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BEST PRACTICE

Radiological Dispersal Device Incident Response Planning: Incident Site Medical Management

PURPOSE

Describes pre-planning initiatives for the onsite medical management of victims following a Radiological Dispersal Device (RDD) incident.

SUMMARY

Jurisdictions should plan for the onsite medical management of injured and/or contaminated victims following an RDD incident. This Best Practice discusses medical management, monitoring issues, and procedures that planners should consider as they develop their RDD plans and standard operating procedures (SOP). This document reviews core concepts of onsite medical management of victims, medical consequences of an RDD event, medical management of victims with life-threatening injuries, and monitoring and record keeping issues. This document discusses:

- Medical Consequences of an RDD Event
- Radiation Exposure Symptoms
- Core Concepts of Onsite Medical Management
- Medical Management of Victims with Life-threatening Injuries
- Monitoring and Record Keeping
- First Receivers

This document does not discuss management of victims or decontamination issues at healthcare facilities.

DESCRIPTION

Medical Consequences of an RDD Event

The medical consequences of an RDD event will depend largely on such factors as type and quantity of radioactive material used, weather conditions at the time of the release, and concentration of population in the incident area during the event. Explosive and non-explosive RDDs can cause different types of injuries:

- **RDDs that employ explosive means:** Dirty bombs are multi-hazard weapons that can cause acute blast trauma injuries and radiation exposure. The most common injuries after such an explosion could be thermal and/or mechanical injuries from shrapnel or antipersonnel materials, such as nails or screws. Fragments of the radioactive source also could be embedded into the wounds. It is considered unlikely that the exposure or contamination of people outside the immediate blast area will have any clinical impact.
- **RDDs that do not employ explosive means:** These devices could produce radiation-exposure injuries. However, the health effects from exposure to the low

radiation levels expected from an RDD would likely be minimal. Experts believe the probability that victims of such an event will manifest the symptoms associated with acute radiation exposure is low but cannot be excluded.

Radiation-Exposure Injuries

The Radiation Emergency Assistance Center/Training Site's (REAC/TS) [Guidance for Radiation Accident Management, Types of Radiation Exposure](#) identifies three types of radiation-exposure injuries that can occur as a result of an RDD event:

- **External exposure** occurs when all or part of the body is exposed to penetrating radiation from an external source distant from or in close proximity to the body. SOPs should ensure that responders first on scene of an RDD event are aware of the following concepts:
 - The dose is discontinued as soon as the victim is moved to a location at a safe distance from the source.
 - The radioactive material is not transferred from the source to the victim.
 - Victims of external exposure do not become radioactive as a result of external exposure. Thus, they will not irradiate other victims or emergency responders during emergency rescue operations.
- **Contamination** occurs when radioactive materials in the form of gases, liquids, or solids are released into the environment and deposited or transferred on victims' clothes or skin. SOPs could include the following concepts:
 - Contaminated victims could cross-contaminate other victims or emergency responders during emergency rescue operations.
 - Contaminated victims are not expected to be a radiation hazard for emergency rescuers. The Armed Forces Radiobiology Research Institute, Military Medical Operations's [Medical Management of Radiological Casualties Handbook](#) states that "it is impossible for a patient to be so contaminated that he is a radiation hazard to healthcare providers." However, some experts recognize that, while highly unlikely, such cases are not impossible. For example, after a dirty bomb explosion that dispersed a radioactive metal source, some victims could have imbedded fragments sufficiently intense to require exposure control for first responders and receivers.
 - SOPs also should inform emergency response personnel that victims could be:
 - **Externally contaminated:** SOPs could provide guidance to emergency responders to be careful not to spread contamination further on the victim's body, themselves, or the surrounding area when external contamination occurs.
 - **Internally contaminated:** Ingestion or inhalation of radioactive materials is treated by medical personnel at healthcare facilities.
- **Incorporation** occurs when radioactive material is absorbed into tissues or target organs such as the liver, thyroid, or kidney. Incorporation is treated by medical personnel at healthcare facilities.

Emergency response organizations should consider addressing in their SOPs medical guidelines for radiation protection and contamination avoidance for responders first onsite of an RDD event. The Department of Homeland Security's (DHS) [Working Group on Radiological Dispersal Device \(RDD\) Preparedness: Medical Preparedness and Response Sub-Group's Report](#) includes medical guidelines for the protection of first responders and first receivers.

Radiation Exposure Symptoms

Experts believe that the radiation dose delivered by many types of RDDs will not cause radiation exposure symptoms immediately after the event. Personnel at healthcare facilities may be the first ones to recognize radiation exposure symptoms in some victims.

Nevertheless, jurisdictions might find it helpful to train emergency response personnel likely to respond to an RDD event to recognize radiation exposure symptoms as well as to manage the medical consequences of a radiological release event. For more information on training programs, please refer to the *Lessons Learned Information Sharing Best Practice* document, [Radiological Dispersal Device Incident Response Planning: Training and Exercises](#).

The New York State Department of Health's [Radiological Terrorism Rapid Response Card for EMS Personnel](#) provides Emergency Medical Services personnel and other healthcare providers with basic information on the management of exposed or contaminated patients. This quick reference guide includes a section on the recognition of radiation-related illnesses.

Onset of Radiation Symptoms

Experts agree that the onset of radiation exposure symptoms is not likely to manifest at doses below about 100 radiation absorbed dose (rad), or 1 Gray (Gy), delivered at a relatively high dose rate. However, the Centers for Disease Control and Prevention (CDC) maintains that the earliest symptoms of acute radiation syndrome (ARS) (as defined by the CDC [Glossary of Radiological Terms](#)) could start at 75 rads. Early symptoms of ARS include nausea, fatigue, vomiting, and diarrhea.

The Armed Forces Radiobiology Institute Military Medical Operations's [Medical Management of Radiological Casualties Handbook](#) includes information on whole-body radiation absorption, the type of symptoms, the timing of symptom onset, the duration of symptoms, and other relevant information.

Variables Influencing Radiation Symptoms' Onset and Severity

The onset and severity of radiation exposure symptoms can depend on several factors, including type and quantity of radioactive material released, dose received, duration of the exposure, and body areas exposed. Symptoms might also depend on the age, health, and other specific characteristics of the victim. However, studies show that, in general, there is a direct correlation between symptoms' severity and radiation dose received. As the total body dose increases, both the probability of incidence and the speed of onset will increase. Thus, exposure to very large doses of radiation may trigger severe symptoms and cause death within a few days or months, while exposure to low radiation doses may lead to no health effects or to adverse health effects that could manifest themselves years after the event. As a result, experts generally assume that:

- **After a small RDD event:** The radiation dose delivered by an RDD will be below the 1 Gy (100 rad) threshold and cause minimal symptoms. RDD victims may not show any particular radiation symptoms after the event. A dirty bomb explosion, for example, would probably disperse the radioactive material at detonation, immediately reducing the intensity of the exposure. Heat, debris, and force of the conventional explosion would cause a large percentage of the resulting victims. Symptoms also might be a result of extended exposure to a passive RDD hidden in a public place such as a library, subway, or a church.

Small RDD Events

There have been two documented small RDD events. In both cases, the devices were deactivated and no health consequences were reported. For more information on these events, please refer to the *Lessons Learned Information Sharing Best Practice* document, [Radiological Dispersal Device Incident Response Planning: Overview](#).

- **After a large RDD event:** Recent studies show that a number of radiological sources could be used to produce large RDDs. A large RDD could deliver a high dose of radiation in a short period of time, thus causing ARS among those exposed. Emergency responders should be able to recognize symptoms caused by exposure to radioactive materials. For more information on medical and psychological casualty management following an RDD event, please refer to *the Lessons Learned Information Sharing Best Practice document, Radiological Dispersal Device Incident Response Planning: Psychological Management* (forthcoming).

The following sources provide an in-depth discussion of radiation exposure symptoms, effects, and casualty management:

- American College of Radiology, Disaster Planning Task Force. [Disaster Preparedness for Radiology Professionals: Response to Radiological Terrorism](#). 2002.
- Armed Forces Radiobiology Research Institute, Military Medical Operations. [Medical Management of Radiological Casualties Handbook](#). Apr 2003.
- Headquarters, Department of Army, the Navy, and the Air Forces, and Commandant, Marine Corps. [Treatment of Nuclear and Radiological Casualties](#). 20 Dec 2001.

Core Concepts of Onsite Medical Management

Experts believe that a small number of deaths could occur as a direct consequence of radiological material exposure after an RDD event. As a result, SOPs for an RDD event should emphasize, among others, the following concepts:

- Being contaminated is rarely life-threatening;
- Being exposed to radiation does not make an individual radioactive;
- Radiological incidents can be managed using emergency responders' equipment and protocols; and
- Rescue and treatment of medical emergencies typically take precedence over victims' radiological assessment and treatment.

SOPs also could stress that RDD events are very unlikely to contaminate victims in a way that will be harmful to emergency responders. Indeed, the DHS Working Group on Radiological Dispersal Device (RDD) Preparedness: Medical Preparedness and Response Sub-Group's [Report](#) states that "if a victim is acutely injured, responders should attend to those injuries immediately, regardless of the type or degree of personal protective equipment that is available. Normal barrier clothing and masks should be used if available, but care of patients with life-threatening injuries should not be delayed because first responders lack adequate personal protective equipment. Contaminated personnel, equipment, and vehicles can be cleaned later, at little risk to human health or the integrity of the equipment."

The Headquarters, Department of the Army, the Navy, and the Air Force, and Commandant, Marine Corps's [Treatment of Nuclear and Radiological Casualties Handbook](#) includes sections on blast injuries, combined injuries (blast, thermal, and radiological), and medical care of low-dose radiation injuries.

Altered Standards of Care after a Large RDD Event

Some experts believe that an RDD event involving a large number of victims could compromise the ability of the healthcare system to deliver essential services. Jurisdictions should be aware that in some cases first responders onsite of an RDD event as well as first receivers at healthcare facilities may not be able to guarantee current standards of care for all the victims. As such, it is critical that jurisdictions develop RDD-specific guidance for

allocating scarce medical care resources available in a jurisdiction during a mass casualty event.

The Department of Health and Human Services's Agency for Healthcare Research and Quality as well as the Office of the Assistant Secretary for Public Health Emergency Preparedness's [Altered Standards of Care in Mass Casualty Events](#) offers a framework for how to provide optimal care during a public health emergency that involves a large number of victims. This report includes an RDD scenario that describes a series of dirty bomb explosions in a large metropolitan subway system. The explosions cause approximately 10,000 victims. In addition, 40 percent of the local healthcare facilities are targeted and are no longer operational.

Medical Management of Victims with Life-Threatening Injuries

SOPs should emphasize that the medical management of victims with life-threatening injuries is a priority after an RDD event. Treatment of life-threatening injuries takes precedence over patient decontamination and other measures that address radioactive contamination and/or exposure. Indeed, the Department of the Navy's [Initial Management of Irradiated or Radioactively Contaminated Personnel](#) states that "medical emergency response personnel teams must not be impeded when proceeding to render emergency care for reasons such as issuing dosimeters or controlling access to restricted areas. To stop emergency response personnel in such situations clearly displays a lack of understanding and good judgment."

The National Council on Radiation Protection and Measurements's *Management of Terrorist Events Involving Radiological Material*, NCRP Report No. 138, advises emergency response personnel to stabilize patients with life-threatening injuries and to transport them to a medical facility where they will be decontaminated. An individual with radiological protection training should accompany the patient when possible.

Related Practice Notes

The following *Lessons Learned Information Sharing* Practice Note documents, among others, can help jurisdictions establish SOPs for the medical management of victims following an RDD event.

- [Radiological Incident Response: New York City's Guidelines for Transport of Radioactively Contaminated Patients](#). The New York City Fire Department issued guidelines for transporting radioactively contaminated patients from a radiological incident site to medical facilities. These guidelines help limit the spread of radioactive material.
- [Radiological Incident Response: Phoenix, Arizona's Guidelines for the Treatment of Radioactively Contaminated Victims](#). The Phoenix Fire Department established guidelines for treating radioactively contaminated victims at a radiological incident site. These guidelines help protect emergency response personnel and limit the spread of radioactive material.

The following resources provide valuable information on emergency medical management following an RDD event:

- American College of Radiology's [Disaster Preparedness for Radiology Professionals: Response to Radiological Terrorism](#). This primer includes basic principles for handling contaminated patients, medical management and hospital response, radiological assessment, and internal and external contamination treatment.
- Armed Forces Radiobiology Research Institute, Military Medical Operations's [Medical Management of Radiological Casualties Handbook](#). This handbook includes a section on radiological dispersal devices that describes treatment of internal and external

contamination, psychological effects, decontamination of victims and equipment, and personnel precautions when treating a contaminated patient.

- National Council on Radiation Protection and Measurements's *Management of Terrorist Events Involving Radioactive Material*, NCRP Report No. 138. This report provides guidance for emergency response operations following a large-scale disaster involving exposure to ionizing radiation.
- National Council on Radiation Protection and Measurements's *Management of Persons Accidentally Contaminated with Radionuclides*, NCRP Report No. 65. This report includes initial patients' management, diagnostic techniques, treatment decisions, and therapy procedures and drugs.
- Jane's Information Group's *Mass Casualty Handbook: Pre-Hospital, Emergency Preparedness and Response*. This handbook includes sections on nuclear and radiological planning and preparedness, materials and weapons, and incident response procedures.

The United States Department of Health and Human Services's [Radiation Event Medical Management](#) (REMM) Web site includes guidance for healthcare providers on clinical diagnosis and treatment during a radiological or nuclear incident. REMM also offers guidelines, tools, and templates for first responders, mental health professionals, and public information officers.

Monitoring and Record Keeping

Experts concur that many jurisdictions are unprepared to perform mass monitoring and record keeping after an RDD event. Indeed, monitoring and record keeping after such an event is likely to be a time-consuming, resource-intensive process. Many jurisdictions also do not have mass monitoring and record keeping procedures in place for an RDD event. As a result, the extent of these tasks could easily overwhelm many jurisdictions.

Experts advise jurisdictions to establish mechanisms to perform onsite radiological assessment of victims at the onset of RDD incident response. NCRP Report No. 138 states that emergency responders with radiological health training could perform radiological assessment procedures under the supervision of onsite medical personnel. This assessment should include radiation measurements and the collection of information relevant to the decontamination and treatment of the patient, including:

- **Administrative and clinical information**, such as patient name, age, sex, clinical history, and any other information on the patient's status. This category should also include the name of the emergency responder conducting the survey, the time of the survey, the type of instrument used, etc.
- **Circumstances of the incident**, including time of incident, probable exposure pathways, type and quantity of radioactive material dispersed, additional onsite hazardous materials, etc.
- **Distribution of radioactivity** on the victim's body and locations of wounds.
- **Onsite medical treatment**, including any medical treatment given to the patient and decontamination procedures performed.

NCRP Report No. 138 advises planners that the [United States General Services Administration's](#) Standard Form 531 may be used to record survey results and medical histories following an RDD event. This form includes a diagram of an anatomical figure that can be used to sketch the locations of radioactivity and wounds.

Planners should establish record keeping procedures to document victims' radiation measurements and other relevant information. However, planners should be aware that

current documentation standards may be impossible to maintain in many jurisdictions after an RDD event. Emergency response personnel onsite of an RDD event may be able to collect and document only limited information. As a result, planners should consider identifying a list of minimally required critical information that emergency response personnel could collect after an RDD event involving a large number of victims.

First Receivers

RDD SOPs should include provisions to alert local healthcare facilities and providers at the onset of emergency response that a radiological release event took place. Many victims could leave the incident area after an RDD event without knowing that they may have been contaminated. These victims may include “walking wounded” who will likely report to nearby healthcare facilities. Many people also could proceed to local healthcare facilities to be screened after learning that an RDD event took place. These people could quickly overwhelm the healthcare system in a jurisdiction by crowding local emergency rooms and by exhausting limited medical resources. Informing medical personnel that an RDD event has occurred could help first receivers manage this influx of people, limit secondary contamination, and provide an adequate level of care.

The Department of Labor Occupational Safety and Health Administration's [*OSHA Best Practices for Hospital-Based First Receivers of Victims from Mass Casualty Incidents Involving the Release of Hazardous Substances*](#) provides practical information to help hospitals address employee protection following mass casualty incidents involving chemical, biological, or radiological substances.

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