

Introduction to Chemical Agents

Pacific Emergency Management, Preparedness and
Response Information Network and Training Services
(Pacific EMPRINTS)

University of Hawaii
Department of Anthropology

Chemical Agent Use

- Used on the battlefield
- Used in recent past



History of Chemical Agents


- 1000 BCE, China:
 - Chinese blew arsenical smoke towards enemies.
- 1915 Belgium, World War I:
 - Germany released 168 tons of chlorine, killing 5,000 troops.
- 1980-88, Iraq:
 - United Nations inspections revealed the use of chemical weapons against Iran and Iraqi Kurds.

Recent History of Chemical Agents

- Aum Shinrikyo:
 - June 1994 Matsumoto, Japan: Local police called because numerous people were being rushed to the hospital.
 - 5 found deceased in an apartment.
 - 2 transported to hospital.
 - Dead dogs, birds, insects & fish found around a pond near apartment.
 - Victims complained of darkened vision, eye pain, nausea and miosis.
 - March 1995: Sarin put on underground railways. Within minutes > 600 victims were brought to one hospital.

Chemical Agents

- Form: Aerosol, liquid, or solid
- Odor
- Solubility
- Latency
- Volatility
- Persistence
- Meteorological factors



Routes of Exposure

- Dermal
- Inhalation
- Ingestion

Routes of Dissemination

- Air
- Food and beverages
- Objects



Chemical Delivery Systems

- Commercial handheld agricultural sprayers
- Spray tanks on aircraft or ships
- Munitions delivered in gravity bombs
- Warheads on ballistic or cruise missiles

Categories of Chemical Agents

- Blister Agents
- Choking Agents
- Nerve Agents
- Blood Agents
- Incapacitating Agents*

* Incapacitating agents are sometimes referred to as a fifth category in some chemical agent literature.

Additional Chemical Agents

- Biotoxins
- Caustics (Acids)
- Long-acting anticoagulants
- Metals
- Organic solvents
- Riot control agents
- Toxic alcohols
- Vomiting agents
- Industrial chemicals*

Centers for Disease Control and Prevention:
www.cdc.gov

* Not listed by the CDC, but also considered a chemical danger.

Identification of Chemical Exposure

- Symptoms of chemical exposure may be similar to symptoms evoked by common diseases.
- Symptoms may have a long period of latency.
- Exposure to contaminated food, water, or consumer products may only be able to be identified via examination of epidemiological data.
- Exposure to two or more chemicals may result in symptoms that are not suggestive of either chemical.

Decontamination

- Three zones are typically established in any chemical attack:
 - The **Hot Zone** is the area of attack, and represents the highest risk of contamination.
 - The **Warm Zone** is where decontamination occurs, and represents the transitional area between hot and cold zones.
 - The **Cold Zone** is an area of the site that is free of contamination and can be used as a staging and planning area.
- Vapor off-gassing and direct contact with liquid agents present contaminates both the victims affected in the initial attack, and staff working to clean the area.
- Personal Protective Equipment for Responders:
 - **Respiratory Protection:** Pressure-demand, self-contained breathing apparatus (SCBA).
 - N-95 masks are **NOT** effective against vapors.
 - **Skin Protection:** Chemical-protective clothing and butyl rubber gloves and boots.

Victim Decontamination

- Remove and double-bag clothing and jewelry.
- Flush eyes with water or saline for 10 minutes.
- Shower body with soap and water.
- Do not induce vomiting.
- If victim has entered the hospital without first being decontaminated:
 - Decontamination must occur in an area of the hospital with negative airflow and floor drains for showering.
 - Same form of victim decontamination used in the Hot Zone may be performed.
 - Same Personal Protective Equipment (PPE) may be worn by hospital staff.

Sources

- Hersh, *Chemical and Biological Warfare*, 3; Paul Halsall, Course Reading on Chinese Dynastic History for Brooklyn College.
- Presentation "Disaster Preparation for Health Professionals," delivered by John Casken, RN, MPH, PhD, Fellow, Royal Society of Health, School of Nursing and Dental Hygiene, University of Hawaii at Manoa with the assistance of Dr. Lorie Wong, School of Nursing and Dental Hygiene, University of Hawaii at Manoa, 2006.
- Presentation "WMD Awareness: Response to CBRNE Incidents," delivered by Carter Davis, First Responder Trainer, 2006.
- Pacific EMPRINTS course, "Emergency Preparedness for the Dental Profession," constructed by Dr. Patsy Fujimoto, 2006.
- "Emerging Threats in Public Health: Chemical Terrorism," Georgia Training Resource and Inventory Network, <http://www.sph.emory.edu/GTRAIN/trainings/cds/ct.html>
- "Emergency Preparedness for Dentists," Columbia University Center for Public Health Preparedness, <http://www.ncdp.mailman.columbia.edu/dentist/>
- www.cdc.gov
- Dr. Lawrence Fuortes, "Chemical Warfare," University of Iowa College of Public Health, Iowa Center for Public Health Preparedness.

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Course Transcript

Slide 1: "Introduction to Chemical Agents"

Welcome to the Introduction to Chemical Agents tutorial designed by the Pacific Emergency Management, Preparedness and Response Information Network and Training Services at the University of Hawaii at Manoa.

Slide 2: "Chemical Agent Use"

Chemical agents have been used as weapons of mass destruction many times in history, especially on the battlefield. Although they are considered to be less likely to be used in this modern era, they have nonetheless played a part in recent terrorist attacks, and as such, should be carefully examined as possible tools of mass destruction. This tutorial will discuss the history of chemical weapons use, some characteristics of chemical agents, their routes of dissemination, their categorization and decontamination procedures.

Slide 3: "History of Chemical Agents"

In the year 1000 BCE, the Chinese are known to have utilized arsenical smoke when in battle by blowing the smoke towards enemies in order to incapacitate them. Chemical agents have been used throughout history in different forms, mostly as methods of warfare during battles. The first large-scale use of chemical weapons occurred during World War I, when Germany began using chemical weapons in Belgium against Allied troops. In 1915, Germany released 168 tons of chlorine on Belgium, killing some 5,000 troops. As the war continued, the chemical agents utilized changed from chlorine gas to mustard agents, and all players in the war began to utilize chemical weaponry. In the more recent past, during the 1980s, United Nations inspections revealed the use of chemical weapons against Iran and Iraqi Kurds.

Slide 4: "Recent History of Chemical Agents"

Aum Shinrikyo is perhaps the most high profile case of a chemical weapons attack that occurred recently on a civilian populace. Aum Shinrikyo, a Japanese cult, manufactured their own sarin and used it in a series of attacks on local populations. In June of 1994, in Matsumoto, Japan, local police were called because numerous people were being rushed to the hospital. Five victims were found dead in an apartment, and 2 more were transported to the hospital. Dead dogs, birds, insects and fish were also discovered around a pond near the apartment. Victims who survived complained of darkened vision, eye pain, nausea and miosis as a result of the attack. In March 1995, Aum Shinrikyo struck again, releasing sarin, a type of nerve agent, on underground railways. Within minutes of the attack, over 600 victims were rushed to one nearby hospital, overwhelming their surge capacity.

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Slide 5: “Chemical Agents”

Chemical agents have several characteristics that can distinguish their use and potency as weapons of mass destruction. These are form, odor, solubility, latency, volatility, persistence, and meteorological factors. Chemicals can take an aerosol, liquid or solid form, and may be destructive in one or all of these forms. While some chemicals are odorless, others have a distinguishing smell, such as mustard. Solubility refers to the ability of the chemical to dissolve in the presence of another chemical, and is another distinguishing characteristic. Most chemicals that are used as weapons of mass destruction have a short latency period, meaning that there is generally a short period between exposure to an agent and the production of symptoms. Volatility, similar to solubility, refers to the ability of the chemical to become vapor. Chemicals that are used as Weapons of Mass Destruction are most effective if they have the ability to persist in the environment for longer than 24 hours after dispersal. However, meteorological factors such as wind, temperature, atmospheric stability and precipitation all play a part in the effectiveness of the dispersal of the agent. While the characteristics of a given chemical are important considerations in the power of a chemical weapon, the routes of exposure as well as the routes of dissemination are equally important factors in gauging the effectiveness of a weapon of mass destruction.

Slide 6: “Routes of Exposure”

Chemicals may infiltrate the body dermally, through the respiratory tract, or through ingestion. While the skin generally acts as a protective barrier against most chemicals, some agents, especially those used as weapons of mass destruction, may be directly absorbed through the skin, injected into the skin, or be able to enter through cuts and abrasions. The eyes, nose and mouth of an individual are especially susceptible to chemical infiltration. Chemical agents that can be inhaled are generally considered to be the most dangerous. Chemicals that are inhaled are then absorbed through the mucous membranes of the respiratory system, affecting the individual via the respiratory tract. As with inhalational chemical agents, chemical agents that are ingested can harm not only the gastrointestinal tract, but be spread throughout the body through mucous membranes in the gastrointestinal tract. Dermal, inhalation and ingestion are the main three routes of exposure for any chemical agent.

Slide 7: “Routes of Dissemination”

There are three main routes of dissemination for a chemical agent: via air, through ingestion of contaminated food or water, and through contact with contaminated objects. Dissemination of a chemical agent via the air is usually the most effective route. In this route, the chemical agent is dispersed through evaporation and aerosolization. From a terrorist's point of view, the maximum number of people can be affected via air dispersal as well as contamination of crops, food, beverages, and water supplies. Possible methods of disseminating chemical agents into the air include crop-dusting planes and other equipment for wide-scale dissemination, small aerosol-generating sprayers for building

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ventilation systems or closed spaces, and canisters containing chemicals for explosion in public areas. Large numbers of people could also be affected if chemicals were introduced into food and beverage processing plants and production facilities. Chemicals placed in an eating facility such as a restaurant could produce fatalities and illness on a smaller scale. As a final route of dissemination, finely powdered chemical agents may also be placed on objects subject to skin exposure or inhalation.

Slide 8: “Chemical Delivery Systems”

Other possible chemical delivery systems include commercial handheld agricultural sprayers, spray tanks mounted on aircraft or ships, munitions delivered in gravity bombs, and warheads on ballistic or cruise missiles.

Slide 9: “Categories of Chemical Agents”

In general, chemical agents are classified according to the way they clinically affect victims. The CDC organizes chemical agents into four categories: blister agents, choking agents, nerve agents, and blood agents. A fifth category, incapacitating agents, is sometimes referred to in other chemical agent literature.

Slide 10: “Additional Chemical Agents”

Additional chemical agent dangers are identified and explained by the Centers for Disease Control and Prevention, at their website, www.cdc.gov. These additional categories of chemical agents include biotoxins, caustics or acids, long-acting anticoagulants, metals, organic solvents, riot control agents, toxic alcohols and vomiting agents. Industrial chemicals are also considered to be a chemical danger by some sources.

Slide 11: “Identification of Chemical Exposure”

For clinicians who are examining incoming patients, a number of challenges may present themselves in the correct identification of a chemical exposure. The first thing to remember is that symptoms of chemical exposure may be similar to symptoms evoked by common diseases. While healthcare professionals are trained to think of the likeliest explanation for given symptoms, which would not include chemical exposure, it is important to keep chemical exposure in mind as a possibility. Another point to remember is that some chemical exposures may result in a long period of latency before symptoms appear. Therefore, the cause of the symptoms may not be immediately apparent to either patient or practitioner. When considering a chemical exposure via contaminated food, water or consumer products, one should note that a pattern of contamination may only be able to be identified via an examination of epidemiological data, as victims may present at different locations along varying timelines. Finally, exposure to two or more chemicals may result in symptoms that are not suggestive of either chemical. These are several of the difficulties associated with identifying chemical exposures for healthcare professionals.

Slide 12: “Decontamination”

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In any chemical attack, three zones are typically established. The Hot zone is the area of attack, and represents the highest risk of contamination. The Warm Zone is where decontamination occurs, and represents the transitional area between hot and cold zones. The Cold Zone is an area of the site that is free of contamination and can be used as a staging and planning area for chemical attack responders. Within the Hot Zone, vapor off-gassing and direct contact with liquid agents present contaminates both the victims affected in the initial attack, and responders working to clean the area. In order to ensure the safety of responders who are entering the Hot Zone, Personal Protective Equipment, or PPE, must be utilized. Responders should wear respiratory protection such as a pressure-demand, self-contained breathing apparatus. It is important to note that N-95 masks will not be effective against chemical vapors, and should not be used in this case. For skin protection, responders should wear chemical-protective clothing and butyl rubber gloves and boots.

Slide 13: "Victim Decontamination"

Decontamination for victims of a chemical weapons attack include removing and double-bagging clothing and jewelry. Eyes should be flushed with either water or saline for 10 minutes. Victims should shower using soap and water. Do not induce vomiting. If the victim has entered a hospital without first being decontaminated, decontamination must then occur in an area of the hospital with negative airflow and floor drains for showering. The same form of victim decontamination used in the Hot Zone may be performed at the hospital. The same Personal Protective Equipment, or PPE, may be worn by hospital staff dealing with chemical attack victims.

Slide 14: "Sources"

The displayed sources were consulted in the development of this tutorial.

Slide 15: "Pacific EMPRINTS"

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Sources:

1. Hersh, *Chemical and Biological Warfare*, 3; Paul Halsall, Course Reading on Chinese Dynastic History for Brooklyn College.
2. Presentation "Disaster Preparation for Health Professionals," delivered by John Casken, RN, MPH, PhD, Fellow, Royal Society of Health, School of Nursing and Dental Hygiene, University of Hawaii at Manoa with the assistance of Dr. Lorrie Wong, School of Nursing and Dental Hygiene, University of Hawaii at Manoa, 2006.
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4. Pacific EMPRINTS course, "Emergency Preparedness for the Dental Profession," constructed by Dr. Patsy Fujimoto, 2006.
5. "Emerging Threats in Public Health: Chemical Terrorism," Georgia Training Resource and Inventory Network,
<http://www.sph.emory.edu/GTRAIN/trainings/cds/ct.html>
6. "Emergency Preparedness for Dentists," Columbia University Center for Public Health Preparedness,
<http://www.ncdp.mailman.columbia.edu/dentist/>
7. www.cdc.gov
8. Dr. Lawrence Fuortes, "Chemical Warfare," University of Iowa College of Public Health, Iowa Center for Public Health Preparedness.

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