


**Radiological Preparedness  
& Emergency Response**

EMORY  
UNIVERSITY  
INSTITUTE FOR  
EMERGENCY MEDICINE

Radiological Preparedness & Emergency Response

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**Session I**

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**Overview of Different Types of  
Threats Using Historical Examples**

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**Objectives**

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- Discuss the threat from radiological terrorism and accidents.
- Describe the different types of incidents using historical examples.

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## Why Are You Here?

- Radiation threats are real.
- We may not be well prepared.



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## Are Radiation Sources Available?

- There are around:
  - 150,000 licensed radioactive facilities in the USA
  - 2,000,000 radioactive sources
  - 400 lost sources per year in the world



Source IAEA



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## Emergency Responders Attitudes and Perceptions

- A survey performed in Hawaii hospitals has shown that responders ranked radiation threats highest in terms of the fear generated when compared to chemical or biological terrorist attacks.



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## Emergency Responders and Radiological Preparedness

- Research has shown that US clinicians and Public Health workers felt unprepared to respond to radiological or nuclear incidents.
- Canadian survey-based study: 31% of EMS providers reported receiving training in radiation detection.



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## US Emergency Medicine Physician Survey

- 48% felt uncomfortable caring for radiation victims.
- 56% felt similarly about performing a radiation detection survey on patients.
- 52% and 68% felt uncomfortable diagnosing ARS and internal contamination.
- Majority were unfamiliar with use of DTPA, Prussian blue, and Filgrastim.
- Many respondents were unable to differentiate between contamination and exposure with radiological material.



ED Evaluation of IED Injuries



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## Possible Scenarios

- Simple radiological device.
- Improvised nuclear device (IND).
- Nuclear weapon detonation.
- Nuclear power plant accident.
- Radioactive dispersal device (RDD).



Photo Credit: Sandra National Laboratories and Wikipedia



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## Simple Radiological Device

- Exposure to penetrating ionizing radiation.
- Insidious onset.
- Initially silent.



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## Lja, Republic of Georgia-2002



Source IAEA



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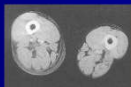
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## Yanango, Peru. Feb 20, 1999

- Iridium source loss.
- Picked up by worker and put in his back pocket.
- The patient developed severe radiation burn in his pelvic area as well as ARS.
- He survived with significant disability.



Source IAEA



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## Yanango - Peru May and December, 1999

Patient treated in France

May 1999 →



December 1999 →




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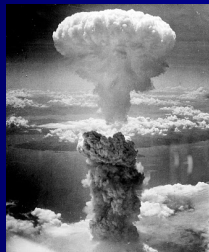
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## Nuclear Weapon Detonation or Improvised Nuclear Detonation (IND)



Air burst versus ground burst

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## Nuclear Detonation

- Fission reaction.
- Damage and mortality secondary to Nuclear weapon detonation:
  - Thermal blast (35%)
  - Radiation (15%): initial and fallout
  - Shock (50%)
- Electromagnetic pulse.



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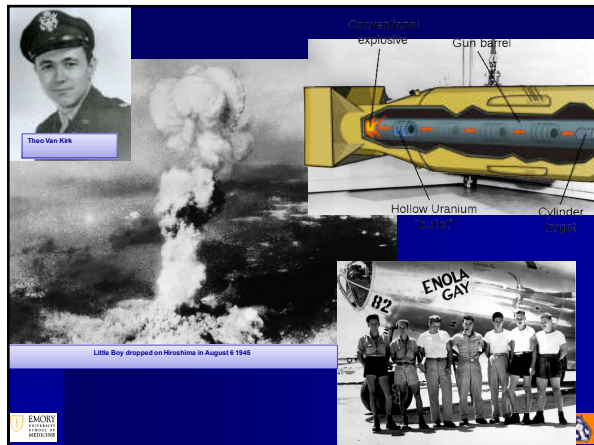
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## Nagasaki, 1945

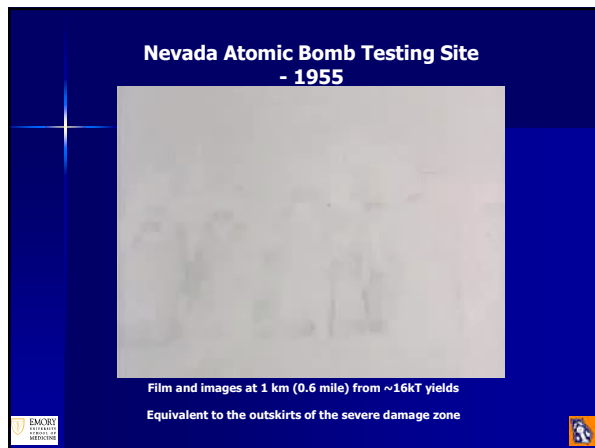


Pre and Post



### Severe damage zone (0.5 mile radius):

- Near complete collapse
- Few, if any, buildings still standing
- 99% immediate fatalities




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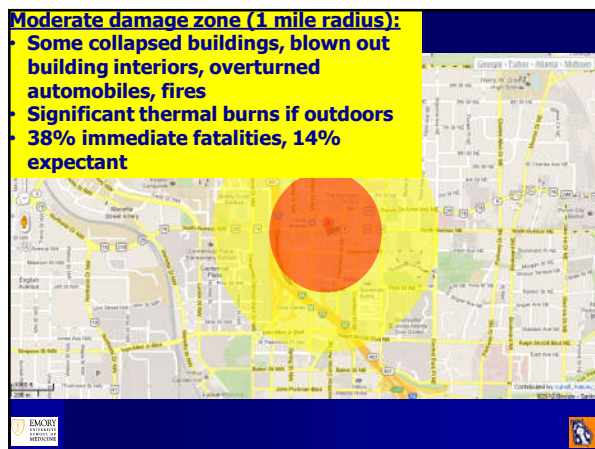
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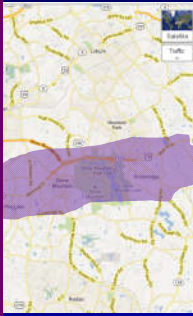
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### **Dangerous Fallout Zone or Dangerous Radiation Zone:**

- Extends 25 miles downwind of ground zero
- Reaches maximum extent at 1 hr
- Severely hazardous fallout will descend to the ground within a few hours and may shrink to a few miles in a couple of days (decay)
- Mostly visible to naked eye (grains of sand)
- Exposure rate  $>10$  R/h



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### **Casualties (10 kT model)**

- For large city with 2 million population
  - 230,000 immediate fatalities
  - 323,000 injured survivors
    - 99,000 will succumb without medical treatment
    - 73,000 will still succumb with medical treatment
    - **26,000 can be saved with medical treatment**



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### **Nuclear Power Plant Accident- Fukushima**

- 6 reactors
- Meltdown risk
- I-131
- Other radionuclides



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## Nuclear Power Plant Accident-Chernobyl

- Nuclear reactor can occur leading to an explosion.
- Iodine is a fission product and is majorly responsible for human exposure.



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## Firefighters in Chernobyl

- 237 emergency workers had ARS.
- ARS was identified as the cause of death for 28 of these people within the first few months after the disaster.



Source Wikipedia



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## Long Term Clean Up



Source NY Times



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## Criticality Accident-Tokai Mura Japan in 1999

- Irradiation accident resulting from human error.
- Uranium mixing error.
- 119 workers exposed to 1 mSv.
- 3 workers were involved.



Source IAEA and Health Physics



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### Worker 1

- Lost consciousness a few minutes after the explosion and then began to vomit.
- He recovered consciousness 70 minutes later and had diarrhea.
- He developed acute radiation syndrome.
- Received BMT from sister.
- Died 3 months later.



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### Worker 2

- Vomited after an hour.
- Developed acute radiation syndrome.
- Survived almost one year.



Source JAEA



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## Worker 3

- Was in an office 10-20 m away.
- Asymptomatic. Only mild nausea.
- Survived.



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## Radiological Dispersal Device (RDD)

- Radioactive material
  - Dispersed using explosives (dirty bomb)  
or
  - Dispersed without the use of explosives (Goiania incident)



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## Moscow Park and Market-1995



Source PBS



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## Jose Padilla

- Arrested in 2002 in Chicago's O'Hare airport.
- Accused of plotting a terrorist attack in the US.
- Thought to have received dirty bomb detonation instructions in Pakistan.



Source Wikimedia Commons



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## "Dirty Bomb"

- Conventional explosive + radioactive material= "dirty bomb".
- High "fear factor" in the press/public.
- Economic toll



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## "Dirty Bomb simulation"

- Simulation of long-term contamination due to a cobalt-60 bomb in New York City.
- Cancer deaths due to radiation: Inner ring: One per 100 people Middle ring: One per 1,000 Outer ring: One per 10,000.



Courtesy Federation of American Scientists



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## Goiania Incident: RDD



Source IAEA

- 1985.
- Abandoned teletherapy clinic.
- 2 thieves and a junkyard owner.
- Material glows at night.

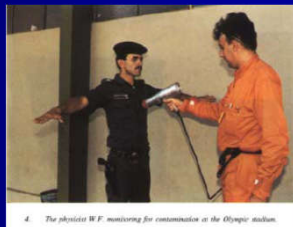


## Goiania incident

- 112,000 people were surveyed at the Olympic stadium.



5. Monitoring people for contamination at the Olympic stadium.



4. The physicist W.F. monitoring for contamination at the Olympic stadium.

Source IAEA



## Goiania incident

- 249 found to be contaminated.
- 1 amputation
- 4 Deaths.
- Prussian Blue therapy.
- Evacuations.
- Demolition of homes, etc.



26. An improved view of the site after the contaminated material was removed.




27. Workers in protective suits handling the contaminated material.


Source IAEA



## Summary Points

- Radiological and nuclear threats are real.
- Emergency responders are not well prepared to respond.
- Different types of threats exist.

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## Any Questions?

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