Chemical Incident Response Guidelines

STADARD OPERATING GUIDELINES

-This plan was developed to establish guidelines for IDPH EMS Region 2 Hospitals to respond to a Chemical Incident

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Plan Activation: In the event of a large-scale Chemical Incident in Region 2,
please contact the Region 2 RHCC at 800-252-5433 and ask for the Disaster Preparedness Office.

Introduction:

Purpose:

The Illinois Department of Public Health requires that Illinois based Healthcare Coalitions (HCC) develop and maintain a plan for the management of patients from a large-scale chemical incident. This plan will provide guidance and direction, along with procedures for requesting Region 2 Healthcare Coalition resources.

The purpose of this plan is to support and help protect healthcare coalition facilities and staff during a large-scale chemical incident with a surge of patients. The goal is to set out a comprehensive coalition wide approach to guide coalition members and partners.

Note: This document will not provide recommendations, protocols, or specific guidance on medical treatment of patients during a chemical incident. Consult your facilities medical directors for further direction on medical treatment.

Scope:

The Region 2 Chemical Incident Response Plan involves the coordination of healthcare facilities in IDPH EMS Region 2, their medical systems and organizations, along with their supporting resources, to manage potentially exposed and/or contaminated patients following a chemical incident. Any large-scale incident involving a release of hazardous materials will likely result in a surge of patients that may be beyond local capabilities to manage. This will most likely require regional, state and federal resources and coordination.

Situation:

The Region 2 Healthcare Coalition has numerous chemical facilities, entities and or locations with hazardous materials within the region. There are numerous scenarios that involve a release of hazardous materials that could potentially occur within the region. Along with fixed facilities storing, having, or using hazardous materials, it is important to remember that hazardous materials are transported using interstates, highways and railways and potentially barges through or within the region daily.

Assumptions:

The plan is not intended to supersede, infringe upon or replace any plans, procedures, policies, or protocols in place. This plan is designed to present guidance and allow for local flexibility in response to the release of hazardous or biohazardous materials.

It is assumed that a chemical incident can be accidental in nature and not be from nefarious actions or terrorism. We must allow for flexibility in our response to an incident. Not every incident can be responded to in the same manner. Incidents involving the release of a hazardous material from an industrial facility or storage facility may require a different response than a transportation or terrorism related release. Contamination assessments, proper PPE utilization, and decontamination efforts will be essential in protecting coalition partners, staff, and the public. Contamination from a hazardous materials event may be low or non-existent in some instances. Especially the farther away from the release the person is. Since some contamination cannot be detected by human senses, this may result in a surge of “worried well” patients to medical facilities seeking treatment. This surge of “worried well” patients to the medical facilities, will result in the implementation of healthcare facility surge plans at the local and regional level.

Background

Hazardous materials are commonly stored, used, transported, or manufactured in the region. This may include areas outside our region but affect the region in the event of a release. While companies from neighboring jurisdictions are not subject to reporting their inventory to your county or region, a release or spill may impact the communities within the region. An accidental release of hazardous materials could pose a threat to the local population or environment. A hazardous materials incident may be caused by or occur during another emergency, such as flooding, a major fire or earthquake.

A major transportation hazardous materials incident may require the evacuation of citizens from any location in Region 2. This may also lead to a surge in contaminated patients seeking medical treatment at regional medical facilities. These patients may seek medical treatment at facilities other than hospitals/medical centers.

Assumptions:

An emergency resulting in multiple casualties beyond normal limits from any cause will stress the metropolitan health care system and likely result in degradation of response and treatment capabilities and capacities.

The local hazardous materials response units have the capability to identify the presence of some chemical, radiological, or biological agents. Most regional hospitals have the capacity to decontaminate chemical, radiological, or biological agents off any patients prior to treatment.

Regional facilities may be quickly overrun by patients requiring decontamination requiring medical treatment. This may require assistance from local, regional, or state agencies or resources. Also, decontamination resources such as team members, PPE and other decontamination equipment may be quickly exhausted or consumed.

Local EMS transportation resources may not be able to meet the needs of a large-scale event or other emergency incident. They may be degraded or exhausted quickly, and other resources may need to be requested from the state or other authorities or through mutual aid agreements.

During surge events requiring patient decontamination hospitals may choose to open their Hospital Command Center and staff a Hospital Incident Management Team. Facilities should use the Hospital Incident Command System (HICS) for incident management.

Incident Notification:

Hazardous material release notifications can come from multiple sources, and may include the facility, emergency responders, or local emergency management. Verification and vetting of this information must be done before response actions are taken. With the proliferation of social media and other open-source information being made available, verification of an incident, vetting information acquired from openly sourced publicly available sources becomes imperative. Each regional facility should work to develop relationships with local and regional authorities that can assist with the verification and vetting of information.

Emergency Response:

Material Identification: Impacted facilities should work with local first response agencies, local EMA, and others to identify the contaminating hazardous materials. Regional hospitals should also conduct their own material identification and chemical information gathering using multiple sources. Sources such as the ERG (Emergency Response Guidebook) is an example of a great tool to acquire information for chemicals and their properties. There are other sources readily available including both print and electronic resources. Examples of printed materials are SDS Sheets, Janes Manuals, Transportation Manifests, NIOSH pocket guidebook and others. Examples of electronic sources are ATSDR (Agency for Toxic Substance and Disease Registry), NIOSH Pocket Guidebook, CDC Viral Special Pathogens Branch and ATSDR ToxProfiles.

Other electronic resources are available in the form of apps (applications installed on an electronic device) such as CAMEO, ERG and NIOSH Pocket Guide.

Facility Access Control: Facilities experiencing a surge in patients from a hazardous materials event should consider implementing access control measures to ensure patients who are contaminated with a hazardous materials do not accidentally or incidentally gain access to facilities prior to patient decontamination. This may also include access control and flow control of patients in the decontamination line (patients waiting for decontamination). It can be detrimental to a facility should a patient, who is contaminated with a hazardous material, is able to make entry or is able to access a facility. This could include potential contamination of the accessed area, inability to use that area until the impacted area is decontaminated and approved/certified for repatriation or even potentially destruction of contaminated equipment or supplies in the contaminated area.

Decontamination: Patient Decontamination should be conducted prior to any patient who is contaminated with a hazardous material is allowed to enter a medical facility. There are some exceptions to the rule, those exceptions should be made on a facility by facility and case by case basis. Facilities should follow their facilities decontamination plan. The type of decontamination performed, methods used, length of time and other considerations including treatment should all be based upon the identification of the contaminating material.

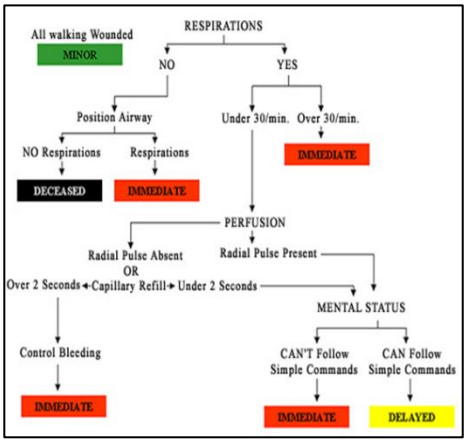
If regional facilities require assistance in the process of decontaminating patients they should request consultation with local first responders, local EMA and the Region2 RHCC. It should be noted that in Region 2 the Regional Medical Emergency Response Team (RMERT) does have decontamination assets including a mobile trailer, PPE and trained team members that can assist as needed. Decontamination is discussed in depth later. Link to Region 2 website

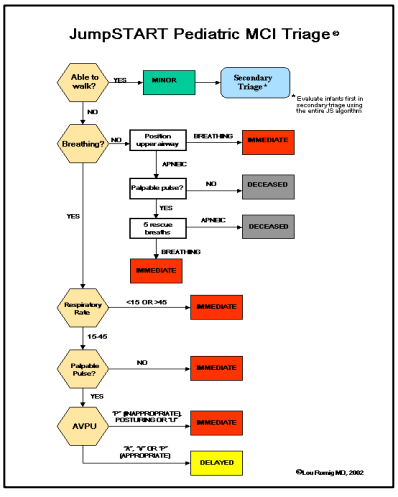
PPE: PPE used for the decontamination of patients should consider the properties of the contaminating agent if possible. Referenced materials used to reference the chemical properties will typically discuss appropriate or recommended PPE. Prior to these emergency events facilities should research facilities, storage centers, commodity flow studies and Tier II Reports from there service area to ensure the PPE used meets the requirements for protection levels including permutation times for the contaminating agents in their area to ensure the greatest level of safety and protection for their team members. PPE should always be used when decontaminating patients or when in contact with contaminated patients in the Hot or Warm Zone.

Patient Triage: (START and JumpSTART Triage)

To provide the best possible care and outcomes to contaminated patients, we must have an objective tool to effectively triage contaminated patients for decontamination. Simply put, in the event of a surge of contaminated patients to our medical centers simply providing decontamination to patients in the order they arrive may not be the most effective method of resources. We may need to triage or re-triage, our patients for decontamination based upon their medical acuity. In Illinois pre-hospital resources use START and JumpSTART triage for acuity-based patient triage using a basic assessment of a patient's respiratory status, peripheral perfusion, and a brief high-level assessment of a patient's mental status. START and JumpSTART triage training is available from the Region 2 RHCC office and from online resources.

(See Appendix for training resources).





Patient Treatment

Most chemicals do not have antidotes and treatment is symptomatic. But in the event the chemicals are CWA's (Chemical Warfare Agents) an antidote or specific treatment may be available. A chemical exposure can cause tearing eyes and burning of the eyes, nose, throat, chest, and skin. It may cause headache, sweating, blurred vision, stomach aches and diarrhea. It is common for even mild symptoms from a harmful chemical to make people feel anxious. Once exposure is stopped, mild symptoms usually go away quickly. A large chemical exposure may additionally cause more serious effects such as difficulty breathing, coughing, wheezing, a faint feeling, or weakness. The worst effects from the most harmful chemicals are collapse, convulsions, and possibly even death. Some effects occur immediately while others may take hours to develop.

Identifying and Treating (CWA)Chemical Warfare Agents

Among the Weapons of Mass Destruction, chemical warfare agents (CWA) are probably one of the most brutal created by mankind in comparison with biological and nuclear warfare. Chemical weapons are inexpensive and are relatively easy to produce, even by small terrorist groups, to create mass casualties with small quantities. Chemical Warfare Agents can be classified as follows:

- Nerve Agents
- Vesicants (blistering agents)
- Blood Agents (cyanogenic agents)
- Choking Agents (pulmonary agents)
- Riot-control agents (tear gases)
- Psychomimetic agents
- Toxins

Nerve Agents: Nerve agents acquired their name because they affect the functioning of the nervous system. Nerve agents do not occur naturally and are manufactured. The first known nerve agent, Tabun (GA), was first developed by the German chemist, Gerhard Schrader, in the 1930s during his research in the development of new organophosphate insecticides. Nerve agents are more toxic than the other reported CW agents. They are highly toxic and can cause death within few minutes to few hours after exposure, depending on the concentration. In the pure state, all nerve agents are colorless liquids.

The treatment of nerve agent poisoning requires constant attention by the medical personnel. Three drugs, atropine, pralidoxime chloride and diazepam, are used to treat nerve agent exposure. Autoinjectors, if necessary and prescribed, are available for deployment from statewide strategically placed Chempacks. Patients arriving at the ED with an unclear exposure history who are symptomatic from nerve agent exposure should be fully decontaminated before entering. Link to Region 2 Chempack resources (bottom of page), DHS CHEMM resources, ASPR CHEMPACK resources, CDC/ATSDR Nerve Agent Tox Profile

Identification of exposure to nerve agents can be as follows. The victim may experience increased saliva, tearing, runny nose, thick secretions in the airways, and sweating; remembered by the acronym SLUDGE: salivation, lacrimation, urination, defecation, and gastrointestinal emesis.

Blistering Agents: Blistering agents or vesicants are toxic compounds that produce skin injuries resembling those caused by burns. These agents on inhalation affect the upper respiratory tract as well as the

lungs, producing pulmonary edema. These agents can also cause severe eye injuries. There are two forms of vesicants: mustards and arsenicals. One of the primary blistering agents is Mustard Gas. Pure sulfur mustard is a colorless and odorless liquid; the impure product has a characteristic smell similar to mustard or garlic. The clinical hallmark of mustard exposure is the relative lack of symptoms following exposure. In the form of gas or aerosol, mustard attacks the skin, eyes, and the respiratory tract. Chemical damage begins in 1–2 min after contact, but onset of pain is delayed for 4–6 hours. There is no specific antidote for mustard toxicity and the treatment is like that of burn injuries.

Blood Agents: Blood agents are cyanide group of chemicals that affect bodily functions by preventing the normal utilization of oxygen by body tissues. The term "blood agent" is a misnomer because these agents do not typically affect the blood, although they may interrupt the production of blood components. Hydrogen cyanide (HCN) and cyanogen chloride (CNCl) are the main CW agents in this class.

The onset and intensity of symptoms depend on the concentration of inhaled toxic vapor and duration of the exposure. Symptoms of exposure to low doses of HCN are weakness, giddiness, headache, confusion and, sometimes, nausea and vomiting. Clinical signs appear only at high levels of exposure, which include fast and painful respiration, lack of coordination of movement, cardiac irregularities, hypoxic convulsions, coma, and respiratory failure culminating in death. Diagnosis may be aided by characteristic odor of cyanide (bitter almond) or a faint pale-red hue of the skin.

Choking/Pulmonary Agents: Choking/Pulmonary agents injure an individual mainly in the respiratory tract, i.e., in the nose, throat, and particularly, the lungs. In extreme cases, membranes swell, the lungs become filled with liquid and death results from lack of oxygen; thus, these agents "choke" the unprotected individuals. Fatalities of this type are referred to as "dry-land drownings." Chlorine and phosgene are the best known among this class. At room temperature, chlorine is a pungent, green-yellow gas. It can be liquefied under moderate pressure. Even at toxic levels, phosgene gas has little distinguishing odor and usually kills its victims only after a considerable delay (up to 24 hours).

Treatment of phosgene poisoning is essentially palliative. The main objective of the treatment is to prevent the development of pulmonary edema and other secondary effects arising out of anoxia. Treatment is extended in three steps. Under first aid, the victim should be allowed fresh air and should be kept warm. The treatment is phased in a manner to provide basic therapy within 30 min of exposure followed by selected additional therapy. Immediate medical aid involves artificial respiration if necessary.

Riot Control Agents: Riot control agents are compounds that cause temporary incapacitation by irritation of the eyes (tearing and blepharospasm), causing them to close, and irritation of the upper respiratory tract. They are often called irritants, lachrymators, and harassing agents. The general public usually calls them tear gases. Only three chemical agents, viz. CN, CS and CR are significant. CN, CS and CR are solid at room temperature and are dispersed as aerosols. They are relatively insoluble in water which causes issues with decontamination. To decontaminate patients, remove all clothing and thoroughly wash and rinse (using cold or warm water) the contaminated skin of the patient/victim using a soap and water solution. Be careful not to break the patient/victim's skin during the decontamination process and cover all open wounds.

Psychomimetic Agents: Psychomimetic Agents are chemical agents that consistently produce changes in thought, perception, and mood, without causing any major disturbances in the autonomic nervous system or other serious disability, are classified as psychomimetic agents. This group of agents usually includes

substances which, when administered in low doses, cause conditions like psychotic disorders or other symptoms emanating from the central nervous system, such as loss of feeling, paralysis, hallucinations, etc. Among them, LSD is the most well-known member. Other members of this group include Psilocybin, ibogaine and harmine.

The common signs and symptoms produced by the psychomimetic agents are:

a) restlessness, dizziness, or giddiness; failure to obey orders, confusion, erratic behavior; stumbling or staggering; vomiting.
b) dryness of mouth, tachycardia at rest, elevated temperature, flushing of face; blurred vision, pupillary dilation; slurred or non-sensical speech; hallucinatory behavior; disrobing; mumbling and picking behavior; stupor and coma
c) inappropriate smiling or laughter, irrational fear, distractibility, difficulty expressing self, perceptual distortions, and phobias.

Clinical effects from ingestion or inhalation of psychedelics appear after an asymptomatic or latent period that may be as little as 30 min or as long as 20 hours; the usual range is 0.5–4 hours. However, there is no effect even after 36 hours on skin exposure. General supportive management of the patient includes decontamination of skin, clothing, weapons, and other related items from the patient. The greatest risks to the patient's life are injuries from his or her own erratic behavior and hyperthermia, especially in patients who are in hot or humid environments or are dehydrated from overexertion or insufficient water intake. Management of heat stress assumes a high priority in a severely exposed patient.

Identifying and Treating Biological Agents used as weapons:

Biological agents include bacteria, viruses, fungi, other microorganisms, and their associated toxins. These agents may appear to be chemical agents housed in powders, liquids, gels, gases, or other types of forms. These agents can adversely affect human health in a variety of ways, ranging from relatively mild, allergic reactions to serious medical conditions—even death. Some organisms, including various types of mold and Legionella bacteria, are found readily in the natural and built environment. Many can spread from person to person (e.g., bloodborne pathogens and influenza viruses), either directly or indirectly. In some forms, biological agents can also be weaponized for use in bioterrorism or other crimes.

Anthrax: Anthrax is an acute infectious disease caused by a spore-forming bacterium called Bacillus anthracis. It is generally acquired following contact with anthrax-infected animals or anthrax-contaminated animal products. The symptoms of anthrax depend on the type of infection and can take anywhere from 1 day to more than 2 months to appear. All types of anthrax have the potential, if untreated, to spread throughout the body and cause severe illness and even death

Cutaneous anthrax symptoms can include:	
• A group of small blisters or bumps that may itch • Swelling can occur around the sore • A painless skin sore (ulcer) with a black center that appears after the small blisters or bumps. ○ Most often the sore will be on the face, neck, arms, or hands.	

Inhalation anthrax symptoms can include:

• Fever and Chills	• Chest Discomfort	• Shortness of Breath	
• Headache	• Sweats (drenching)	• Body Aches	
• Confusion or Dizziness	• Cough	• Nausea, vomiting or stomach pain	

Gastrointestinal Anthrax symptoms can include:	
• Fever and chills	• Diarrhea or bloody diarrhea
• Swelling of neck or neck glands	• Headache
• Sore Throat	• Flushing face and red eyes
• Painful Swallowing	• Stomach Pain
• Hoarseness	• Fainting / syncope
• Nausea and vomiting, especially bloody vomit	• Swelling of abdomen (stomach)

Injection anthrax symptoms can include:
• Fever and chills
• A group of small blisters or bumps that may itch
• A painless skin sore with a black center that appears after the blisters or bumps
• Swelling around the sore
• Abscesses deep under the skin on in the muscle where the drug was injected
Injection anthrax symptoms are like those of cutaneous anthrax, but injection anthrax can spread throughout the body faster and be harder to recognize and treat than cutaneous anthrax. Skin and injection site infections associated with injection drug use are common and do not necessarily mean the person has anthrax.

Decontaminating patients that are contaminated with Anthrax spores is kept to soap and water. Surface and equipment decontamination is best done using a 0.5% (1:10 dilution) sodium hypochlorite solution.

Treatment for an Anthrax exposure, all types of anthrax infection can be treated with antibiotics, including intravenous antibiotics. If someone has symptoms of anthrax, it's important to get medical care as quickly as possible to have the best chances of a full recovery. Medical staff will select antibiotics that are best for treating anthrax and that are best for the patient based on their medical history.

Another form of treatment for Anthrax exposure is by using an antitoxin. When anthrax spores get inside the body, they can be "activated." When they become active, anthrax bacteria can multiply, spread out in the body, and produce toxins—or poisons. Anthrax toxins in the body cause severe illness. After anthrax toxins have been released in the body, one possible treatment is antitoxin. Antitoxins target anthrax toxins in the body. Doctors must use antitoxin together with other treatment options. Currently, there are a few types of antitoxins that can be used for treating anthrax.

Botulism: Cases of botulism are usually associated with consumption of preserved foods. However, botulinum toxins are currently among the most common compounds explored by terrorists for use as biological weapons.

Symptoms of botulism usually start with weakness of the muscles that control the eyes, face, mouth, and throat. This weakness may spread to the neck, arms, torso, and legs. Botulism also can weaken the muscles involved in breathing, which can lead to difficulty breathing and even death.

Since a patient suffering from a exposure to Botulism most likely occurred several days ago, decontamination of these patients may not be required. However, if exposure was recent then the use of soap and water is recommended.

Treatment usually involves the use of an antitoxin, which prevents the toxin from causing any more harm. Antitoxin does not heal the damage the toxin has already done. Some patients with wound botulism sometimes need surgery to remove the source of the bacteria and may need to take antibiotics. The development of antitoxin and modern medical care means that people with botulism have a much lower chance of dying than in the past, when about 50 in every 100 people with botulism died. Today, fewer than 5 of every 100 people with botulism die.

Even with antitoxin and intensive medical and nursing care, some people with botulism die from respiratory failure. Others die from infections or other problems caused by being paralyzed for weeks or months. Patients who survive botulism may have fatigue and shortness of breath for years afterward and may need long-term therapy to help them recover.

EBOLA (EVD -Ebola Virus Disease): Ebola hemorrhagic fever (EHF) (sometimes called Ebola Virus Disease, or EVD) is the disease caused by infection with an Ebola virus. It is a type of viral hemorrhagic fever (VHF) brought on by any of several strains of viruses in the Ebolavirus genus. EVD is usually marked by fever, muscle pain, headache, and sore throat. The illness progression includes nausea, vomiting, diarrhea, and impaired organ function. In some cases, rash, internal and/or external bleeding, and death may occur. The incubation period for Ebola is 2-21 days with symptom onset between 14 and 21 days.

Decontamination of patients is not necessary unless exposure was very recent, and contamination is still wet on the body surface. For individuals who become infected with EVD, there is currently no treatment, antiviral therapy, or approved vaccine. Supportive hospital care for patients with EVD (like other viral hemorrhagic fevers) includes fluid and blood replacement, maintaining stable blood pressure, and treating other comorbidities (i.e., other injuries or infections) as appropriate.

Ricin: Ricin is one of the most toxic and easily produced plant toxins. It has been used in the past as a bioterrorist weapon and remains a serious threat. Ricin poisoning can occur through several routes of exposure, including inhalation, ingestion, and skin and eye contact. Ricin is a toxin that is contained in castor beans, seed hulls, and the unrefined oil from the seed. Castor beans are processed, the oils are retrieved, and the oil is used in many industries including biofuels, soaps, waxes, greases, lubricants, and coatings.

A covert release of ricin may not be immediately recognized, since the incubation period between exposure and symptom onset ranges from 4 to 12 hours. Ricin-exposed persons exhibiting symptoms are likely to present to an emergency department after symptoms have developed. Suspect a potential terrorism release of ricin when there is a sudden unusual temporal or geographic clustering of otherwise healthy persons manifesting a constellation of clinical signs and symptoms/toxic effects typical for ricin exposure.

Smallpox: Smallpox is a highly contagious disease unique to humans. It is estimated that no more than 20 percent of the population has any immunity from previous vaccination. Smallpox outbreaks have occurred for thousands of years, but in 1980 the disease was declared eradicated following worldwide vaccination programs. Although smallpox is no longer causing global illness, high-security laboratories maintain stockpiles of variola viruses, which if lost or stolen and released as a bioweapon, could lead to a public health catastrophe. Although naturally occurring smallpox has been eradicated, there is still heightened concern that the variola virus might be used as an agent of bioterrorism[1,2]. Smallpox has been identified by the Centers for Disease Control and Prevention (CDC) as a "Category A" agent, meaning it has been given high priority due to its potential threat to national security. Smallpox is not considered to be

contagious by the CDC during its incubation period [3]. The incubation period post smallpox exposure is 7-19 days, but the average length is 10-14 days. Initial symptoms include high fever, body aches and sometimes vomiting. At this time, people are usually too sick to carry on their normal activities.

Smallpox is best known for the red rash that's starts as small red spots on the tongue and in the mouth. These spots change into sores that break open and spread large amounts of the virus into the mouth and throat. The person continues to have a fever. Once the sores in the mouth start breaking down, a rash appears on the skin, starting on the face and spreading to the arms and legs, and then to the hands and feet. By the fourth day, the skin sores fill with a thick, opaque fluid and often have a dent in the center. By day 6 of the rash, the sores become pustules. By the end of the second week after the rash appears, most of the sores have scabbed over.

Treatment will start prior to exposure for those that are in areas with outbreaks or are considered high risk for exposure. If you receive the vaccine within 3 days of being exposed to the virus, the vaccine might protect you from getting the disease. If you still get the disease, you might get much less sick than an unvaccinated person would. If you receive the vaccine within 4 to 7 days of being exposed to the virus, the vaccine likely gives you some protection from the disease. If you still get the disease, you might not get as sick as an unvaccinated person would.

There are 3 antiviral drugs that are FDA approved or are in the process of seeking FDA approval for treatment of a patient with Smallpox. These antivirals include tecovirimat (TPOXX) and brincidofovir (TEMBEXA) for the treatment of smallpox. The third drug, cidofovir, has also been shown to stop the growth of the virus that causes smallpox and to be effective in treating animals that had diseases similar to smallpox. Cidofovir has not been tested in people who are sick with smallpox but has been tested in healthy people and in those with other viral illnesses. Cidofovir is not FDA-approved.

Tularemia: Tularemia is also known as "rabbit fever" or "deer fly fever" and is extremely infectious. Relatively few bacteria are required to cause the disease, which is why it is an attractive weapon for use in bioterrorism. Tularemia is an occupational risk for farmers, foresters, and veterinarians, and is listed by the U.S. Centers for Disease Control and Prevention (CDC) as one of the six category A, or high-priority, biological warfare agents. Tularemia is easily treatable with antibiotics as long as victims receive treatment quickly. If a patient is not treated, the fatality rate can exceed 30 percent. Isolation is not recommended for tularemia patients because it is not transmitted from person to person.

Signs and symptoms of Tularemia exposure include fever, chills, headache, cough, and myalgia. A cutaneous ulcer occurs in approximately 60% of patients and is the most common sign of tularemia. Treatment for Tularemia consists of antibiotic therapies including the use of Streptomycin. Patients treated with Streptomycin usually respond within 48 hours post administration. The use of gentamicing has been used with some success. Tetracycline and chloramphenicol are often effective, but some patients will relapse if administered too early or if usage is not long enough.

PPE Recommendations for triage and decontamination:

First Receiver: Recommended PPE and practices in a radiation emergency		
First receivers delivering care to victims **more likely** to be externally contaminated: i.e., healthcare providers working in **pre-decontamination (triage) and decontamination areas**	Level C PPE usually provides sufficient level of respiratory and skin protection	Recommended respiratory PPE includes a full-face piece air purifying respirator with a P-100 or High Efficiency Particulate Air (HEPA) filter. *Lead aprons are cumbersome and do not protect against exposure from high-energy, highly penetrating ionizing radiation

Decontamination of Patients:

Contamination versus Exposure

- Contamination is hazardous material (e.g., solid, liquid, or gaseous vapor) that physically remains on a person, animal, or object. Direct contamination results from direct contact with a contaminant or through cross contamination.
- Cross contamination occurs when a "clean" person is contaminated by a "dirty" object or individual.
- Exposure is the term used when a person is subjected to a toxic or harmful substance through any route into the body (e.g., injection, open wound, absorption, inhalation, or ingestion). Exposure can produce immediate injury or illness or can have a delayed presentation.

The decontamination process is dependent on the chemical and its physical properties, as well as the inherent hazards associated with the agent. You can remove a vast amount of contaminants with the judicious use of high-volume, low-pressure tepid water, and when necessary, use a non-reactive mild soap as a surfactant and a soft sponge. Using the minimum standard of 5 minutes of time in the shower is typically adequate for most contaminants. Using a non-reactive soap such as a tear fee baby shampoo or Dawn Dish Soap (Dawn Original) is recommended for contaminant encapsulation and expedient removal of contaminating agents.
Tepid water is defined (ANSI standard Z358.1-2014) as water with a temperature between 60- and 100-degrees Fahrenheit. If a hospital is required to meet the standards recommended by EMSC (Emergency Medical Services for Children) EDAP (Emergency Department Approved for Pediatrics) accreditation, that recommendation is for water between the temperature of 98- and 110- degrees Fahrenheit. This is to prevent hypothermia in pediatric patients.
Any staff members conducting decontamination operations or any time any staff members are in the warm or hot zone they must be wearing PPE. The PPE used must protect the user from the effects of the chemical(s). Training on the correct methods of patient decontamination, PPE donning and doffing along with appropriate training in the methods of erecting or preparing the decontamination corridor. Each individual facility may have different equipment, PPE, policies or procedures and staff should attend at a minimum annual education and training.

- ✓ Remove clothing:
  Quickly take off clothing that may have contamination on it. If possible, any clothing that must be pulled over the head should be cut off the body instead, so the contaminant does not get near the eyes, mouth, or nose.
  If helping other people remove their clothing, try to avoid touching any areas that may have the chemical on them, and remove the clothing as fast as possible. Dispose of the clothing in bags or bins and mark with a specific identifier specific to each patient.
- ✓ Wash affected areas:
  As quickly as possible, wash any chemical from the skin with lots of soap and water.
  If the eyes are burning or vision is blurred, rinse the eyes with plain water for 10 to 15 minutes.
  If contact lenses are worn, remove them and put them with the clothing. Do not put the contacts back in.
  If eyeglasses are worn, wash them with soap and water. Eyeglasses can be put back on after they are washed.
- ✓ Discard contaminated items:
  Place the clothing and any other contaminated items that may have come into contact with the contaminant inside a plastic bag. Avoid touching them by wearing rubber gloves, turning the bag inside out and using it to pick up the clothing, or putting the clothing in the bag using tongs, tool handles, sticks or similar objects.
  Anything that touches contaminated clothing should also be placed in the bag.
  Seal the bag, and then seal that bag inside another plastic bag.

Recovery:

Hospital Command Center Information: First response agencies will consolidate and compile for storage and future reference copies of patient tracking information and Hospital Command Center paperwork (including position specific Job Action Sheets) and notes from the incident. These documents should be given to the Planning Section Chief assigned to their Hospital Command Center.

After Action Report – Improvement Plan (AAR-IP): Hospitals receiving patients from the chemical incident should complete an AAR-IP for their facility. This AAR-IP will outline the facilities response and coordination for this incident along with any plans for improvement in the future. The AAR-IP for each facility should then be forward to the RHCC. Once all AAR-IP's are received, aggregated and compiled from the impacted facilities, the RHCC will develop a regional AAR-IP for the incident.

Mental Health – Prioritize mental health for those who were providing support, patient care, incident management or played any other role in this event. It should be the goal to provide mental health support in form of Critical Incident Stress Management, Critical Incident Stress Debriefing, counseling or other forms of mental health support within 72 hours of the stabilization of the event.

Logistics – Upon conclusion of the event response agencies should inventory supplies and provide a list of supplies used, equipment that will need repaired or replaced, PPE damaged that needs replaced or any other logistical supply costs incurred by the impacted agencies, facilities or entities. Order replacement supplies to ensure the future capability to decontaminate patients in a future incident.

Appendix:

Appendix A –Resources

Resources	
START Triage Training	https://www.triagetags.com/Online-START-Triage-Course
JumpSTART Triage Training	https://www.publichealthlearning.com/course/search.php?search=triage
CHEMM	https://chemm.hhs.gov/hospitalproviders.htm
CDC - Nerve Agents	https://emergency.cdc.gov/agent/nerve/
CDC - Chemical Warfare Agents	https://emergency.cdc.gov/agent/agentlistchem.asp

Appendix B – Emergency Contacts

Illinois State Emergency Contacts	
Illinois Emergency Management Agency	
IEMA Communications Center	1 (800) 782-7860
Radiological Duty Officer on-call	(217) 785-0600
Illinois Department of Public Health	
Office of Preparedness of Response	(217) 558-0560
Springfield Headquarters	(217) 782-4977
Bioterrorism Preparedness and Emergency Response	(217) 558-0560

Incident Response Guide: Chemical Incident

Mission

To provide a safe environment for patients, staff, and visitors within the hospital following a chemical incident that may or may not impact the safety of the hospital or availability of services; and to provide the safe continuation of care for patients, visitors, and those seeking care post-incident.

Directions

Read this entire response guide and review the Hospital Incident Management Team Activation chart.

Use this response guide as a checklist to ensure all tasks are addressed and completed.

Objectives

- ☐ Provide safe and effective decontamination of incoming contaminated patients
- ☐ Protect patients, staff, and the hospital from contamination and safely restore normal operations
- ☐ Communicate effectively with the local Emergency Operations Center and emergency response partners

Immediate Response (0 – 2 hours)				
Section	**Officer**	**Time**	**Action**	**Initials**
Command	**Incident Commander**		Receive notification of incident from local officials. Notify the emergency department of incoming casualties that are possibly contaminated.	
			Notify hospital Chief Executive Officer, Board of Directors, and other appropriate internal and external officials of situation status.	
			Activate the Emergency Operations Plan, Chemical Incident Plan, Hospital Incident Management Team, Medical-Technical Specialists, and Hospital Command Center.	
			In conjunction with Medical-Technical Specialist: Chemical, determine threat to the hospital and the need for shelter-in-place or hospital evacuation.	
			Establish operational periods, incident objectives, and regular briefing schedule. Consider use of Incident Action Plan Quick Start for initial documentation of the incident.	
			Consider limiting or ceasing nonessential services.	
			Consider activation of ambulance diversion status.	
	Public Information Officer		Develop patient, staff, and community response messages to convey hospital preparations, services, and response.	
			Monitor media outlets for updates on the incident and possible impacts on the hospital. Communicate information via regular briefings to Section Chiefs and the Incident Commander.	
	Liaison Officer		Notify community partners in accordance with local policies and procedures (e.g., consider local Emergency Operations Center, other area healthcare facilities, local emergency medical services, and healthcare coalition coordinator), to determine incident details, community status, estimates of casualties, and establish contacts for requesting supplies, equipment, or personnel not available in the facility.	
			Contact appropriate authorities and experts to provide hospital status and request support and recommendations for chemical decontamination.	

	Safety Officer		Monitor safe activation of the Chemical Incident Plan and the Decontamination Plan.	
			Monitor safe and consistent use of appropriate personal protective equipment by staff.	
			Conduct ongoing analysis of existing response practices for health and safety issues related to patients, staff, and hospital and implement corrective actions to address; complete HICS 215A.	
	Medical-Technical Specialist: Chemical		Assist in obtaining specific information regarding chemical agent such as antidotes, treatment, decontamination procedures, etc.	
			Provide expert input in the Incident Action Planning process.	
			Assist the Incident Commander in determining the threat to the hospital and the need for shelter-in-place or hospital evacuation.	

Immediate Response (0 – 2 hours)

Section	Branch/Unit	Time	Action	Initials
Operations	**Section Chief**		Implement the Chemical Incident Plan.	
			Implement the Evacuation, Shelter-in-Place, or Hospital Abandonment Plan, as directed by the Incident Commander.	
	Medical Care Branch Director		Conduct an inpatient and outpatient census and prioritize for safe discharge or cancellation of appointments and procedures.	
			Identify evacuation priorities and transfer requirements.	
			Determine inpatient and outpatient capacity required to handle patient surge in shelter-in-place conditions.	
			Provide safe medical care to patients remaining in the hospital.	

	HazMat Branch Director		Implement the hospital's Chemical Incident Plan: ☐ Establish triage and decontamination areas with a clear perimeter and direction on ingress and egress ☐ Provide rapid triage and disposition of potentially contaminated patients, non-contaminated patients, media, family members, etc. ☐ Implement staff monitoring and rotation through the decontamination area ☐ Consult with Medical-Technical Specialist: Chemical, and internal and external consultants to ascertain treatment protocols ☐ Relocate medications and antidotes to clinical care and decontamination areas ☐ Consider the need for evidence collection	
	Security Branch Director		Activate security policy and procedure to: ☐ Secure the hospital and campus ☐ Establish access and egress routes ☐ Implement crowd and traffic control protocols ☐ Establish and secure areas for collection of contaminated belongings and valuables	
	Infrastructure Branch Director		As directed, implement the hospital's Shelter-In-Place Plan, including shutdown of heating, ventilation, and air conditioning system or sealing of the hospital.	
			Conduct a damage, structural integrity, and utilities assessment of the hospital.	
			Monitor hospital air quality for safe occupation.	
Planning	**Section Chief**		Establish operational periods, incident objectives and the Incident Action Plan in collaboration with the Incident Commander.	
	Resources Unit Leader		Initiate personnel and materiel tracking.	
	Situation Unit Leader		Gather situational assessment and response data from internal and external sources.	
			Initiate patient and bed tracking in collaboration with Operations Section (HICS 254–Disaster Victim/Patient Tracking).	
Logistics	**Section Chief**		Activate the Support Branch to provide the logistics needs of hospital staff and operations.	

	Support Branch Director		Activate Labor Pool and Credentialing Unit.	
			Initiate staff call-in systems, if instructed to do so and if it is safe for arriving staff.	
			Inventory equipment, supplies, and medications on hand and prepare to ration materiel as needed.	
			Anticipate increased need for medical and surgical supplies, medications, and equipment and take actions to obtain when possible.	
	Labor Pool and Credentialing Unit		Determine numbers and capability of onsite and call in staff along with solicited and unsolicited volunteers.	

Intermediate Response (2 – 12 hours)				
Section	**Officer**	**Time**	**Action**	**Initials**
Command	**Incident Commander**		Review the overall impact of the ongoing incident on the hospital with Command Staff and Section Chiefs.	
			Reevaluate need to shelter-in-place versus evacuate.	
			Monitor that communications and decision making are coordinated with external agencies and area hospitals, as appropriate.	
			Direct implementation of any and all additional response plans required to address the incident.	
			Consider deploying a representative to the local Emergency Operations Center.	
	Public Information Officer		Conduct briefings to patients, staff, people seeking shelter, and media to update them on incident and hospital status.	
			Coordinate risk communication messages with the Joint Information Center, if able.	
			Assist with notification of patients' families about the incident and inform them about the likelihood of evacuation, if required.	
	Liaison Officer		Maintain contact with local Emergency Operations Center, area hospitals, and regional medical health coordinator to relay status and critical needs and to receive community updates.	

	Safety Officer		Continue to implement and maintain safety and personal protective measures to protect patients, staff, visitors, and hospital.	
			Monitor that victim decontamination is in compliance with established decontamination practices.	
			Update HICS 215A as required.	
			Continue to monitor proper use of personal protective equipment and decontamination procedures.	
	Medical-Technical Specialist: Chemical		Support the Operations Section as needed, by coordinating information regarding specific decontamination and treatment procedures; provide direct oversight of decontamination operations as directed.	
			Continue to provide expert input into the Incident Action Planning process.	

Intermediate Response (2 – 12 hours)				
Section	**Branch/Unit**	**Time**	**Action**	**Initials**
Operations	**Section Chief**		Monitor continuation of medical mission activities.	
	Medical Care Branch Director		Continue patient, staff, and hospital monitoring for chemical exposure, and provide appropriate follow up as required.	
			Evaluate and update staff scheduling to accommodate decontamination team support and scheduling.	
			Activate Fatality Management Plan and management of contaminated remains.	
	Infrastructure Branch Director		Continue to monitor hospital air quality.	
			Monitor impact of alterations in heating, ventilation, and air conditioning system for ability to maintain operations and comfortable environment.	
	Security Branch Director		Implement procedures for patient valuables management and evidence collection in cooperation with law enforcement.	
			Maintain hospital security, including restrictions in entry, egress, traffic, and crowd control.	
	HazMat Branch Director		Monitor decontamination response and project needs for additional staff, supplies and equipment.	
			Monitor proper wastewater and expendable materials disposal.	
	Patient Family Assistance Branch Director		Establish a patient information center in cooperation with the Liaison Officer.	
Planning	**Section Chief**		Revise and update Incident Action Plan, including planning for supply, staffing, and other needs.	
	Resources Unit Leader		Continue staff and equipment tracking.	
	Situation Unit Leader		Continue patient and bed equipment tracking.	
Logistics	**Section Chief**		Refer to the Job Action Sheet for appropriate tasks.	

	Service Branch Director		Provide for patient, staff, and visitor food and water needs.	
	Support Branch Director		Initiate employee monitoring for chemical exposure and provide appropriate follow up care.	
			Establish an Employee Family Care Unit, if required.	
			Continue staff call-in, if safe to do so, and provide additional staff to impacted areas.	
Finance/ Administration	**Section Chief**		Coordinate with Risk Management for additional insurance and documentation needs.	
	Time Unit Leader		Track the hours associated with the emergency response.	
	Procurement Unit Leader		Facilitate the procurement of needed supplies, equipment, and contractors.	
	Cost Unit Leader		Track response expenses and expenditures.	

Extended Response (greater than 12 hours)				
Section	**Officer**	**Time**	**Action**	**Initials**
Command	**Incident Commander**		Reassess the incident objectives and Incident Action Plan; revise them as indicated by the response priorities and overall mission.	
			Continue regular briefing of Command Staff and Section Chiefs.	
			Reevaluate the hospital's ability to continue its medical mission.	
			Plan for a return to normal services in coordination with Command Staff and Section Chiefs.	
	Public Information Officer		Continue regularly scheduled briefings to media, patients, staff, families, and people seeking shelter.	
			Communicate regularly with the Joint Information Center to update hospital status and coordinate public information messages.	

			Address social media issues as warranted; use social media for messaging as situation dictates.	
	Liaison Officer		Maintain contact with local Emergency Operations Center, other area hospitals, and regional medical health coordinator to relay status and critical needs and to receive incident and community updates.	
	Safety Officer		Continue to oversee safety measures and use of personal protective equipment for staff during demobilization of decontamination response.	
	Medical-Technical Specialist: Chemical		Continue to support the Operations Section as needed by coordinating information regarding specific decontamination and treatment procedures.	
			Continue to provide expert input into the Incident Action Planning process.	
			Monitor the movement of the chemical plume (if applicable), consult with local health department and emergency management, and advise the Incident Commander if the external area is safe for discontinuation of shelter-in-place.	

Extended Response (greater than 12 hours)				
Section	**Branch/Unit**	**Time**	**Action**	**Initials**
Operations	**Section Chief**		Monitor the continuation of medical mission activities, including patient care and hazardous materials (HazMat) activities.	
	Medical Care Branch Director		Continue patient monitoring for chemical exposure and provide appropriate follow up care as required.	
	Infrastructure Branch Director		Continue to monitor hospital air quality.	
			With Medical -Technical Specialist: Chemical and when shelter-in-place is suspended, conduct an external inspection of the hospital for damage and determine need for outside decontamination.	
			Continue infrastructure monitoring, maintenance, and air quality monitoring in collaboration with the Safety Officer.	
	Security Branch Director		Continue to ensure hospital security, traffic, and crowd control.	
			Monitor the enforcement of hospital policies and cooperation with local, state, and federal law enforcement agencies when interviewing patients and collecting evidence.	
	HazMat Branch Director		Provide for hospital and equipment decontamination where appropriate.	
Planning	**Section Chief**		Update and revise the Incident Action Plan in collaboration with Command Staff and Section Chiefs.	
			Ensure that updated information and intelligence is incorporated into the Incident Action Plan. Ensure the Demobilization Plan is being readied.	
	Situation Unit Leader		Continue to update status boards and other communication devices with latest hospital and community status.	
Logistics	**Section Chief**		Refer to the Job Action Sheet for appropriate tasks.	
	Support Branch Director		Monitor and address the health status of staff that participated in, supported, or assisted in decontamination activities.	

			Restock and repair all supplies and equipment used in the response.	
Finance/ Administration	**Section Chief**		Refer to the Job Action Sheet for appropriate tasks.	
	Procurement Unit Leader		With the Logistics Support Branch, facilitate the procurement of supplies, equipment, and medications for response and patient care.	
	Compensation/ Claims Unit Leader		Assess and implement risk management and claims procedures for reported staff and patient exposures or injuries.	
	Cost Unit Leader		Continue to track response costs and expenditures and prepare regular reports for the Incident Commander.	

Demobilization/System Recovery

Section	Officer	Time	Action	Initials
Command	**Incident Commander**		Determine the termination of event or "all clear" in collaboration with Command Staff, Section Chiefs, local law enforcement, and Hazmat officials.	
			Oversee and direct demobilization and system recovery operations with restoration of normal services.	
			Ensure that the process is mobilized to complete response documentation for submission for reimbursement.	
	Public Information Officer		Conduct final media briefing and assist with updating staff, patients, people seeking shelter, families, and others of termination of the incident.	
	Liaison Officer		Communicate the final hospital status and termination of the incident to regional medical health coordinator, local Emergency Operations Center, area hospitals, and local emergency medical services.	
	Safety Officer		Monitor the proper disposal of contaminated waste and wastewater.	
			Assist with monitoring the completion of hospital repairs and decontamination, in conjunction with the Operations Section.	

			Monitor and maintain a safe environment during the return to normal operations.	

Demobilization/System Recovery				
Section	**Branch/Unit**	**Time**	**Action**	**Initials**
Operations	**Section Chief**		With Infrastructure Branch, monitor and manage the decontamination of the hospital.	
	Medical Care Branch Director		Coordinate patient care services returning to normal operations.	
			Reschedule canceled surgeries, procedures, and outpatient appointments.	
			Repatriate transferred patients, if applicable.	
	Infrastructure Branch Director		Restore heating, ventilation, and air conditioning systems to normal service.	
			With the Safety Officer, continue to monitor the disposal of contaminated waste and wastewater.	
			Conduct or facilitate hospital repairs and return of the hospital to normal operating conditions.	
			Complete a hospital damage report, including the progress of repairs, and estimated timelines for restoration of hospital to normal operating conditions.	
	Security Branch Director		Return entry and egress restrictions, traffic flow, and security personnel to normal services.	
	HazMat Branch Director		Ensure that all personnel, supplies, and equipment utilized in the response have been properly decontaminated and stored.	
			With Infrastructure Branch, monitor and manage the decontamination of the hospital.	
Planning	**Section Chief**		Finalize and distribute the Demobilization Plan.	
			Conduct debriefings and hotwash with: ☐ Command Staff and section personnel ☐ Administrative personnel ☐ All staff ☐ All volunteers	

			Write an After-Action Report and Corrective Action and Improvement Plan for submission to the Incident Commander, describing: ☐ Summary of the incident ☐ Summary of actions taken ☐ Actions that went well ☐ Actions that could be improved ☐ Recommendations for future response actions	
	Documentation Unit Leader		Collect, correlate, and archive all electronic and written documentation generated in the event response.	
			Prepare a summary of the status and location of all incident patients, staff, and equipment. After approval by the Incident Commander, distribute it to appropriate external agencies.	
Logistics	**Section Chief**		Inventory all Hospital Command Center and hospital supplies and replenish them as necessary, appropriate, and available.	
	Support Branch Director		Initiate long term monitoring of employees exposed to chemicals and participating in decontamination or patient care activities, including provision of behavioral health services, as required.	
Finance/ Administration	**Section Chief**		Refer to the Job Action Sheets for appropriate tasks.	
	Compensation/ Claims Unit Leader		Contact insurance carriers to assist in documentation of structural and infrastructure damage and initiate reimbursement and claims procedures.	
	Cost Unit Leader		Compile a final response and recovery costs and expenditures and estimated lost revenues summary and submit it to Planning Section Chief for inclusion in the After-Action Report.	

Documents and Tools

Emergency Operations Plan, including:

- ☐ Chemical Incident Plan
- ☐ Evacuation, Shelter-in-Place, and Hospital Abandonment Plan
- ☐ Decontamination Plan
- ☐ Surge Plan
- ☐ Triage Plan
- ☐ Patient, staff, and equipment tracking procedures
- ☐ Employee Health Monitoring and Treatment Plan
- ☐ Business Continuity Plan
- ☐ Behavioral Health Support Plan
- ☐ Alternate Care Site Plan
- ☐ Security Plan
- ☐ Fatality Management Plan
- ☐ Volunteer Utilization Plan
- ☐ Emergency Patient Registration Plan
- ☐ Risk Communication Plan
- ☐ Isolation protocols
- ☐ Interoperable Communications Plan
- ☐ Centers for Disease Control (CDC) Medical Management Guidelines for the specified chemical
- ☐ Demobilization Plan

Forms, including:

- ☐ HICS Incident Action Plan (IAP) Quick Start
- ☐ HICS 200 – Incident Action Plan (IAP) Cover Sheet
- ☐ HICS 201 – Incident Briefing
- ☐ HICS 202 – Incident Objectives
- ☐ HICS 203 – Organization Assignment List
- ☐ HICS 205A – Communications List
- ☐ HICS 214 – Activity Log
- ☐ HICS 215A – Incident Action Plan (IAP) Safety Analysis
- ☐ HICS 221 – Demobilization Checklist
- ☐ HICS 251 – Facility System Status Report
- ☐ HICS 253 – Volunteer Registration
- ☐ HICS 254 – Disaster Victim/Patient Tracking
- ☐ HICS 255 – Master Patient Evacuation Tracking

Job Action Sheets

Access to hospital organization chart

Access to HazMat/Terrorism/CBRNE annexes of local Emergency Operations Plan

Hospital and campus floor plans and maps
Television/radio/internet to monitor news
Telephone/cell phone/satellite phone/internet/amateur radio/2-way radio for communication

Hospital Incident Management Team Activation: Chemical Incident

Position	Immediate	Intermediate	Extended	Recovery
Incident Commander	X	X	X	X
Public Information Officer	X	X	X	X
Liaison Officer	X	X	X	X
Safety Officer	X	X	X	X
Medical-Technical Specialist: Chemical	X	X	X	X
Operations Section Chief	X	X	X	X
Medical Care Branch Director	X	X	X	X
Infrastructure Branch Director	X	X	X	X
Security Branch Director	X	X	X	X
HazMat Branch Director	X	X	X	X
Patient Family Assistance Branch Dir.		X	X	X
Planning Section Chief	X	X	X	X
Resources Unit Leader	X	X	X	X
Situation Unit Leader	X	X	X	X
Documentation Unit Leader				X
Logistics Section Chief	X	X	X	X
Service Branch Director		X	X	X
Support Branch Director	X	X	X	X
Labor Pool & Credentialing Unit Leader	X	X	X	X
Finance /Administration Section Chief		X	X	X
Time Unit Leader		X	X	X
Procurement Unit Leader		X	X	X
Compensation/Claims Unit Leader			X	X
Cost Unit Leader		X	X	X

NEWS & TERRORISM
COMMUNICATING IN A CRISIS

A fact sheet from the National Academies and the U.S. Department of Homeland Security

CHEMICAL ATTACK
WARFARE AGENTS, INDUSTRIAL CHEMICALS, AND TOXINS

WHAT IS IT?

A **chemical attack** is the spreading of toxic chemicals with the intent to do harm. A wide variety of chemicals could be made, stolen, or otherwise acquired for use in an attack. Industrial chemical plants or the vehicles used to transport chemicals could also be sabotaged. Harmful chemicals that could be used in an attack include:

- Chemical weapons (warfare agents) developed for military use.
- Toxic industrial and commercial chemicals that are produced, transported, and stored in the making of petroleum, textiles, plastics, fertilizers, paper, foods, pesticides, household cleaners, and other products.
- Chemical toxins of biological origin such as ricin.

The toxicity of chemicals varies greatly. Some are acutely toxic (cause immediate symptoms); others are not very toxic at all. Chemicals in liquid or vapor form generally lead to greater exposures than chemicals in solid form.

How Toxic Chemicals Could be Used

The severity of an attack is related to the toxicity of the chemical and its concentration when it reaches people. Many variables affect the concentration of a chemical including wind and the volatility of the chemical. The release of toxic chemicals in closed spaces (e.g., in subways, airports, and financial centers) could deliver doses high enough to injure or kill a large number of people. In an open area, a toxic chemical cloud (plume) would become less concentrated as it spreads and would have to be released in large quantities to produce a lot of casualties. Potential delivery methods of toxic chemicals include:

- Ventilation systems of a building.
- Misting, aerosolizing devices, or sprayers.
- Passive release (container of chemical left open).
- Bombs, mines, or other explosive devices that contain chemicals other than those used to create the explosion.
- Improvised chemical devices that combine readily available chemicals to produce a dangerous chemical.
- Sabotage of plants or vehicles containing chemicals.
- Introduction of toxins in the food and water supply.

Detection

Many chemicals at high concentrations can be readily detected with hand-held detection equipment carried by many emergency responders.

Symptoms of Exposure

Visual signs of exposure could include people grouped together who have similar symptoms such as choking or eye irritation. Symptoms in the animal population (birds, wildlife, pets) can be important first indicators, often at concentrations much lower than detected by hand-held devices.

Facts about Chemical Weapons

- First used in World War I, chemical weapons drew from existing industrial chemicals (chlorine, phosgene).
- The Chemical Weapons Convention was ratified by more than 160 nations in 1997 with the goal of eliminating state production, storage, and use. The United States is actively destroying its stockpile of chemical agents and has successfully eliminated over 25% to date.
- The 1995 sarin attack on the Tokyo subway by the cult Aum Shinrikyo proves that fabrication and use of chemical weapons by non-state groups is possible. Twelve people died and more than 5,000 were injured.

Facts about Industrial Chemicals

- Industrialized countries produce, transport, and store large quantities of chemicals, some of which are toxic.
- In 1984, a release from a tank of methyl isocyanate at the Union Carbide plant in Bhopal, India killed more than 3,800 people and injured 170,000.
- Environmental laws enacted in 1986 and 1990 were aimed at reducing risk of accidental releases.
- The overall safety record of the chemical and transportation industries are very good, and recent engineering and other advances have made them even safer.

Facts about Toxins of Biological Origin

Agents such as botulinum toxin and ricin are toxins produced by plants, animals, and bacteria. Other examples include toxins from dangerous algal blooms and snake venoms. These substances can be gathered in nature, or alternatively created in labs. Unlike biological agents, they do not reproduce or spread from person to person. Unlike other chemical agents, they are not volatile (do not vaporize) and tend to be more toxic on a weight basis.

Botulinum toxin is a nerve toxin produced by bacteria. It causes botulism, a rare but serious paralytic illness that can be fatal. The three naturally-occuring forms of the illness are foodborne, infant, and wound botulism. An antitoxin is available to treat botulism, but must be administered within hours of exposure.

Ricin is a toxin from castor beans that is part of the waste produced when castor oil is made. It is very toxic—a dose the size of the head of a pin could be lethal but only if injected. Ricin is not absorbed by the skin and is not effective when eaten or inhaled except in impractically large amounts. Ricin was reportedly found in Al Qaeda caves in Afghanistan in the 1980s. There is no antidote.

WHAT IS THE DANGER?

Immediate Impact to Human Health

Acutely toxic chemicals can cause injury or fatalities if they are inhaled or absorbed by the skin. The harm that chemicals can cause depends on; 1) their degree of toxicity 2) the concentration of the chemical, 3) the route of exposure, and 4) the duration of the exposure. The symptoms of exposure to most toxic chemicals would appear in minutes to hours. Different chemicals have different effects on the body. Table 1 shows the health effects for some chemical weapons. Some of the most toxic industrial chemicals can produce similar types of health effects at high concentrations. Table 2 shows lethal concentrations for some chemical weapons and industrial chemicals.

The Area Affected

In an open-air environment, the area affected would depend upon such factors as the type and amount of the chemical agent, the means of dispersal, the local topography, and the local weather conditions. For highly toxic chemicals, lethal or immediately life-threatening results could be seen close to where the agent is released where the concentration is highest, while severe to moderate symptoms could be seen at some distance from the event. A toxic cloud would spread roughly with the speed and direction of the wind, but the concentration of the chemical would be greatly diminished at distances far from the source. For a release in a closed space, a volatile chemical will disperse to fill the space. The smaller the space, the greater the concentration of the chemical.

Exposure Through Contaminated Food

Chemical agents can make foods highly toxic, sometimes without changing the appearance or taste of the foods. Butter, oils, fatty meats, and fish absorb nerve agents so readily that removal of the agents is virtually impossible. Foods in bottles, cans, or wrappings are not affected by agent vapor and can be salvaged following decontamination. The food supply is vulnerable to intentional contamination by toxins such as botulinum toxin.

Table 1. Effects and treatment of some chemical weapons developed for military use

	Nerve Agents		Blister Agents (injure skin, eyes, and airways)		Blood Agents (cause blood changes and heart problems)		Choking Agents	
Examples	Sarin	VX	Mustard	Lewisite	Hydrogen Cyanide	Cyanogen Chloride	Chlorine	Phosgene
Odor	Odorless		Garlic or Mustard	Geraniums	Burnt almonds		Bleach	Mown hay
Persistency*	Non-persistent (min. to hrs.)	Persistent (>12 hrs.)	Persistent		Non-persistent		Non-persistent; vapors may hang in low areas	
Rate of Action	Rapid for vapors; liquid effects may be delayed		Delayed	Rapid	Rapid		Rapid at high concentrations; delayed at lower concentrations	
Signs and Symptoms	Headache, runny nose, salivation, pinpointing of pupils, difficulty in breathing, tight chest, seizures, convulsions, nausea, and vomiting		Red, burning skin, blisters, sore throat, dry cough; pulmonary edema, eye damage, nausea, vomiting, diarrhea. Symptoms may be delayed 2 to 24 hrs		Cherry red skin/lips, rapid breathing, dizziness, nausea, vomiting, convulsions, dilated pupils, excessive salivation, gastrointestinal hemorrhage, pulmonary edema, respiratory arrest		Eye and airway irritation, dizziness, tightness in chest, pulmonary edema, painful cough, nausea, headache	
First Aid	Remove from area, treat symptomatically, Atropine and pralidoxime chloride (2-PAM chloride), diazepam for seizure control		Decontaminate with copious amount of water, remove clothing, support airway, treat symptomatically		Remove from area, assist ventilations, treat symptomatically, administer cyanide kit		Remove from area, remove contaminated clothing, assist ventilations, rest	

Exposure Through Contaminated Water

Toxic chemicals could be used to contaminate the drinking water distribution system. Surface water sources in the area of a chemical release could become contaminated, but dying fish or aquatic life might warn of the release before human use. Deep ground water reservoirs and protected water storage tanks are regarded as safe sources of drinking water following a vapor release of chemical agents. There are methods of treating large volumes of potentially contaminated water for emergency drinking.

WHAT SHOULD PEOPLE DO TO PROTECT THEMSELVES?

Practical Steps

If the release is inside a building or a closed space, people should:

1. Do whatever it takes to find clean air quickly: exit the building if they do so without passing through the contaminated area or break a window to access clean air.
2. Remove outer clothing and place it in a sealed plastic bag.
3. Wash with soap (preferably liquid) and water. Flush skin with lots of water; flush eyes with water if they are irritated.
4. Put on clean clothes.
5. Seek medical attention if they have been exposed, even if they have no immediate symptoms.

If they are near an outdoor chemical release, people should:

1. Avoid any obvious plume or vapor cloud.
2. Walk away from the site and into a building in order to shelter-in-place.
3. Bring family and pets inside.
4. Lock doors, close windows, air vents, and fireplace dampers.
5. Turn off fans, air conditioning, and forced air heating systems.
6. Go into a room with as few windows as possible. Seal the room to create a temporary barrier between people and the contaminated air outside.
7. Seal all windows, doors, and air vents with plastic sheeting and duct tape.
8. Improvise with what is on hand to seal gaps to create a barrier from any contamination.
9. Watch TV, listen to the radio, or check the Internet often for official news and instructions as they become available.

Decisions Regarding Evacuation

Evacuation as a toxic cloud is passing could result in greater exposures than staying inside. The best course of action will be provided by emergency officials who may use computations from models to calculate the path and potential health effects of the toxic cloud.

Medical Treatment

Immediate medical treatment is required for those exhibiting signs and symptoms of exposure to toxic chemicals. (See Table 1)

Antidotes

There are reliable antidotes for nerve agent exposure, which may be available from medical professionals. Some antidotes, such as atropine, pralidoxime chloride (2-PAM chloride), and diazepam, are contained in the medical kits of first responders, but larger quantities of these antidotes may be found at hospitals and treatment facilities. A specific antidote kit is available for cyanide, but it may have to be administered in a hospital. Supportive medical care and hospital therapy is required for large exposures to phosgene and chlorine vapor.

Table 2. Varying toxicity of chemicals.

The more toxic a chemical, the smaller the amount of chemical required to cause harm. The table compares the lethal concentrations in parts per million (ppm) for acute (all-at-once) exposures to some chemical weapons and some common industrial chemicals.

Chemical agent	Approx. lethal concentration* (in ppm)
Some Chemical Weapons	
Sarin (GB)	36
Hydrogen Cyanide**	120
Some Industrial Chemicals	
Chlorine**	293
Hydrogen chloride	3,000
Carbon monoxide	4,000
Ammonia	16,000
Chloroform	20,000
Vinyl chloride	100,000

Increasing Toxicity

*Based on LC_{50} values in laboratory rats: exposure concentration for 60 minutes at which 50% of rats would die. Rats are used for toxicology tests in part because of similarity to humans, but they are likely to be more susceptible because they have higher metabolisms.

**Used both as chemical weapons and as industrial chemicals

Source: NRC, EPA, and ATSDR

WHAT ARE THE LONG-TERM CONSEQUENCES?

Late Health Effects of Chemical Agent Exposure

Most health effects from a chemical attack would occur quickly. Some injuries from acute exposure to toxic chemicals, such as eye damage and chemical burns, can persist for a lifetime. Detailed information on the possibility of developing other types of health effects later in life would be made available once a specific exposure is known. Of the military chemical weapons, only mustard gas is a known carcinogen. Although some industrial chemicals are carcinogenic, the risk of developing cancer later in life is not likely to increase significantly following a one-time exposure.

Monitoring and Clean-up of Affected Areas

In the days and weeks following the use of a chemical agent, officials might be expected to:

- Evacuate the limited area near the release site.
- Ensure proper ventilation of the area.
- Establish a plan for careful monitoring and assessment of affected areas.
- Decontaminate areas where liquid agent was present.
- Assure the public that the threat has passed after thorough testing of the affected area.

Economic Impact

Such impacts might involve disruption to lives and livelihoods as the contaminated area is being cleaned up. An attack on a food or agricultural crop could result in long-lasting economic impact for suppliers and their communities as well as consumers.

ADDITIONAL INFORMATION

Department of Homeland Security—**http://www.dhs.gov/dhspublic** • **http://www.ready.gov**

Centers for Disease Control and Prevention—**http://www.bt.cdc.gov/agent/agentlistchem.asp** • **http://www.atsdr.cdc.gov** • **http://www.bt.cdc.gov/agent** • **http://www.bt.cdc.gov/planning**

Department of Defense—**http://www.njha.com/ep/pdf/bio-USAMRICDResources.pdf** • **http://chemdef.apgea.army.mil/TBMED296.aspx**

Other Resources—**http://www.biomedtraining.org** • **http://www.chem-bio.com/resource**

This report brief was prepared by the National Academy of Engineering and the National Research Council of the National Academies in cooperation with the Department of Homeland Security. For more information, contact Randy Atkins at 202-334-1508, atkins@nae.edu, or visit www.nas.edu/factsheets. *Making the Nation Safer, Tracking the Atmospheric Dispersion of Hazardous Materials Releases,* and other National Academies reports related to this topic are available from the National Academies Press, 500 Fifth Street, NW, Washington, DC 20001; 800-624-6242; www.nap.edu.

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Homeland Security

Appendix E: DHS Biological Attack Fact Sheet