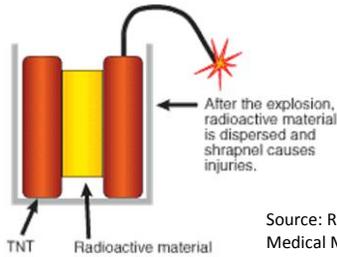


# Dirty Bombs and the Response to a Dirty Bomb Explosion

## 1. Dirty Bombs

- A dirty bomb consists of conventional explosives plus radioactive material.



Source: Radiation Emergency Medical Management (REMM)

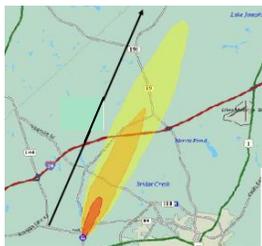
- It is one type of radiation dispersal device (RDD), and is sometimes called an explosive RDD.
- A dirty bomb has been termed a weapon of mass disruption. It is not a nuclear bomb or improvised nuclear device (IND). Detonation of a nuclear bomb or IND, as compared to a dirty bomb, would cause enormously greater amounts of physical destruction and radiological hazard, and the numbers of injuries and deaths would likewise be enormously greater.

## 2. Destructive Effects of the Explosion

- The explosion can cause serious injury and death to those nearby, as well as damage to buildings, vehicles, and other environmental structures.

## 3. Dispersal of Radioactive Material

- The explosion will also disperse radioactive dust and debris into the air where the wind can carry it for a distance of several blocks to miles. This dispersal is in the form of a plume, represented in the figure below.



Source: Interagency Modeling and Atmospheric Assessment Center (IMAAC)

- As the radioactive material falls to earth, it can contaminate the environment (buildings, vehicles, road surfaces, etc.), as well as people, animals, and plants, over an area ranging from a few square blocks to many square miles.
- High levels of radioactivity will only be found near the explosion site; the farther out one goes from this location, the lower the amount of radioactivity in the environment.
- Radiation levels on inanimate surfaces, and on people's skin and clothing, can be measured by emergency response and public health personnel with appropriate detection equipment.



Source: Radiation Emergency Assistance Center/Training Site (REAC/TS)



Source: Oak Ridge Institute for Science and Education (ORISE)

- Following a dirty bomb explosion, monitoring of the environment with radiation detection equipment will take place. The information obtained through such monitoring will help emergency officials determine the boundaries of the contaminated area, and the levels of radioactivity

throughout this area. Such determinations will be very approximate during the early phase of the response, but will become increasingly precise over time as more and more measurements of radioactivity are taken.

- Emergency response personnel and other persons responding to the event will use appropriate protective clothing and other equipment, and will be continually monitored to ensure that they do not exceed established limits to radiation exposure.

## 4. Evacuation vs. Sheltering in Place

- Once it is determined that the explosion has released radioactive material into the environment (i.e., that the explosion was caused by a dirty bomb), local emergency officials may require evacuation of the area surrounding the explosion site to make sure that no one is exposed to high radiation levels.
- Persons farther out from the explosion site may, during the emergency phase of the event, be told to shelter in place (i.e., stay inside) until it is determined that it is safe for them to come out. The primary purpose for sheltering in place is to minimize exposure to radioactive material that was dispersed by the explosion.
- The boundaries of the evacuation area, and of the area in which persons are told to shelter in place, will likely change over time as emergency officials get more information on radiation levels and other factors.

## 5. Radiation-Associated Illness (Acute Radiation Syndrome) Beginning in the Hours to Days Following a Dirty Bomb Explosion

- For radiation-associated illness to occur in the hours to days following radiation exposure, the radiation dose received would have to be relatively large, and it would have to occur over a short period of time.
- In general, a dirty bomb is not expected to produce enough radiation to cause this type of illness (known as acute radiation syndrome, or ARS) except possibly in a small number of persons who were very close to the explosion.
- Early symptoms of ARS include nausea and vomiting. Radiation damage to the bone marrow can cause the person to be at risk for serious infections until the bone marrow is able to recover.
- ARS, if it does occur, can be diagnosed and (unless the radiation dose is extremely high) successfully treated.

## 6. External Contamination

- People who get radioactive material on their skin and clothing (i.e., are externally contaminated) are not in any immediate life-threatening danger, but they should, as soon as possible, remove and bag their clothing, and then take a shower with soap and warm water.
- This process of decontamination should, if done carefully, essentially eliminate further risk from external contamination.
- The location(s) where decontamination will take place following a dirty bomb explosion will depend on the number of persons who potentially have external contamination, the availability of resources to provide decontamination, and other factors. Local emergency responders may set up sites where potentially exposed persons can come for radiation monitoring and decontamination. However, in a large event, uninjured but potentially contaminated persons may be told to go home, remove and bag their clothes, shower with soap

and warm water, and then listen to local TV or radio stations for instructions on any additional actions they may need to take.

## 7. Internal Contamination

- A main risk from external contamination with radioactive material is that this material could be taken into the body (leading to internal contamination) through inhalation, ingestion, or entry through a break in the skin.
- Once the material is inside the body, the radiation it emits can damage cells and tissues, which can cause the person to be at some increased risk for the subsequent development of cancer (years to decades later).
  - The risk of subsequently developing cancer increases with increasing levels of radiation exposure.
  - It is very important to remember that simply because a person has some degree of internal contamination does not necessarily mean he/she will later develop cancer.
- Note that the radioactive material stays inside the body until it is removed by natural processes (e.g., in the urine) or by medical countermeasures (e.g., certain medications).
  - Medical countermeasures function to reduce the amount of internal contamination present.
  - Whether or not a person with internal contamination is treated with a medical countermeasure will depend on: 1) the type of radioactive material (i.e., the isotope or isotopes) involved, and 2) the amount of internal contamination estimated to be present.
  - Not everyone with internal contamination will require treatment with a medical countermeasure, particularly if the level of contamination is very low.

## 8. Provision of Information and Recommendations to Those Affected By or Involved With the Incident

- Emergency response and public health officials will be providing continually updated information and recommendations to a variety of different groups, including the public, medical providers, government officials, and others.
- The public will be instructed to listen to local TV or radio stations for the latest information and guidance.

## 9. Population Monitoring for Exposure to Radiation/Radioactive Contamination

- Following a dirty bomb explosion that has resulted in large numbers of persons potentially experiencing radioactive contamination and/or radiation exposure, a process termed population monitoring will be conducted by public health officials.
- The purpose of population monitoring, which will likely take place at locations called Community Reception Centers (CRCs), is to assess people for
  - External contamination with radioactive material. If present, decontamination can be done at the CRC.
  - Significant external radiation exposure.
  - Internal contamination with radioactive material. If an individual is believed to have significant internal contamination, he/she can be referred for further evaluation and necessary treatment. In some instances, initial treatment might take place at the CRC.
  - The need for additional medical care, psychosocial services, and/or other assistance.
- CRC staff can answer questions, and provide information, instructions, and necessary referral, to all those presenting.

## 10. Clean-Up/Remediation of the Contaminated Area

- Clean-up/remediation of the area contaminated with radioactive material will be undertaken to reduce radiation

in the environment to acceptable levels so that persons can return to their homes and places of employment.

- This process may take months or years to complete, and it will be expensive.
- Decisions will have to be made regarding what residual radiation levels are acceptable, and how best to conduct the clean-up/remediation process. These decisions will ultimately be made by elected public officials, in consultation with technical experts, and with input from persons living in the contaminated area, or who will otherwise be directly affected by the decisions. The goal is to develop sound, cost-effective cleanup strategies that are protective of human health and the environment.
- While clean-up/remediation activities are taking place, relocation of persons living in areas with unacceptably high radiation levels will occur. (Relocation specifically refers to a protective action, taken in the post-emergency phase, through which individuals who may or may not have been evacuated during the emergency phase are asked to relocate from a contaminated area to avoid long-term radiation exposure from deposited radioactive material.) Depending on the situation, relocated persons may, on occasion, be allowed temporary re-entry into the restricted zone under controlled conditions.

## 11. Effect of Radioactive Contamination on Agriculture

- In the early phase of the event, a temporary embargo on agricultural products and activities in the affected area may be put in place following discussions between state and federal public health and agriculture officials.
- There will be ongoing environmental sampling of agricultural products from the affected (and nearby) areas for evidence of radiation concentrations that exceed those at which continued interventions would be necessary.

## 12. Summary: Consequences of a Dirty Bomb Explosion

- The main consequences of a dirty bomb explosion will be: 1) damage from the blast, including blast-related injuries and deaths; 2) the psychological effects on persons who received (or believe they have received) radiation exposure; and 3) economic costs, especially those associated with relocation and clean-up.
- Some persons who were very near the blast may experience acute radiation illness (i.e., ARS) and will require medical care.
- Many persons in the affected area may have external contamination, and some may have internal contamination. All individuals with external contamination will need to undergo decontamination, which could take place at a variety of locations. Persons who have had external contamination need to be assessed for internal contamination. In the case of a large event, such assessment will likely occur at a CRC. If the level of internal contamination is judged to be significant, treatment with medical countermeasures may be needed.
- Persons who have experienced significant levels of internal contamination, or who have received significant amounts of external radiation exposure, can be at some increased risk for developing cancer years to decades later. These individuals will need medical follow-up.

For more information on radiation and radiation events:

General Audiences

<http://health.mo.gov/emergencies/ert/nucgen.php>

Medical and Public Health Professionals

<http://health.mo.gov/emergencies/ert/nucmed.php>

