by an inert gas or depleted by combustion (6). Massive gas release from either volcanoes or water lakes can also be a hazard (28). Exposure to physical asphyxiants can occur without patient knowledge or physician recognition, these gases being colourless and often odourless, and asphyxiation can occur without direct pulmonary damage (26). Symptoms of asphyxia including hyperventilation, sweating and headache will appear when oxygen concentration falls below about 15 per cent. Memory loss, incoordination and stupor are seen with levels below 10 per cent. Loss of consciousness followed by death will occur when oxygen concentration falls below 6 to 8 per cent (6,22,26). Representative physical asphyxiants are carbon dioxide, nitrogen, methane, propane and nitrous oxide. Management of patients exposed to physical asphyxiants includes removal of the victims from the toxic exposure, administration of oxygen, respiratory support and other life support measures as indicated and as possible according to the available resources in EMS personnel and equipment.

(b) Respiratory irritants

Respiratory irritants produce pulmonary damage through direct chemical burns and an inflammatory response. The specific signs and symptoms of irritant inhalation injury depend in large part on the water solubility of the agent. Highly water soluble compounds (ammonia, sulphur dioxide) readily dissolve in the moisture of the upper respiratory tract and cause intense irritation of nose, mouth and upper airway but also of the eyes and skin. Although such injuries produce the most dramatic immediate symptoms, they are often the least serious in the long term. The intense irritation caused by these compounds allows a good warning potential and forces individuals away from the spell avoiding long exposures. However very high concentrations or long exposures can cause lower airway and alveolar effects leading to severe lung injury. Mild exposure produces complaints of lacrimation, cough with a burning sensation and headache. Moderate exposure is in addition associated with dyspnea, wheezing, tightness in the chest and nausea and vomiting. Severe exposure presents with laryngospasm, stridor, cyanosis and pulmonary edema (6,26,27).

Substances with moderate water solubility (chlorine) may cause irritation of both the upper and lower airways and generally have less warning properties when used in low concentrations. Clinical manifestations in mild and moderate exposure include lacrimation, increased secretions, cough, headache, sore throat, burning sensation and tightness in the chest, dyspnea, nausea and vomiting. Severe exposure can lead to severe tracheobronchitis, pulmonary edema and respiratory failure (6,26,27).

The lower solubility agents (phosgene, nitrogen dioxide), with poor warning properties, cause diffuse alveolar injury often with a latent stage. Usually no symptoms occur at the time of exposure, with the exception of a slight cough and perhaps nausea. At higher concentrations cough, bronchospasm, dyspnea, chest pain, headache, nausea and vomiting are seen (6,26,27).

The acute management of casualties exposed to respiratory irritants is primarily supportive and is similar regardless of the agent (6,17,26,27). Withdrawal from exposure and removal of contaminated clothing are the first priorities and should be coincident with administering of cadiopulmonary resuscitation. The casualties should rest, if possible in a half sitting position. If skin or eyes were exposed, copious irrigation with water or saline solution is needed. Imminent oropharyneal and laryngeal edema may require early endotracheal intubation. Hypoxemia will be prevented or treated with supplemental oxygen. In mild exposures administration of humidified oxygen by mask is usually sufficient, however after more severe exposure or inhalation of lower airway and alveolar irritants continuous positive airway pressure (CPAP) or intubation with positive end expiratory pressure ventilation should be initiated early. Nebulized or parenteral bronchodilators may be needed for bronchospasm. General use of corticosteroids remains controversial in the acute setting. There is some experimental and clinical evidence to support inhalational treatment with some corticosteroids (17,29,30). In disaster situations antibiotics are recommended as pneumonia is a common complication in casualties having lower airway or alveolar injury. Fluids should be given according to standard protocols and the specific clinical situation such as burns or pulmonary edema. All casualties with a history of significant toxic inhalation should be admitted to the hospital for inpatient observation for at least 24 hours because of the latent toxicity of many compounds and the potential for sudden deterioration. Outpatient follow up is indicated, as residual longterm pulmonary complications have been noted.

© Systemic toxicants

Systemic toxicants produce a variety of systemic effects and can be divided into three groups according to their primary effects: chemical asphyxiants, volatile hydrocarbons and miscellaneous systemic poisons including organophosphorous compounds (insecticides and nerve gases) and metal fumes (6,26,27). Systemic effects can be due to skin absorption of chemicals, respiratory exposure and vapours produced on the skin or clothing. The systemic toxins may penetrate more easily wounds and burns than intact skin. Some systemic toxicants (hydrogen sulphide) can cause upper airway or alveolar injury (23). It is important to identify as soon as possible the specific compound involved, since some of these toxins have specific antidotes.

(d) Chemical asphyxiants

Asphyxiation by inhalation of chemical asphyxiants occurs by combining with hemoglobin or cellular enzymes such as cytochrome oxidase, so that oxygen either cannot reach the tissues or be used at the cellular level (6,26,27). They impair cellular respiration leading to anaerobic cellular respiration, cellular anoxia and finally cell death (26). Representation of this group include carbon monoxide, hydrogen cyanide and hydrogen sulphide. The initial management of chemical asphyxiants includes the removal of the casualties from the source of exposure concurrent with basic and advanced life support as needed. If the exposure is not immediately lethal and ventilatory support is provided recovery can be expected in most victims. Several of those toxins do have antidotes, which should be administered as soon as possible.

Oxygen is the cornerstone of treatment especially in carbon monoxide poisoning, consequently the administration of 100 per cent oxygen should be initiated as soon as the diagnosis is suspected. Antidote therapy in hydrogen cyanide poisoning is indicated for any patient with more than minor symptoms as represented by restlessness, anxiety or hyperventilation (26). Standard antidotes include amyl nitrite, sodium nitrite and sodium thiosulfate. However the administration of these antidotes is quite demanding in mass casualty situations and the use of hydroxycobalamine or dicobaltethylenediamine is more justified (6,31).

(e) Volatile hydrocarbons

An overwhelming number of hydrocarbon compounds are produced and used in industry and are frequently shipped in large quantities. Many of these compounds are flammable and accidents involving them lead to toxicity from combustion products when they ignite as well as toxicity from the original compound (22). Depending on their chemical structure and principal toxic action, volatile hydrocarbons are classified as aliphatic (acetone, propane, butane, various alcohols, aldehydes, ketones and ethers), halogenated aliphatic (trichloroethylene, chloroform, carbon tetrachloride, methylchloride, freon and perchloroethylene) or aromatic (benzene, toluene, xylene, aniline and phenol). In addition there are several widely used mixtures of volatile hydrocarbons such as gasoline and kerosene (6). Inhalation of most hydrocarbons do not cause much respiratory irritation or pulmonary damage at low concentrations, although some can be quite irritating at high concentrations and their combustion products may at any concentration (6,22). Some halogenated hydrocarbons can decompose into hydrochloric acid and phosgene when overheated. In general volatile hydrocarbons cause systemic toxicity, particularly to the liver and kidneys. Central nervous system narcosis, coma, seizures, cardiac arrhythmias and sudden death may also occur (6,22).

The management of a volatile hydrocarbon intoxication is purely supportive with standard therapies applied to the potential acute complications of seizures and dysrhythmias (26).

(f) Organophosphates

Organophosphate compounds are commonly used as pesticides but can also be used as chemical warfare agents. The toxicity seen with these agents is due to inhibition of acetylcholinesterase, which causes accumulations of acetylcholine at cholinergic synapses, accounting for a cholinergic crisis with a variety of central and peripheral neurologic manifestations. Increased muscarinic activity produces activation of all the exocrine glands causing lacrimation, salivation, perspiration and excessive secretion by the bronchial and intestinal glands and stimulation of the pancreas, bronchospasm, sinus bradycardia, miosis and involuntary contractions of the muscles of the gastrointestinal tract causing abdominal cramps, vomiting, diarrhea and involuntary urination. Pulmonary symptoms are most marked after an inhalation exposure (6,22,26). Nicotine effects include those involving the skeletal muscles including the muscles of the respiratory system as reflected by fasciculations and fibrillation and weakness followed by paralysis but also hypertension and tachycardia (6,22,26). Central nervous system effects are confusion, anxiety, restlessness, agitation, insomnia, ataxia, drowsiness, convulsions, coma and paralysis of respiratory centres (6,22,26).

Both central respiratory depression and the ventilatory compromise produced by bronchospasm, hypersecretion and respiratory muscle weakness are the most life threatening manifestations (6,22,26). Management of organophosphate poisoning requires removal of casualties from fumes and spills, decontamination should be performed after administration of antidotes and life support measures.

Atropine blocks the muscarinic and central manifestations and oximes counteract the nicotinic effects and some muscarinic effects (6,22,26). Pralidoxime promotes the reactivation of acetylcholinesterase activity. Anticonvulsants such as diazepam also may be needed to treat seizure activity in the poisoned casualties.

Immediate decontamination of the eyes should be carried out with the utmost speed after caustic exposure by irrigating continuously by ordinary tap water or physiologic saline solutions. Transportation to a hospital should not be considered more important than thorough onsite irrigation for at least 15 30 minutes. As eye pain causes blepharospasm, the victim needs assistance in keeping the eye lids open. A topical anaesthetic will facilitate adequate eye irrigation and make the patient more comfortable. Despite the theoretical advantage of using special agents for neutralizing certain chemicals, this type of treatment has seldom provided a significant improvement over immediate irrigation with water or saline, both of which are also usually much more readily available for first aid treatment (17). All burns of the eye should be followed up by a formal ophtalmological examination. After exposure of the skin to toxic chemicals, contaminated clothing, shoes, waist watches and jewellery should be removed and flushing with copious amounts of water should be started as soon as possible and continued for at least 15 30 minutes. In some cases, application of an antidote on the skin is of crucial importance. For hydrofluoric acid, calcium gluconate jelly is applied (17). When appropriate the victim should be given intravenous fluids on the scene of disaster.

(6) Regulation and transfer of casualties

Regulation and transportation of casualties to the most appropriate medical facilities is an integral part of triage and an important link in the chain of emergency medical care. Medical regulation is the process which coordinates the evacuation of casualties from the site of disaster to the medical facilities. Factors which can influence the regulation process are treatment capacity of medical facilities, specialized treatment capacity such as burn centres, decontamination facilities and hyperbaric oxygen centres, means of transport, time limit for treatment, distance to the medical facilities and number and clinical condition of casualties (10). Efficient communications are critical in the regulation of casualties to appropriate medical facilities. The casualties will be evacuated in appropriate means of transport with appropriate supervision. In chemical disasters, regulation and transfer of victims must take into account the possibility of contaminated casualties, the availability of many ambulances equipped with an oxygen supply and respirators, and specialized medical facilities with decontamination units and stocks of antidotes. Proper registration of all exposed victims is essential, even of those who are free of symptoms in the acute phase. Symptoms following exposure to some toxic compounds may be postponed by hours and days. In these situations, it is important to reach these persons if they have been sent home or to reception centres.

The victims should be as clean as reasonably possible before transport. When transporting a contaminated patient by ambulance special care should be exercised in preventing contamination of the ambulance. Maximum fresh air ventilation (e.g. by open windows), that weather conditions permit, should be provided to the patient and driver's compartment regardless of the presence or absence of odors (24).

The use of disposable equipment is recommended whenever possible. Exposed surfaces that the casualty is likely to come into contact with should be covered with plastic sheeting. Equipment that comes in contact with the patient should be segregated for disposal or decontamination. Ambulance personnel should wear appropriate protective clothing and use respiratory protection if indicated (24). During transport treatment started at the site of the disaster should continue such as administering oxygen, ventilation, intravenous fluids, eyes irrigation, etc. The receiving hospital will be contacted in order to obtain instructions on approaching and entering the hospital with contaminated victims and to inform the hospital on patient's condition and treatment provided (24). The ambulance with contaminated victims should go directly to a predesigned decontamination centre or area outside or in the hospital and victims should not be brought into the emergency department before permission has been received from the hospital staff (24). Exposed personnel, contaminated ambulances and equipment should be decontaminated before going back in service. Contaminated disposable articles should be sealed.

Different intervention scenarios are possible in chemical disasters and are determined by the seriousness of the injuries, the dispersion of the toxic chemical(s) and the actors present on the site of the disaster : rescuers, casualties and the involved population (residents and non residents). Depending on the real and potential extent of the chemical disaster, the response will be an internal or site action plan or a local and/or regional action plan. If the toxic substances can not immediately be identified careful observation of the initial clinical symptoms in the casualties, will give indications on the compound category of the chemical substance(s) and on the seriousness of the injuries (table 1). Besides the clinical status of the victims their dispersal within a geographic zone and the physicochemical nature of the material will allow to be informed about the dispersion of the toxic compound (table 2)(19).

Table 1. Offending chemical and level of seriousness according to observed symptoms

INITIAL OBSERVED SYMPTOMS	EVOLUTION OF SIGNS ON THE SCENE	THE OFFENDING CHEMICAL	LEVEL OF SERIOUSNESS
minor irritation of eyes	constant symptoms in entire affected area	pulmonary irritant in low concentration	S1
minor irritation of eyes and upper airway	constant symptoms in entire affected area	pulmonary irritant in moderate concentration	S1
minor irritation of eyes and upper airway	increase of signs moving closer to the source	pulmonary irritant in large quantities and moderate concentration	S2
minor alteration in level of consciousness and no respiratory signs	constant symptoms in entire affected area	substances with systemic toxicity in low concentration physical asphyxiants in low concentration	S2
severe irritation of airway	increasing of signs moving closer to the source	pulmonary irritant in high concentration	S3
moderate alteration in level of consciousness with respiratory or circulatory distress	worsening of symptoms and increase in number of victims getting closer to certain zone	substances with systemic toxicity in moderate concentration. physical asphyxiants in moderate concentration	S3
major respiratory failure	worsening of symptoms and increase in number of victims getting closer to certain zone	pulmonary irritants in very high concentration	S4
severe alteration in level of consciousness, state of apparent death	very severe signs, speedy appearance of symptoms, very wide dispersal of victims	substances with systemic toxicity in high and very high concentration. physical asphyxiants in high and very high concentration	S4

Table 2 : Type of dispersion of toxic chemicals

TYPE OF DISPERSION	PHYSICOCHEMICAL NATURE	EFFECT ON POPULATION
D1	droplets and particles in suspension vapours of spilled liquids	population in open air around emission source
D2	aerosols or gas cloud (explosion, fire, leaks, chemical reactions)	entire population but more marked in open air but also indoors

(a) Scenario D1S1 and D1S2

The rescuers must be protected in open air. The casualties will shelter from the toxic chemical(s) by their own means, guided by rescuers, in grouping centres (stores, movie theaters, etc) in the contaminated zone or outside this zone in triage centres according to the distance to the boundary of the contaminated zone. As indicated casualties will be decontaminated and first aid measures will be provided. The casualties will be evacuated in a delayed and non protected way to triage centres, hospitals or reception centres but in vehicles if a persistent toxic is present. Residents will be confined in their house or evacuated to reception centres according to the presence or absence of a persistent toxic. Non residents will be evacuated outside the contaminated zone if possible by their proper means.

(b) Scenario D1S3 and D1S4

The rescuers must be protected in open air. The casualties will shelter in grouping centres inside or outside the contaminated zone guided or carried by protected rescuers. Life support measures will be provided. As indicated casualties will be decontaminated. The casualties will be evacuated as soon as possible, protected or not according to the presence of a persistent toxic by non medicalized transport means to triage centres.

Residents will be confined in their houses or evacuated to reception centres protected or not according to the presence of a persistent toxic. Non residents will be confined in grouping centres or will be evacuated protected or not according to the presence of on persistent toxic.

© Scenario D2S1 and D2S2

The rescuers must be protected systematically. The casualties will be evacuated outside the contaminated zone guided by the rescuers to the triage centre(s). As necessary decontamination and first aid measures will be provided. The casualties will be evacuated to hospitals or reception centres. All the population will be evacuated outside the contaminated and the threatened (contaminative) zone by their proper means going into the wind.

(d) Scenario D2S3 and D2S4

The rescuers must be protected systematically. The casualties will be rescued, protected and evacuated outside the contaminated zone to the triage centre(s). Life support measures will be provided and as indicated decontamination will be performed. The population will be confined in drought proof premises or evacuated in a protected way outside the contaminated and contaminative zone going into the wind.

g. Management in medical facilities

Treatment of disaster casualties in medical facilities is the final purpose of the chain of medical assistance. In a mass casualty situation the problems and the response for treating the casualties will be quite different according to the degree of preparedness of the hospital to receive a great number of casualties and according to the prior stabilization and conditioning of the casualties before their arrival in the hospital. Consequently the normal structure and functioning of the hospital must be adjusted to the mass casualty situation and anticipated in a hospital disaster plan.

Architectural adjustments are necessary such as a circuit for ambulances, a large reception area, an intra hospital circuit of casualties and transformation of some departments. Some specific departments or services must be established or reinforced such as telephone central, reception and information centre for families and media and coordination centre. Quantitative and qualitative reinforcement in manpower will be necessary such as administrative, care, technical and catering personnel, but also in drugs, medical supplies and equipment according to a prior study of the various hazards in the region.

Hazardous materials disasters, especially after explosions, can require mass casualty procedures in the hospital. A high level of preparedness is necessary regarding planning, knowledge, training, chemical incident protocols including management of chemical burns, inhalational injuries and systemic toxicity, provision of protective clothing and availability of decontamination facilities and antidotes (3,4,17,19). These actions and protocols must be practiced before a chemical disaster occurs. Few hospitals are equipped with appropriate protective equipment and effective decontamination facilities (5,7,23).

As contaminated or poorly decontaminated casualties can arrive at the hospital, protection measures should be provided and decontamination stations should be arranged at every emergency hospital susceptible to manage a chemical disaster. The same hospitals should have protocols for treating large numbers of casualties exposed to hazardous materials and adequate provision of antidotes and supplies for poison elimination (5,7,17). Hospitals situated in an area where a threat exists for a large number of casualties with inhalation injuries, has to made an inventory of available respirators together with procedures to obtain additional respirators as well as the personnel to handle this equipment.

Communications should be kept open with onsite medical response personnel, medical HAZMAT teams and poison control centres to obtain as much information as possible.

From the moment the casualties reach the hospital, persistent contamination should be ruled out and a complete clinical assessment should be carried out including technical examinations and biological and toxicological tests. The management of the casualties will be continued based on symptomatic care including intensive care, neutralization and elimination of the toxic chemical and prevention of complications

(19). Proper registration is a matter of importance to be able to identify all exposed persons so that adequate following up may be carried out, particularly in cases where many persons have been exposed to unusual chemicals, for which experience of the effect upon human beings is limited (17).

Epidemiological and scientific studies need a short-term and long term follow up of the exposed victims together with an evaluation of the disaster.

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