APPENDIX D. Radiation Emergencies

This section provides basic information on four types of radiation emergencies:

- Nuclear power plant attack
- Radiological dispersal device (e.g., dirty bomb)
- Improvised nuclear device (e.g., suitcase bomb)
- Nuclear weapon

Please note that the descriptions of signs and symptoms in this section are not meant to be used to self-diagnose illness—they are for informational purposes only. Contact a health care provider if you suspect that you have been exposed to one of these agents or if you feel sick.

BASIC FACTS

The first step in understanding radiation emergencies is to draw the distinction between a **nuclear event** (like the bomb dropped on Hiroshima, Japan) and a **radiological event,** such as a nuclear power plant incident or a radiological dispersal device (e.g., dirty bomb).

NUCLEAR EVENT

- Produces a nuclear detonation involving the joining (fusion) or splitting (fission) of atoms to produce an intense pulse or wave of heat, light, air pressure, and radiation
- Highly destructive explosion that instantly devastates people and buildings because of extreme heat and impact of the blast
- Leaves large amounts of radioactivity and fallout behind

RADIOLOGICAL EVENT

- May involve explosion and release of radioactivity, but no nuclear fission.
- Typically, less radioactivity is released than in a nuclear event.

In both cases, wind direction and weather patterns can spread radioactivity beyond the immediate incident site.

RADIOACTIVE CONTAMINATION

- The deposition of radioactive material (e.g., dirt, dust, debris, liquid) on the surfaces of structures, areas, objects, or people. It can be airborne, external, or internal.

RADIATION EXPOSURE

- Exposure occurs when radiation penetrates the body and deposits its energy. For example, when a person has a chest X-ray, that person is exposed to radiation, but not contaminated.

For more details on the difference between radioactive contamination and exposure, see http://www.bt.cdc.gov/radiation/contamination.asp.

LESSENING THE IMPACT OF EXPOSURE TO RADIOLOGICAL AND NUCLEAR AGENTS

- **Follow the instructions of emergency workers, if possible.**
- **The most important concepts to minimize exposure are time, distance, and shielding.**

  Time: Decrease the amount of time spent near the radiation source.

  Distance: Increase your distance from the radiation source.

  Shielding: Increase the shielding between you and the radiation source. Shielding is anything that creates a barrier between people and the radiation source.
- **Stay indoors and shelter-in-place to reduce exposure. Being inside a building (particularly basement), inside a vehicle, or behind a wall would provide some protection.**
- **Close doors and windows and shut off ventilation systems using outside air.**
- **If outdoors, cover mouth and nose with a scarf, handkerchief, or other type of cloth to avoid inhaling radioactive dust.**
- **If near the site of an attack and dust or debris is on your body or clothing, decontaminate (remove outer layer of clothing and bag it, shower without harsh scrubbing, and wash hair) before leaving to avoid spreading contamination.**
- **Treatment of life-threatening injuries should not be delayed in order to perform decontamination. Seek medical attention if injured by the explosion.**
- **Do not eat potentially contaminated foods or drink potentially contaminated water.**
- **Federal agencies have developed real-time models to predict how a nuclear or radiological attack would affect a given area. This information can be used to quicken response efforts and limit the number of people affected by an attack.**

RADIATION EMERGENCIES QUICK REFERENCE CHART

AGENT	DESCRIPTION	FIRST SIGNS AND SYMPTOMS	FIRST ACTIONS	MEDICAL RESPONSE
Nuclear Power Plant Attack	Attack on a nuclear power plant using explosives, hacking into computers, or crashing a plane into a reactor or other structures.	Radiation release unlikely—power plants are built to sustain extensive damage. Possible traumatic injuries if there is an explosion.	As a precaution, seek shelter or stay indoors if near the plant. Tune in to local radio and television for further instructions from public health authorities. Immediately seek medical care for blast injuries.	Care for blast injuries.
Radiological Dispersal Device (e.g., dirty bomb)	Dirty bomb: explosive device laced with radioactive materials. Radioactive materials may also be spread as aerosol or liquid.	Traumatic injuries caused by the explosion. Radiation sickness not likely with dirty bomb, but shrapnel could be highly radioactive.	Seek shelter or stay indoors. Immediately seek medical care for blast injuries. Cover nose and mouth with mask or cloth. If exposed, remove clothing, place in a plastic bag, and shower or wash.	Care for blast injuries. Possible decontamination if radioactive material is present.
Improvised Nuclear Device/ Nuclear Weapon	Powerful bomb involving splitting of atoms. Comes in various sizes and types, producing various levels of destruction.	Severe thermal burns, lung and ear drum damage, blindness or retinal burns, injuries from flying objects. Radiation sickness may follow.	Do not look toward the explosion. Seek shelter behind any shield or in a basement. Lie on the ground and cover your head.	Wide range of medical response depending on severity of exposure.

You may notice that specific guidance on food and water safety after a terrorist attack is not included in this guide. The effect of an attack or other public health emergency on food and water supplies is very situation specific. As a result, public health officials will provide specific information on food and water safety as needed.

THE IMPACT OF RADIATION EMERGENCIES

RADIATION INJURIES

- Could result from the aftermath of a nuclear blast—less likely after a radiological incident.
- May not be apparent for months or years after exposure to radiation.
- The type and extent of injury may depend on:
  - The amount (dose) of radiation to which a person is exposed
  - The type of radiation (alpha, beta, gamma) to which a person is exposed (more information on this topic can be found in the media reference guide at http://www.hhs.gov/emergency)
  - Whether exposure is external (e.g., skin) versus internal (e.g., inhaled)
- Internal contamination occurs if radioactive materials are ingested or inhaled and the materials are incorporated by the body.
- If the radiation dose is large enough, victims can develop acute radiation syndrome or radiation sickness (more information is available at http://www.bt.cdc.gov/radiation/ars.asp). Signs and symptoms, not all of which develop at the same time, include:
  - Nausea
  - Vomiting
  - Diarrhea
  - Fever
  - Loss of appetite
  - Skin damage (e.g., redness, itching, swelling, blisters)
  - Seizures
  - Coma

INSTRUCTIONS TO SHELTER-IN-PLACE AND SEAL THE ROOM DUE TO RADIATION EMERGENCIES

If you have been exposed:

- **If coming from outside, remove outer layer of clothing and seal it in a plastic bag.**
- **Shower and gently wash with soap, if possible.**

To shelter-in-place and seal the room:

- **Find a room with as few windows and doors as possible.**
- **Go to the lowest level possible.**
- **Turn off the air conditioner, heater, and fans.**
- **Close the fireplace damper.**
- **Tape plastic over windows and doors; seal with duct tape.***
- **Tape over vents and electrical outlets (and any other openings).**
- **Fill sinks and tubs with water.**
- **Turn on the radio.**
- **Keep a telephone handy.**

*** Note: Within a few hours, the plastic and tape needs to be removed and fresh air should be allowed to enter the room to prevent suffocation. Follow the instructions of emergency workers and/or public health officials.**

Signs and symptoms are nonspecific and may be indistinguishable from those of other injuries or illness.

- If radiation dose is small, no immediate health effects will be observed. In the long term, there may be an increased risk of developing cancer.
- In general, the higher the radiation dose the greater the severity of immediate health effects and the greater the possibility of long-term health effects.
- Children exposed to radiation may be more at risk than adults. Radiation exposure to unborn children is of special concern—the human embryo is very sensitive to radiation.

TREATMENT

- Many victims would likely need treatment for injuries associated with the explosion (e.g., burns, wounds).
- If contaminated, people should decontaminate themselves by removing the outer layer of clothing, placing the clothing in a bag and sealing it, taking a shower without harsh scrubbing, and washing hair. Exposure may be reduced by removing external contamination.
- Treatment for radiation sickness would depend on the severity of the signs and symptoms. Physicians will treat signs and symptoms, provide supportive care, and try to prevent infections. The worst cases may require blood transfusions and bone marrow transplants.
- There are different classes of drugs that can help:
  - Blocking agents prevent absorption of certain radioactive material in the body (e.g., Potassium iodide).
  - Decorporation agents speed up elimination of certain radioactive materials from the body (e.g., Prussian blue, diethylenetriaminepentaacetate).
  - Other drugs are used to help recovery from radiation sickness (e.g., Neupogen®).
- Potassium iodide, when taken before or soon after exposure to radioactive iodine, can protect the thyroid gland from absorbing radioactive iodine and developing thyroid cancer, but this does not help against other forms of radioactivity that may come with an attack. In addition, not all attacks will involve the release of radioactive iodine.
- There is no vaccine or drug that can make people immune to the effects of radiation.

TYPES OF POTENTIAL EMERGENCIES

	NUCLEAR POWER PLANT ATTACK	RADIOLOGICAL DISPERSAL DEVICE (RDD)	IMPROVISED NUCLEAR DEVICE (IND)	NUCLEAR WEAPON
Type of Event	Radiological	Radiological	Nuclear	Nuclear
Examples of Radiation Dispersal	• Possible escape of radioactive material from attack on plant • Attack could include using explosives, hacking into computers, or crashing a plane into the reactor or other structures	• May be conventional explosives laced with radioactive material (e.g., dirty bomb) • Aerosols or sprays • Could include hiding radioactive material in a populated area (radiation-emitting device [RED])	Smaller nuclear weapon (e.g., suitcase bomb)	Nuclear weapon developed for strategic military purposes
Nuclear Blast	No	No	• Smaller nuclear explosion of varying size • Can be as large as the bomb dropped on Hiroshima	• Highly destructive nuclear explosion • Can be in the order of 100 times the bomb dropped on Hiroshima
Amount of Radiation Exposure	• Less than a nuclear event • Although unlikely, radioactive materials could escape/ contaminate the area and environment	• Limited • Dirty bomb blast could spread contamination around area the size of several city blocks • Exposure from a RED would depend on the size of the source and speed of detection	• Varying • May or may not include fallout	• Considerable • Creates a large fireball that would vaporize everything within it to form what is known as a "mushroom cloud." When materials cool, they condense, form particles and fall back to earth (fallout) • Radioactive particles from the fallout could be carried long distances
Consequences	• Death toll could be limited • Plants are built to sustain extensive damage without releasing radioactive material • Psychological impact could be severe	• Limited death toll • In the case of a dirty bomb, initial explosion could kill or injure people in the immediate area • RED would depend on size of source, how it early it is detected and other factors • Psychological impact could be severe	• Depends on the size of the blast, whether there is fallout, and population of area • Psychological impact could be severe	• Catastrophic damage to people, buildings, and the environment • Psychological impact could be severe

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