JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Radiation Terror 101

Jonathan M. Links, PhD
Johns Hopkins University

JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Part 3

Radiological Terror

Radiological Terror: Four Main Events

1. **Nuclear device**
   - Stolen state-owned nuclear weapons or weapons components
   - Improvised nuclear devices
2. **Dirty bomb** ("radiological dispersal device")
   - Conventional explosive device bundled with radioactive material
   - Intended to efficiently disperse radioactivity

Radiological Terror: Four Main Events

3. **Attack on fixed nuclear facility**
   - Nuclear reactor
   - Spent fuel storage depot
   - Nuclear fuel reprocessing facility
   - High-level waste site
4. **Attack on radioactive material in transit**

Response to Bomb-Type Attack

- **Crisis management**
  - Acute response
- **Consequence management**
  - Long-term effort

Response to Bomb-Type Attack

- **Crisis management**
  - Acute response
- **Consequence management**
  - Long-term effort
- Levels of authority
  - Federal
  - State
  - County
  - City

Acute Response

1. Determine that **radioactivity/radiation** is in the environment
   - First responders
2. Determine the **radionuclide(s)** and **amount(s)**
   - Radiation strike team
3. Estimate **doses** and **geographic dose distribution**
   - Radiation strike team + state environment dept
4. Determine need for (and implement) **evacuation**
   - Radiation strike team + health dept + fire/police

Important First Responders

- **Fire department**
  - Hazmat
  - EMS
- **Police department**
  - Bomb squad
  - Patrol officers
- **Strike team**
  - Health department
  - State Hazmat
  - Radiation experts

NCRP Alarm Levels for First Responders

- **Alarm Level 1**
  - 10 mrem/hour
  - Lifetime cancer fatality risk (per hour) $= 5 \times 10^{-6} = 5$ in a million chance
- **Alarm Level 2**
  - 10 rem/hour or 10 rem total
  - Lifetime cancer fatality risk per 10 rem $= 5 \times 10^{-3} = 5$ in a thousand chance
- **Population limit** (for comparison)
  - 100 mrem/year

Notes Available

Medical Issues

- **Acute**
  - "Usual" medical problems for bomb-type attack
    - Injuries, burns
  - Acute radiation syndromes
  - Patient internal contamination
- **Delayed**
  - Radiation carcinogenesis
- Note: must consider both acute and delayed effects of in utero irradiation

External Contamination with Radioactivity

- **External contamination**
  - Radioactive atoms are on clothing or skin
  - Irradiated by penetrating radiation (X rays and gamma rays)
  - “Carry” contamination away from site on surface

Internal Contamination with Radioactivity

- **Internal contamination**
  - Radioactive atoms enter the body by eating or drinking, breathing gases or aerosols, absorption through skin or wound
  - Irradiated by non-penetrating radiation (α and β) emitted *within* the body
  - "Carry" contamination away from site within body

General Countermeasures

- **External radiation exposure**
  - Sheltering in place
  - Evacuation/relocation
  - Control of access to ground zero site
- **Internal contamination**
  - As above
  - Stable iodine (only when radioiodine present)

Notes Available

General Countermeasures

- **External radiation exposure**
  - Sheltering in place
  - Evacuation/relocation
  - Control of access to ground zero site
- **Internal contamination**
  - As above
  - Stable iodine (only when radioiodine present)
- **Internal contamination due to ingestion**
  - Control of food and water
  - Use of stored animal feeds

Notes Available

Order of Medical Management

- Treat and stabilize life-threatening injuries
- Prevent/minimize internal contamination
- Assess external contamination and decon
- Contain contamination to treatment area
- Minimize external contamination to medical personnel
- Assess internal contamination
- Assess local radiation injuries/burns

Triage

- Separate injured from non-injured
- Decontaminate both groups
  - Remove clothing and double-bag
  - Wash head and hands
- Only injured allowed in the emergency department (ED)
  - If the ED becomes a decontamination site, it is no longer an ED!

Skin Changes

- 300 rem: epilation in 2–3 weeks
- 1,000 rem: erythema in hours to weeks
- 2,000 rem: moist desquamation, ulceration
- 2,500 rem: ulceration
- 3,000 rem: blistering, necrosis at 3 weeks
- 10,000 rem: blistering, necrosis at 1 week

Notes Available

Lymphocyte Count

Lymphocyte Count @ 24 hrs		
Lymphocyte Count (10³ mL⁻¹)	**Absorbed Dose (Gray)**	**Lethality w/o Rx (%)**
3	0–0.25	0
1.2–3	0.25–2	< 5
0.4–1.2	2–3.5	< 50
0.1–0.4	3.5–5	50–99
0–0.1	> 5	100

Notes Available

Therapy for Internal Contamination

- **I-125 or I-131**
  - Thyroid blockage
  - SSKI or potassium iodide
- **Cs-137**
  - Reduction of GI absorption
  - Prussian blue
- **Unknown**
  - Reduction of absorption
  - Emetics, lavage, charcoal, or laxatives in cases of ingestion

Acknowledgements

Johns Hopkins Bloomberg School of Public Health

Lynn Goldman

Tom Burke

Robert Lawrence

Tara O'Toole

Ken Brenneman

Baltimore City Health Department

Peter Beilenson

Ruth Vogel

Dawn LaForce

Dan Barnett

Acknowledgements

Baltimore City Fire Department
Ken Hyde
Ron Addison

Baltimore City Police Department
Rodney Giacomelli
Kevin Forrester
Chuck Schneider
John Skinner