Congressional Research Service

Report RS21766

Radiological Dispersal Devices: Selected Issues in Consequence Management

Dana A. Shea, Resources, Science, and Industry Division

January 26, 2006

Abstract. The threat of terrorist detonation of a dirty bomb, one type of radiological dispersal device (RDD), has focused public attention on efforts to counter use of this weapon. An RDD attack might cause casualties, economic damage, and, potentially, public panic, though experts disagree on the likely magnitude of each of these effects. The impact of an RDD attack would depend on many variables, such as meteorological conditions, type and amount of radiological material, duration of exposure, and method of dispersal. Issues of potential congressional interest include the level of federal funding for research and development of medical countermeasures against RDDs and the appropriateness of current standards for environmental decontamination following an RDD attack.

Order Code RS21766
Updated January 26, 2006

Radiological Dispersal Devices: Select Issues in Consequence Management

Dana A. Shea
Specialist in Science and Technology Policy
Resources, Science, and Industry Division

Summary

The threat of terrorist detonation of a dirty bomb, one type of radiological dispersal device (RDD), has focused public attention on efforts to counter use of this weapon. An RDD attack might cause casualties, economic damage, and, potentially, public panic, though experts disagree on the likely magnitude of each of these effects. The impact of an RDD attack would depend on many variables, such as meteorological conditions, type and amount of radiological material, duration of exposure, and method of dispersal. Issues of potential congressional interest include the level of federal funding for research and development of medical countermeasures against RDDs and the appropriateness of current standards for environmental decontamination following an RDD attack. This report will be updated as events warrant.

Introduction

The possibility that terrorist groups might use a radiological dispersal device (RDD) in a civilian setting increased government and public concern about such weapons.[1] This report addresses controversies surrounding the health effects of low-level radiation, concerns related to decontamination following an RDD attack, and issues of federal research into RDD countermeasures.

RDDs are devices, other than a nuclear explosive device, designed to disseminate radioactive material to cause destruction, damage, or injury.[2] A "dirty bomb" is one type of RDD, in which explosives disperse the radioactive material, but, in general, RDDs do not require explosives. Research indicates that RDDs have little effectiveness as military

[1] See, for example, John Mintz and Susan Schmidt, "'Dirty Bomb' Was Major New Year's Worry," *The Washington Post*, January 7, 2004, p. A1.

[2] FEMA, *Risk Management Series: Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*, FEMA 426, December 2003, Appendix C, p. C-15.

weapons because of their inability to incapacitate prepared soldiers.[3] RDDs may pose a greater threat in a civilian setting. While there may be few immediate health effects from the dispersed radiological material, long-term health risks, such as cancer, may increase. Significant economic damage may result should people be unwilling to live or work in an area with a higher radiation level. Experts contend that terrorists are interested in constructing and using RDDs.[4] No terrorist group has used an RDD to expose civilians to radiation, so the potency of an RDD as a terror weapon is untested.[5]

Both the threat posed by terrorist RDD use and the magnitude of impact are matters of some contention. Some experts believe that terrorists could, without great difficulty, obtain radioactive material and construct an RDD, while others assert that obtaining significant quantities of an intense radiation source would be difficult. They additionally claim that radiation sources intense enough to cause casualties in an RDD attack would be injurious to the terrorists during acquisition and use. Most experts agree that few casualties would be likely to directly result from an RDD attack, but posit significant economic costs arising from contamination following the attack.[6] Whether terrorists more highly value an RDD due to its potential economic and psychological effects or devalue an RDD due to the inherent difficulties of handling radioactive material combined with limited direct casualties is a matter of debate.[7]

Effects of Low-level Radiation

Experts disagree on the health effects of low-level radiation. This debate centers on the validity of extrapolating to low radiation levels the results from scientific studies conducted at higher radiation levels. Past and current research efforts have not yet led to a definitive conclusion regarding the health effects of low-level radiation.

The Environmental Protection Agency (EPA) supports the approach that radiation related health effects can be extrapolated, i.e. the damage caused by radiation exposure

---

[3] Iraq reportedly tested a one-ton RDD in 1987 to assess its military usefulness. William J. Broad, "Document Reveals 1987 Bomb Test by Iraq," *The New York Times*, April 29, 2001, p. A16. The United States also reportedly investigated radiation weapons in the 1940s and 1950s. James L. Ford, "Radiological Dispersal Devices: Assessing the Transnational Threat," *Strategic Forum*, Vol. 136, March 1998.

[4] See, for example, Charles D. Ferguson, Tahseen Kazi, and Judith Perera, *Commercial Radioactive Sources: Surveying the Security Risks*, Center for Nonproliferation Studies, Monterey Institute of International Studies, January 2003; Anthony H. Cordesman, *Radiological Weapons as Means of Attack*, Center for Strategic and International Studies, November 2001; and U.S. Attorney General John Ashcroft, "Al Qaeda 'Dirty Bomb' Plot Disrupted," Speech given June 10, 2003.

[5] In 1995, Chechen separatists demonstrated an RDD capability, directing a news crew to a container of radioactive cesium placed in a Moscow park. Michael Specter "Russians Assert Radioactive Box Found in Park Posed No Danger," *The New York Times*, November 25, 1995, p. A5.

[6] Don Oldenburg, "How Bad Would A Dirty Blast Be? Here's What The Experts Say," *Washington Post*, June 13, 2002, p. C1.

[7] For a discussion of these issues, see CRS Report RS21528, *Terrorist "Dirty Bombs": A Brief Primer*, by Jonathan Medalia.

is linearly dependent on the intensity of the radiation and exposure to any amount of radiation causes increased health risks, such as an increased probability of developing cancer. In contrast, others, including some professional associations, believe that the linear model may overstate the health risks of low-level radiation.[8] Some experts maintain that a threshold exists below which minimal or no ill effects occur.

Supporters of the linear model posit that this model should be used in the absence of definitive experimental evidence since it is the more cautious model. Supporters of the threshold model point out that safety and regulatory actions that apply to radiation levels below a threshold may not be necessary and may greatly increase remediation costs.

As part of the effort to assess these models, the federal government funds scientific research into the health effects of radiation exposure. In 2005, the National Academy of Sciences Board on Radiation Effects Research, assessing the current scientific literature, issued a draft report concluding that current scientific evidence supports a linear, no-threshold relationship between cancer development and low-dose radiation.[9]

Medical Countermeasures

Few medical countermeasures exist against RDDs exposures, and they are limited in scope. The Department of Defense (DOD) has identified treatments that ameliorate the symptoms arising after radiation exposure, but do not treat the radiation-exposure-related damage itself. For example, the DOD uses granisetron, an anti-vomiting drug, to allow soldiers to complete mission goals, following which medical treatment of the radiation effects can be provided.[10] Post-exposure medical therapy is designed to treat the consequences of radiation exposure, rather than prevent the initial radiation damage.

Medications designed to limit or prevent the damage caused by radiation exposure are called radioprotectants. Current radioprotectants are intended as pre-exposure treatments, and have limited application if taken after radiation exposure occurs. In clinical settings, radioprotectants may be used during radiation cancer therapy to reduce damage to healthy tissue.[11] Many compounds provide some degree of radioprotection, but those compounds with the highest protection have significant side effects.[12] Also, most compounds with high radioprotection require injection for maximum efficacy. This

---

[8] For example, see Health Physics Society, "Radiation Risk in Perspective," *Position Statement of the Health Physics Society*, March 2001.

[9] National Research Coucil, *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII — Phase 2,* Draft Report, (National Academies Press: Washington, DC) 2005.

[10] See U.S. Department of Defense, *Treatment of Nuclear and Radiological Casualties*, Field Manual FM 4-02.283, December 20, 2001.

[11] For example, the drug amifostine is licensed for use in cancer radiation therapy. *Radiobiology Research: An Expert Panel Review Conducted by the National Institute of Allergy and Infectious Diseases*, National Institute of Allergy and Infectious Diseases, February 26, 2003.

[12] For an overview of radioprotective compounds, see Leo I. Giambarresi and Richard I. Walker, "Prospects for Radioprotection," in R. I. Walker and T. J. Cerveny (eds), *Textbook of Military Medicine: Medical Consequences of Nuclear Warfare*, (Falls Church, VA: TMM Publications, Office of the Surgeon General, Department of the Army) 1989, Chapter 11.

combination of significant side effects and the need for injection has limited widespread use of these compounds as pretreatments for non-clinical radiation exposure.[13]

Many post-exposure therapies remove radioactive contaminants from the body, thereby limiting the total radiation dose. They either block absorption of radioisotopes by internal organs (for example, potassium iodide decreases radioactive iodine uptake by the thyroid gland) or enhance expulsion of radioisotopes through the gastrointestinal tract. Radioisotope scavenging compounds, such as chelators, may be given to those who are internally contaminated with a specific radioisotope to reduce the time that the radioisotope remains in the body.

Federal Medical Countermeasure Research. The federal government sponsors radioprotectant research. The DOD has long-standing efforts to develop medications allowing soldiers to work in contaminated environments. For many years, the Walter Reed Army Institute of Research supported an anti-radiation drug development program which provided many candidate radioprotectant molecules.[14] The Armed Forces Radiobiology Research Institute (AFRRI) is a focal point of defense radiobiology expertise, and performs research and testing of antiradiation drugs as one component of its mission.[15]

Other federal agencies have been concerned with the development of antiradiation medications as well. The National Institutes of Health have funded research into combination therapies using radioprotective compounds to enhance radiation treatment for cancer patients. In 2003, the National Institute of Allergy and Infectious Disease organized an expert panel to review and identify areas where specific gaps in RDD-related radiation research and development occur and to generate research priorities to address these gaps.[16] The National Aeronautics and Space Administration (NASA) has explored mechanisms of protecting astronauts against radiation in space.[17] The Department of Energy is interested in developing treatments and protections for Department of Energy personnel following a radiation or radioisotope release, and maintains a select inventory of Investigational New Drug medical countermeasures.[18]

---

[13] For example, in 1997, it was recommended to the Department of Energy that, because of its side effects, amifostine, a radioprotectant, not be used during planned-for radiation exposures in emergencies. Joseph F. Weiss, "Pharmacologic Approaches to Protection against Radiation-induced Lethality and Other Damage," *Environmental Health Perspectives*, Vol. 105, Supplement 6, December 1997, pp. 1473-1478.

[14] Leo I. Giambarresi and Richard I. Walker, *op. cit.*

[15] For more information on the Armed Forces Radiobiology Research Institute, see online at [http://www.afrri.usuhs.mil/].

[16] Division of Microbiology and Infectious Diseases, National Institute of Allergy and Infectious Diseases, *Radiobiology Research: An Expert Panel Review Conducted by the National Institute of Allergy and Infectious Diseases*, February 26, 2003.

[17] In addition to research on physical shielding of astronauts, NASA has funded research into medical countermeasures through the Office of Biological and Physical Research, found online at [http://spaceresearch.nasa.gov/].

[18] For more information see the Radiation Emergency Assistance Center/Training Site program,
(continued...)

Among the research activities sponsored by the federal government are several public/private partnerships involving cooperative research and development agreements (CRADAs). These CRADAs allow for joint development of prospective medications between federal agencies and private companies. For example, Hollis-Eden Pharmaceuticals entered into a CRADA agreement with Uniformed Services University of the Health Sciences to develop a prospective radioprotectant drug.[19]

Radiological Contamination

Some experts believe that the economic and psychological effects from an RDD attack would outweigh the direct medical costs. These experts, weighing the current guidelines on radiological contamination and the degree of dispersal expected with a successful RDD attack, state that an RDD attack could contaminate large areas. Because the dispersal of radiological material would likely be uneven, the level of radiation in different areas would vary depending on meteorological factors, such as wind speed and precipitation.

Some models of an RDD event have suggested that the release of finely ground radiological material might contaminate many city blocks to a level higher than the current EPA standard.[20] Some analysts suggest such models exaggerate the seriousness of such contamination because they are based on the linear, no-threshold radiation standard. They claim that concerns related to this level of contamination are overstated, and contend that some inhabited areas have naturally occurring background radiation levels higher than the level current EPA decontamination standards require.

Oversight Issues

RDD-related Research and Development. A matter of some contention is whether the threat of terrorist RDD use justifies an expansion of federally funded research on anti-radiation therapies. In addition to DOD research performed at AFRRI, the National Institutes of Health has increased research into nuclear and radiological countermeasures.

The development of effective medical countermeasures to an RDD attack might have significant health benefits by reducing the number of casualties. Lower potential casualties might act as a disincentive to terrorist acquisition of such weapons. Health effects from radiological dispersal may vary widely and some analysts assert that the

---

[18] (...continued)
found online at [http://www.eh.doe.gov/health/hservices/reacts.html].

[19] Written testimony of Richard B. Hollis, Founder, Chairman and Chief Executive Officer, of Hollis-Eden Pharmaceuticals, before the House Armed Services Committee, Subcommittee on Military Research and Development, March 12, 2002 .

[20] See, for example, Testimony of Dr. Henry Kelly, President, Federation of American Scientists, before the Senate Committee on Foreign Relations, March 6, 2002.

major damage from an RDD attack would likely be economic in nature. Additional investment in medical countermeasures would not necessarily reduce economic damage.[21]

Federal efforts in developing medical RDD countermeasures might serve to reduce the psychological aspects of an RDD attack. Validated medical countermeasures might reduce public panic and concern about the exposure of first responders to radiation during treatment of casualties. Alternately, a similar reduction in the psychological impact of an RDD attack might be achieved through continuing public outreach campaigns.[22]

Some companies have urged the Department of Health and Human Services (HHS) to purchase existing RDD countermeasures using Project Bioshield funds, as nuclear and radiological devices have been determined as material threats. HHS has issued requests for proposals related to select types of RDD countermeasures through the Project Bioshield program.[23]

Decontamination Standards. New decontamination standards developed for RDD terrorist incidents may become an area of future congressional interest. The Department of Homeland Security issued a draft protective action guideline on January 3, 2006 relating to RDD decontamination.[24] This draft guideline has been criticized as being too lenient and potentially harmful to those residing in areas contaminated by an RDD event.[25]

Some analysts claim that the decontamination standards for radiological cleanup are too strict, and that much of the cost associated with an RDD attack would come from removal of radiological material that has little health impact. They assert that the required decontamination under current standards would likely create large amounts of waste. Contaminated buildings might need to be destroyed and the rubble removed. Others view the EPA standard as ensuring that no adverse health effects arise from long-term exposure to RDD residue. Adherence to a stricter decontamination standard might also serve to reduce public anxieties arising from the psychological component of an RDD attack.[26]

---

[21] For example, see Richard L. Garwin, "The Technology of Megaterror," *Technology Review*, September 1, 2002.

[22] Charles Ferguson and William Potter, with Amy Sands, Leonard Spector, and Fred Wehling, *The Four Faces of Nuclear Terrorism*, (Monterey, CA, Center for Nonproliferation Studies, Monterey Institute of International Studies) 2004.

[23] For an overview of requests for information and proposals under Project Bioshield, see online at [http://www.hhs.gov/ophep/bioshield/PBPrcrtPrjct.htm].

[24] 71 *Fed. Reg.* 173-196, January 3, 2006.

[25] For example, see H. Josef Hebert, "Government Has 'Dirty Bomb' Cleanup Guide," Associated Press, January 4, 2006.

[26] For example, see National Council on Radiation Protection and Measurements, *Management of Terrorist Events Involving Radioactive Material : Recommendations of the National Council on Radiation Protection and Measurements*, (Bethesda, MD: National Council on Radiation Protection and Measurements) 2001.