RADIOLOGICAL WEAPONS
Radiological Terrorism

- Radiological terrorism events involve the intentional dispersal of radioactive materials in order to harm people and/or inflict social, psychological, political or economic damage.

- Whereas nuclear terrorism events involve a nuclear chain reaction with accompanying bright flash, loud explosion, intense heat, strong winds and characteristic mushroom cloud, radiological terrorism does not produce a nuclear yield. Rather, radiological terrorism involves the acquisition of radioactive materials (e.g. from a laboratory, hospital, industrial or other source) and their intentional dissemination to inflict harm and spread terror.
Radiological Terrorism: Examples of Incident Types

- Manual dispersal of fine radioactive powders
- Aerosol containing radioactive material sprayed over a populated area
- Dispersal of radioisotopes through the ventilation system of a building
- Radioactive source hidden in an area frequented by large numbers of people (malicious exposure event)

Radiological Terrorism: Examples of Incident Types

- High temperature incendiary/fire and smoke plume that spreads radioactive particles
- Intentional dispersal of radioactive materials resulting from destruction or damage to vehicles, vessels or facilities containing radioactive material
- **Radiological Dispersal Device (RDD or “Dirty Bomb”)**
  - Conventional explosive used to disperse radioactive material.
  - Does *not* involve a nuclear yield/nuclear explosion.
  - Many authorities consider RDDs one of the more likely radiological terrorism scenarios.

Challenges

• When an explosive device is used to disperse radioactive materials:
  – Treatment of casualties is more complex because of contamination, complications associated with other trauma.
  – There is potential for harm to persons not wounded in the immediate attack.
  – The radiological threat, invisible and uncertain in terms of long-term health impacts, will engender considerable public fear and concern.
    • *Mental health impacts may be profound and widespread.*
    • *Hospitals may find themselves deluged with walk-ins and concerned people.*
    • *Psychosocial impacts may constitute a major challenge for healthcare system and healthcare providers.*


RA 1.0
Challenges

– Management of incident requires appropriate monitoring equipment, technical personnel.
– Debris and other normally harmless materials will be contaminated.
– Affected area may be much larger than immediate scene of attack.
– Forensic investigation will be complicated by need to wear protective equipment, evidence contamination, pressure to clean up scene.
– Potential effects on critical infrastructure.


RA 1.0
An Additional Challenge

• Important point to remember for planning and response:

   Possibility of multiple, simultaneous attacks in different locations

Initial Response: Radiation Detection at Incident Site

• First responders likely to be the first on the scene of any explosion or any situation where radioactive contamination may be suspected should be provided with radiation detection equipment.

• Detection equipment should include a mechanism that provides two alarm levels.
  – Initial alarm level: to alert responders that they are entering a radiologically compromised environment. A suitable level for this is an ambient dose equivalent rate of approximately 0.1 mSv h\(^{-1}\).
  – “Turn around” alarm: to alert responders if an unacceptable level has been reached. For this alarm, an ambient dose rate and ambient dose would be approximately 0.1 Sv h\(^{-1}\) or 0.1 Sv.


RA 2.0
Initial Response: Radiation Detection at Incident Site

- When radioactive contamination is suspected or confirmed at the incident site, the incident commander should inform responders of any special precautions that are needed.

- The incident commander will likely set up a "Hot Zone" to control access to the contaminated area. Time in this zone would be limited to what is needed to assist victims.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003; New York State Department of Health, Radiological Terrorism Rapid Response Card.)

RA 2.0
Initial Response:
Care of Victims and Protection of Responders

- RDD ("dirty bomb") events are unlikely to contaminate victims in a way that will be harmful to responders or caregivers.

- 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.

- Universal precautions/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.

- According to the USN Bureau of Medicine & Surgery, no health care worker in the U.S. has ever suffered radiation injury second to rendering emergency care to a contaminated patient.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003; Department of the Navy, Bureau of Medicine and Surgery, Initial Management of Irradiated or Radioactively Contaminated Personnel, 1998.)

RA 3.0
Initial Response: Care of Victims and Protection of Responders

- Concerns about the spread of radioactivity, i.e., radioactive contamination, or the possible contamination of medical personnel are, nonetheless, appropriate, and should be attended to after the patient has been stabilized.

- Likewise, in situations involving less seriously injured victims, or with more time to prepare, additional attention can be given to personal protective equipment.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003; Department of the Navy, Bureau of Medicine and Surgery, Initial Management of Irradiated or Radioactively Contaminated Personnel, 1998.)
First Responders: Personal Protective Equipment

• Level/type of personal protective equipment needed depends on assigned tasks and risks including:
  • Fire
  • Heat
  • Other hazards (e.g. chemical)

• Those providing medical care generally wear Level C PPE. This provides respiratory protection and skin protection.
  • Normal barrier clothing and gloves give excellent personal protection against airborne particles.
  • Disposable medical scrub suits, high-density polyethylene coveralls or other closeweave coveralls (for example surgical scrub suit) and hood should be used if they are available.
  • Rubber or plastic boots.
  • Eye protection.
  • Ordinary surgical face masks provide good protection against particulates. Fitted N-95 HEPA mask provides better protection.
  • Personal dosimeters


RP 4.0
Protection of On-Scene Personnel

• To minimize risk from exposure to ionizing radiation, all on-scene personnel should carry out responsibilities keeping in mind three principles to minimize exposure:
  – First, minimize time spent in a radiological environment.
  – Second, maintain the maximum distance from sources of radiation.
  – Third, whenever possible, use shielding to reduce exposure.

• All personnel responding to the scene of a radiological incident should be given a personal dosimeter and should wear appropriate clothing that will minimize contamination.


RP 4.0
Protection of On-Scene Personnel

- Personnel must put on and take off PPE according to established procedures to avoid spreading contamination. Only trained personnel should be assigned to areas requiring PPE.

- Once removed (except for dosimeters), PPE should be placed in a container lined with a heavy plastic bag until decontaminated or disposed of by an approved hazardous waste contractor. Trained personnel should record the DRD (dosimeter) reading in the responder’s medical surveillance records.


RP 4.0
Assessment, Decontamination and Transport of Patients

- Victims should be monitored for possible contamination at the control line only after they are medically stable.

- Medically stable patients should not be released to ambulance personnel before a radiological survey has been performed.

- If found to be contaminated, patients who do not have life-threatening or serious injuries may be decontaminated.


RP 5.0
Assessment, Decontamination and Transport of Patients

- Removal of patient clothing may reduce surface contamination by up to 90 percent. Removed clothing should be bagged, tagged with patient name, location, time and date, marked clearly as RADIOACTIVE, and retained for later analysis.

- If inhalation is suspected, a nasal sample from both nostrils using two clean swabs may be taken.

- Eyes may be decontaminated with water or sterile saline. Skin may be decontaminated with tepid water and non-abrasive mild soap.


RP 5.0
Assessment, Decontamination and Transport of Patients

• However, transport of the severely injured to available acute care medical facilities should not be delayed due to suspected or confirmed radiological contamination on the patient.

• Medical treatment of emergency medical conditions (conditions which can become medically critical or life threatening) and medical conditions with the risk of morbidity (conditions which will result in permanent injury or deficits) must always take precedence over decontamination or containment procedures.

• If a critically injured but contaminated patient must be transferred immediately, make preparations for limitation of contamination at the destination hospital/healthcare facility.


RP 5.0
Patient Radiological Assessment

- Radiological assessment of an injured individual should be performed by an individual with radiological health training and only under the supervision of on-scene medical personnel.

- This assessment includes radiation measurements and collection of information that is relevant to the decontamination and treatment of the patient.

- The instrument used to perform the survey should be sensitive to both penetrating and non-penetrating radiation (e.g., a Geiger-Mueller tube with a thin wall or entrance window).

- Care should be taken not to contaminate the probe by contact with the patient or any other potentially contaminated surface.


RP 5.0
Patient Radiological Assessment

• If the patient is in a contaminated area, the individual should be moved to an area of lower background under the supervision of the senior medical person on the scene.

• The distribution of radioactivity should be recorded for each patient along with the other relevant remarks such as the location of wounds. Administrative information should also be recorded:
  – Patient’s name
  – The name of the individual conducting the survey
  – The time, date and location at which the survey was performed
  – The serial number and type of instrument used

• A survey form with a diagram of an anatomical figure such as Standard Form 531 available from the US General Services Administration web site (http://www.gsa.gov/forms/medical.htm) is suitable for this purpose.


RP 5.0
Public Health Issues

• Radiological terrorist events may give rise to situations in which radiation exposure continues after the initiating event. Minimizing additional exposure in such circumstances is critical.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 6.0
Nature and Duration of Potential Threat to Population

Depending on the nature of the agent involved and the manner and extent of dispersal, the radioactive materials may represent an immediate threat to people in the affected area, a long-term threat to people in the affected area, or both.

Cesium-137 30 years (half life)
Cobalt-60 5.27 years
Strontium-90 29 years

Depending on the nature of the agent involved and the manner and extent of dispersal, the threat to people in the affected area can be primarily internal, primarily external, or both.

Strontium – threat primarily internal when dispersed
Cobalt metal rods - external
Cesium – internal and external threat

RP 6.0
Population Protection

• Actions or instructions provided to the public in order to accomplish this goal may be termed “interventions.”

• Population dose assessment during the early phases of accident management is at best difficult.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 7.0
Population Protection

- Sheltering and evacuation are two frequently considered options.

- Often it is best to recommend sheltering and showering as an initial intervention until the situation becomes clear. Sheltering is 10-80 percent effective in reducing dose depending on the duration of exposure, building design and ventilation. Sheltering has the advantage that people have access to food, water and communications.

- If there is a passing plume of radioactivity, sheltering may be preferable to evacuation.

- However, sheltering may not be appropriate if doses are projected to be very high or long in duration. In such cases, evacuation may be necessary.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 7.0
Hospital: Radiation Incident Preparations, Containment and Security

- Large numbers of people, including both the injured and those concerned about potential exposure, will seek medical attention.

- Many people will self-triage and go directly to the closest and most familiar hospital.

- Most of the individuals who come to the hospital are ambulatory, minimally injured, or concerned about potential contamination.

- To appropriately contain and secure the radiation area, and prevent possible spread of contamination, hospitals should designate a central point where patients are funneled into the hospital and ensure that it is within walking distance from the hospital.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 7.0
Hospital: Radiation Incident Preparations, Containment and Security

- Since the entrance used for contaminated patients may not be the usual emergency room entrance, ambulance personnel will need to be informed of this fact.

- Hospital security personnel should be stationed at appropriate locations to provide directions to arriving ambulances and to limit access to essential personnel.

- Hospitals should also plan to contact local law enforcement and to augment hospital security staff to control facility ingress and egress (including the parking lot). They will also work with EMS to determine how to address contaminated EMS vehicles.

(National Council on Radiation Protection and Measurements. NCRP 138: Management of Terrorist Events Involving Radioactive Material, 2001; CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 7.0
Hospital: Radiation Incident Preparations, Containment and Security

- Hospitals should clearly identify demarcation points (use control points, pylons, or tape) where people will be monitored when coming in and going out of the hospital. The hospital should provide survey monitors at both points. This also includes the restricting staff movement. Designate separate “clean” vs. “contaminated” areas in the hospital. Segregate contaminated and non-contaminated patients and arrange a location where contaminated patients can be observed with limited staff contact.

(National Council on Radiation Protection and Measurements. NCRP 138: Management of Terrorist Events Involving Radioactive Material, 2001; CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 7.0
Radiological Terrorism: Psychological Effects

- A terrorist incident involving radiation has the potential to yield a large number of psychological casualties.

- The psychological trauma in a radiological terrorism incident may be as varied in severity and type as physical trauma.

- The majority of psychological casualties will not have severe psychiatric conditions that result from the incident.

- The initial reaction of many is one of shock, immobilization and fear.

- Most people will exhibit higher levels of anxiety rather than psychotic behavior; some will also experience Post Traumatic Stress Disorder (PTSD).

- A radiological terrorist event may hit children especially hard. Some children may have been displaced from their homes or neighborhoods, some may have lost their parents, and others may have witnessed gruesome scenes. Healthcare facilities need to be prepared to address the special needs of children.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident; American Academy of Pediatrics. Radiation Disasters and Children.)

RP 9.0
Radiological Terrorism: Psychological Effects

• Even well prepared health facilities will face enormous challenges related to psychological casualties. Less adequately prepared facilities could easily be overwhelmed and rendered ineffective.

• Medical and psychological components of the hospital response effort need to be well integrated, both in terms of approach and personnel. A medical response that lacks an adequate psychological component may leave important impacts unaddressed, while a mental health component that is divorced from the medical response is likely to be unsuccessful.


RP 9.0
Radiological Terrorism: Psychological Effects

• Concern and anxiety are natural reactions to the uncertainty associated with a radiological incident.

• In the aftermath of an incident, large numbers of people may stream into area medical facilities to seek assistance. Some will be walk-ins from the area of the incident, some will be concerned about loved ones, some will be fearful of possible contamination, some will be there for fear of loss of access to mental health medications. Some individuals are also likely to exhibit stress-induced symptoms that mimic the symptoms of radiation exposure, making the triage process considerably more complex.

(National Council on Radiation Protection and Measurements. NCRP 138: Management of Terrorist Events Involving Radioactive Material, 2001; CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 9.0
Principles of Psychological First Aid

- Reduce physiological arousal – encourage rest, sleep, normalization of eat/sleep/work cycles
- Provide food and shelter in a safe environment
- Orient survivors to the availability of services/support
- Facilitate communication with family, friends and community
- Assist in locating loved ones
- Keep families together and facilitate reunions with loved ones
- Provide information and foster communication and education
- Observe and listen supportively to those most affected
- Decrease exposure to reminders of the traumatic event

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 9.0
Principles of Psychological First Aid

- Advise decreasing watching/listening to media coverage of overly traumatic images and sounds
- Educate patients to check rumors with available information resources
- Use established community structures to encourage social conduct and education
- Encourage talking to and involvement with the patient’s natural social supports such as family, friends, neighbors and coworkers
- Offer reevaluation if symptoms persist
- Educate about the expected natural recovery that occurs for most people over time.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)
Record Keeping

• Hospitals must ensure that the triage process has an efficient record-keeping process to be sure injured persons are not missed.

• The Armed Forces Radiobiological Research Institute (AFRRI) and the Radiation Emergency Assistance Center/Training Site (REAC/TS) have developed and tested a record-keeping process and a system of tagging for triage, AFFRI’s Biodosimetry Assessment Tool software application.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 10.0
Assessment Center

• The triage plan should include a process for establishment of an assessment center, separate from the emergency department.

• The assessment center can be used to rapidly screen victims for injury and contamination, as well as to serve as a location removed from the emergency department where decontamination of victims can take place.

• *Radioactive contamination (whether internal or external) is never immediately life threatening and therefore, a radiological assessment or decontamination should never take precedence over significant medical conditions.*

• The assessment center should also be used for observation, limited treatment and evaluation and reuniting with family members where possible.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident; National Council on Radiation Protection and Measurements. NCRP 138: Management of Terrorist Events Involving Radioactive Material, 2001.)

RP 10.0
Internal Hospital Communications

- Phone and cellular circuits are frequently overloaded in disasters, possibly rendering them useless. Therefore, two-way radios and satellite phones should be available as backup communication methods for key hospital personnel.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 10.0
Medical Supplies for a Radiological Terrorism Event

• Suggested supplies and medications to keep on hand and have easily accessible in large quantities include IVs, fluid support, anti-diarrhea, and anti-emetic medications.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)
Radiological Terrorism Event: Treatment Summary

- The general objectives in approximate order of importance for the management of contaminated, injured patients are:
  - 1. First aid and resuscitation
  - 2. Medical stabilization
  - 3. Definitive treatment of serious injuries
  - 4. Prevention/minimization of internal contamination
  - 5. Assessment of external contamination and decontamination
  - 6. Treatment of other minor injuries
  - 7. Containment of the contamination to the treatment area and prevention of contamination of other personnel
  - 8. Minimization of external radiation to treatment personnel
  - 9. Assessment of internal contamination
  - 10. Treatment of internal contamination (this could be concurrent with many of the above)

Radiological Terrorism Event: Treatment Summary

- General objectives in approximate order of importance for the management of contaminated, injured patients (continued)
  - 11. Assessment of local radiation injuries/radiation burns
  - 12. Careful long-term follow-up of patients with significant whole-body irradiation or internal contamination
  - 13. Careful counseling of patient and family members about expected long term effects and risks.


RP 11.0
Medical Guidelines

- Medical personnel who will be handling potentially contaminated patients should wear surgical gloves and appropriate anti-contamination clothing. Disposable gowns are particularly useful for medical personnel because they can be easily and quickly changed if necessary as they move from patient to patient.

- Radioactive contamination in wounds or burns should be handled as if it were simple dirt. If an unknown metallic object is encountered, it should only be handled with instruments such as forceps and should be placed in a protected or shielded area.

Acute Radiation Syndrome

- **Acute Radiation Syndrome (ARS)**
  - Result of a sudden, high dose-rate exposure to radiation
  - Follows a roughly predictable course over a period of time ranging from a few hours to several weeks after exposure to ionizing radiation
  - Symptoms vary with individual’s age, radiation sensitivity, type of radiation, dose, etc.

- **Prodromal phase:** First 48-72 hrs. Nausea, vomiting, loss of appetite, fatigue, diarrhea.

- **Latent phase:** Transitional phase during which many symptoms appear to resolve. May last up to 3 weeks. Time interval decreases as dose increases. During this time, critical cell populations are decreasing as a result of bone marrow insult.

- **Manifest illness phase:** Overt illness develops. Infection, bleeding, electrolyte imbalance, diarrhea, changes in mental status, shock.

- **Recovery or death.** May take weeks or months.

(Domestic Preparedness: Defense Against Weapons of Mass Destruction. Hospital Provider Course.)
Acute Radiation Syndrome

- Acute Radiation Syndrome: during **prodromal** phase, provide supportive care and oral antiemetics
  - Granisetron or ondansetron
  - Antiemetics are not radioprotectants
- With **bone marrow suppression**, the prevention and management of infection governs therapy
  - Antibiotic prophylaxis in afebrile patients with profound neutropenia (<0.1 x 10^9 cells/l)
  - With prolonged neutropenia, risk of secondary infections increases
  - Consider using cytokine hematopoietic growth factors, such as filgrastim or sargramostim, to stimulate hematopoiesis -- must be started within 72 hours of exposure

**Note**: It must be assumed during the care of all patients that even those with a typical gastrointestinal syndrome may be salvageable. Replacement of fluids and prevention of infection by bacterial transmigration is mandatory

(Center for the Study of Bioterrorism and Emerging Infections. Saint Louis University School of Public Health. 2003. Primary Care Preparedness: Radiological.)

RP 11.0
Medical Countermeasures: Potassium Iodide

Potassium Iodide

• Administration of KI is only indicated when there has been a release of radioiodine.

• Potassium iodide (KI), if taken in time and at the appropriate dosage, blocks the thyroid gland’s uptake of RAI and reduces the risk of thyroid cancer and other thyroid diseases that might be caused by exposure to RAI.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 11.0
Medical Countermeasures: Potassium Iodide

- If indicated, potassium iodide should be taken immediately though it may still have a significant impact if taken even 3-4 hours after exposure. It should be available to those in a radioactive fallout area.

- Hospitals should adhere to FDA recommendations (Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies, U. S. Department of Health and Human Services, Food and Drug Administration, Center for Drug Evaluation and Research, December, 2001) for administration of Potassium Iodide

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 11.0
Medical Countermeasures:
Potassium Iodide

• The Chernobyl experience has shown that the fetus, neonate, and children are most at risk for radiation induced thyroid disease. Urgent consideration for giving KI to pregnant women (esp. in 2\textsuperscript{nd} and 3\textsuperscript{rd} trimesters) and children is appropriate.

• There is some debate about the need for KI therapy in adults since the Chernobyl data seem to indicate that the risk of thyroid cancer to exposed people over 20 years of age is small.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)
Medical Countermeasures: Potassium Iodide

- Persons with known iodine sensitivity should avoid potassium iodide, as should individuals with dermatitis herpetiformis and hypocomplementemic vasculitis, extremely rare conditions associated with an increased risk of iodine hypersensitivity.

- Individuals with multinodular goiter, Graves' disease, and autoimmune thyroiditis should be treated with caution -- especially if dosing extends beyond a few days.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)
Medical Countermeasures: Potassium Iodide

- Recommended Potassium Iodide Dosages
  - For adults over 40 (with an exposure greater than 500 rem), adults 18 through 40 (with exposures over 10 rem), and pregnant or lactating women, the dose is 130 mg of KI.
  - For children and adolescents ages 3 to 18, the dose is 65 mg, unless the adolescent is near adult size (>70 kg). Such teens would get the adult dose.
  - Children ages 1 month to 3 years should receive 32 mg and infants (<1 mo, with an exposure over 5 rem) should get 16 mg.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)
Medical Countermeasures for Radiological Terrorism Events

- **Bicarbonate (NAHCO₃):** Although uranium is not considered to be a likely component of an RDD, sodium bicarbonate would be a useful, safe medical countermeasure for RDD victims exposed to certain chemical forms of natural, depleted or enriched uranium.

- **Colony Stimulating Factors:** Cytokines are naturally occurring glycoproteins that induce bone marrow stem cells to proliferate and differentiate into a wide variety of mature cell types. Colony stimulating factors act on hematopoietic cells by binding to cell surface receptors, which in turn, stimulate proliferation, differentiation, commitment and end cell functional activation. There are currently no recommended dosing regimens for patients whose neutropenia is due to radiation exposure, and cytokines do not yet have an FDA-approved indication for use in radiation-induced neutropenia. However, it is anticipated that off-label cytokine therapy would provide similar benefits of decreased infections. For RDD events, however, only small numbers of patients would be reasonably treated with this countermeasure.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 11.0
Medical Countermeasures for Radiological Terrorism Events

- **Ca-DTPA** (Trisodium calcium diethylenetriaminepentaacetate): Chelating agent for **plutonium and other transuranic elements** such as americium, californium and curium. Chelating efficacy is greatest within six hours of exposure. Contraindicated for children, pregnant women, and patients with nephrotic syndrome or bone marrow depression. There is currently an insufficient supply of Ca-DTPA and Zn-DTPA in the U.S. to respond to multiple mass casualty events.

- **Prussian Blue** (ferric hexacyanoferrate): enhances excretion of isotopes of **cesium and thallium** from the body by means of ion exchange. Insoluble PB has been recommended for years by national and international radiation protection societies as the drug of choice for use in treating internal contamination with radiocesium. There is currently an insufficient supply of PH in the U.S. to respond to multiple mass casualty events.

(DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)

RP 11.0
Medical Countermeasures for Radiological Terrorism Events

• **Water**: For ingestion of tritium. Force fluids for isotopic dilution.

• **Aluminum phosphate, stable strontium, calcium, ammonium chloride**: For decreasing absorption and promoting excretion of radiostrontium. Immediately after ingestion, oral administration of aluminum phosphate can decrease absorption by as much as 85%. Administration of stable strontium can competitively inhibit the metabolism and increase the excretion of strontium-90. Large doses of calcium and acidification of the urine with ammonium chloride will also increase excretion.

• **Amifostine (WR-2721)**: Amifostine has been shown to reduce radiation toxicity in patients receiving radiotherapy for head/neck cancer when given *prior* to each radiation fraction. However, there is no clinical evidence that amifostine offers any protective value when given *after* exposure to ionizing radiation. *Amifostine does not appear to be of practical value as a medical countermeasure in most RDD scenarios.*


RP 11.0
Casualties from an RDD

- Many authorities believe that most of the serious casualties from an RDD event will result from the explosion rather than from radiation.

- However, some worst case RDD scenarios or other radiological terrorism scenarios may produce substantial numbers of radiation casualties.

- Hospitals, therefore, need to be prepared to manage such radiation casualties.
Emergency Information & Risk Communication

• Following a radiological terrorism event, people will likely turn to healthcare providers for information and guidance.

• Timely, accurate information is vital for reducing morbidity and mortality and for maintaining public confidence.

• A communication plan should be developed in advance, as should information packets. Remember that unique messages are called for in an incident involving radiation.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.)

RP 14.0
Emergency Information & Risk Communication

• Ensure that all messages are consistent, immediate, accurate and open.

• Key audiences for communications include first responders, EMS, fire, police, media, patients, victims and potential victims, family members, community members, local medical facilities, health departments, local elected officials, and local hospital and disaster volunteers.

• Remember that medical personnel are also subject to fear and terror. Keeping all personnel, including support staff, informed is critical.

(CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident; DHS Working Group on RDD Preparedness, Medical Preparedness and Response Sub-Group, 2003.)
Further Information

• CDC. Division of Environmental Hazards and Health Effects, National Center of Environmental Health. Interim Guidelines for Hospital Response to Mass Casualties from a Radiological Incident.
• Radiation Emergency Assistance Center/Training Site (REAC/TS).
• American College of Radiology. Disaster Preparedness for Radiology Professionals. Response to Radiological Terrorism.
• National Institute for Occupational Safety and Health (NIOSH).