Initial Local Response and Implications for Public Health, Hospitals and EMS

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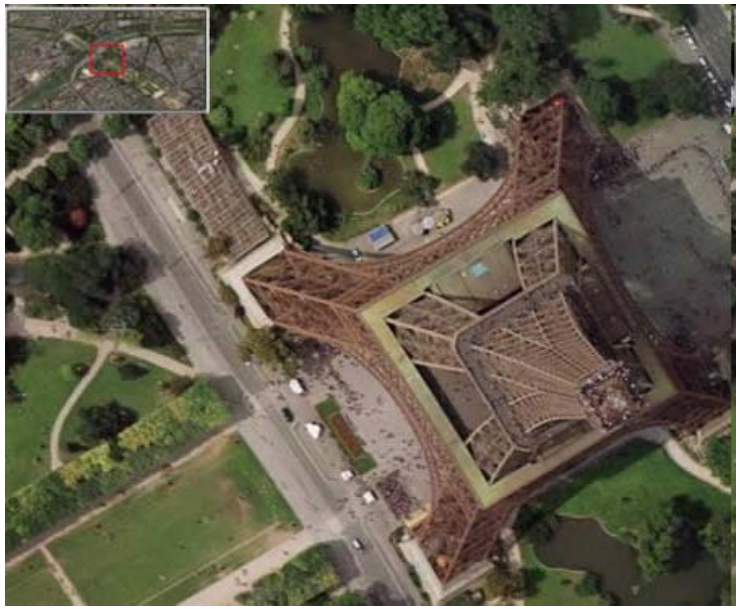
Overview

- Radiation Units and Dose Rate
- Local Response Structure to an IND Incident
- Response Philosophy
  - Protect the Population
    - Control zones
    - Patient care
  - Protect the Workforce
    - Radiation Exposure Limits
    - Personal Protection Equipment
- Hospital response
  - Medical and radiological triage
  - Decontamination
  - Personal Protection Equipment
- Therapeutic Intervention
  - Burns
  - Internal decontamination
  - Long-term treatment
- Role of Public Health Agencies



Radiation Units and Dose Rate

	Exposure	Absorbed Dose	Dose Equivalent
Common Units	roentgen (**R**)	radiation absorbed dose (**rad**)	roentgen equivalent man (**rem**)
SI Units	Coulomb/kilogram (C/kg)	gray (**Gy**)	sievert (Sv)

Sublethal Doses: 100- 250 rem

Lethal Doses: 250 – 450 rem

Supralethal Doses: > 650 rem

Dose Rate
- radiation unit/time
- degree of hazard

Local Response Structure to an IND Incident

CAUSES OF TERRORISM

CRISIS MANAGEMENT

FBI

DHS

Fire/Police
First Responders
HAZMAT
DEP

NERHC
DOE (RAP)

FEMA (Lead)

CONSEQUENCE MANAGEMENT

PUBLIC HEALTH EFFECTS OF TERRORISM

Release

Medical stabilization
Radiological surveys
Triage in field
Decontamination and relocate upwind
Transport injured to hospital

Emergency Department Staff
Radiation safety officer, nuclear medicine techs, health physicist, radiation oncologist

Subspecialists: hematologist, gastroenterologist, burn physician, dermatologist, trauma surgeon, intensivist, neurologist

Dainiak N, Berger P, Albanese J. 2007. Exp. Hematol. 35:17-23

Response Philosophy

- Workforce Protection
- Control Incident Movement
- Protect Population
- Preserve Property

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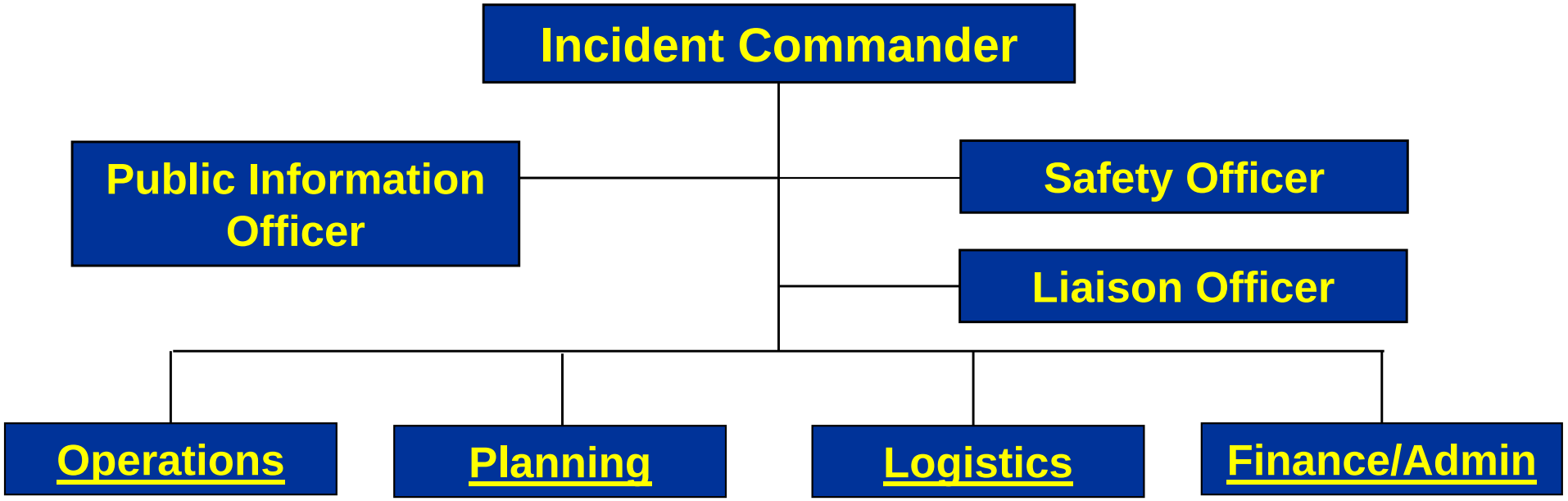
Initial Response Activities – Protect the Population

Actions should be taken quickly and modified as needed, when additional data become available

- Shelter-in-place
- Evacuation
- Administration of medical countermeasures (e.g., stable iodine)
- Decontamination
- Access control (Control Zones)
- Victim extraction

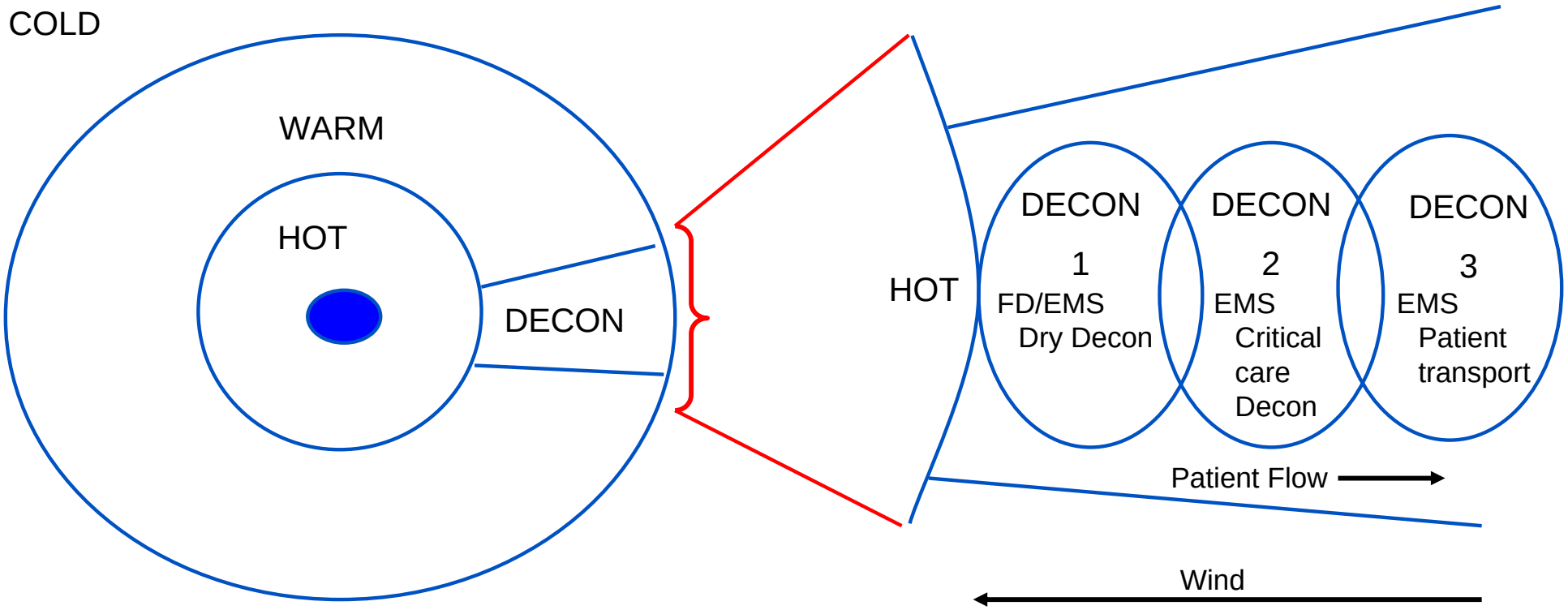
Establish an Incident Command Structure



Delineate Control Zones – Protect the Population

- No-Go Zone – Very high radiation levels – Life-saving unlikely
- Hot zone – radiation hazard is present and only properly trained and authorized personnel may enter – potential for acute radiation syndrome for rescuers
- Warm Zone - used to remove contamination from personnel and equipment and includes:
  - Decontamination corridor
  - Emergency decontamination
- Cold zone
  - Incident command post and other support areas

Patient Flow in Control Zones



Control zone set up will depend on:

–Magnitude of the blast

–Population density

–Environmental factors (e.g., wind direction, day/night, etc.)

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On-Scene Management of Patients

- Personal Protective Equipment
  - SCBA
  - Long-sleeve shirts or coats, gloves and nomex hoods
- Separate contaminated patients from non-contaminated
- Stabilize patient – ABCs of resuscitation
- When possible masks should be used on patients to restrict inhalation or ingestion of radioactive debris
- Bandage wounds to prevent contamination
- Administer radiation countermeasures (if available)
- Prior to transport, contaminated patients should be wrapped in blankets to contain contamination
- Reuse contaminated ambulances for contaminated patients
- EMS personnel should be checked for contamination and decontaminated prior to leaving the scene

First Responders' Concerns

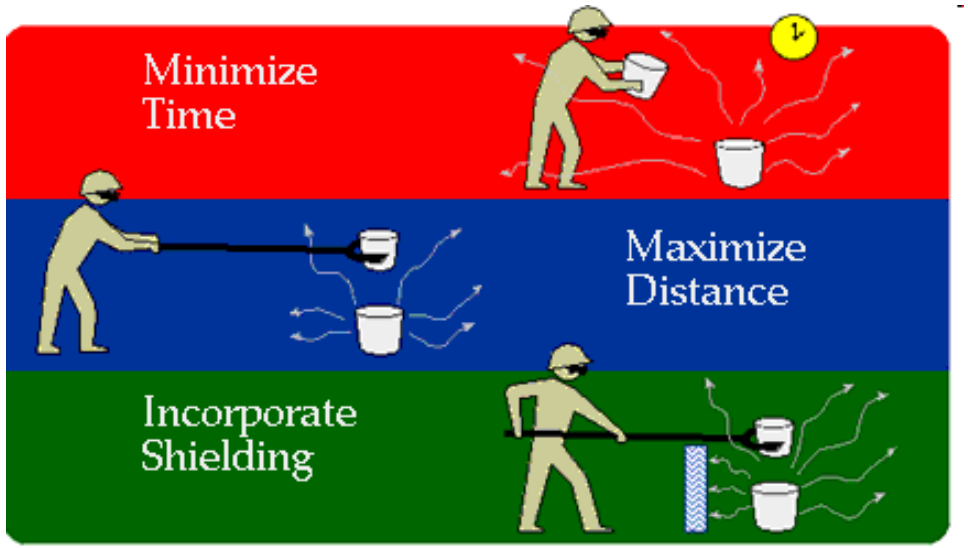
- **Radiation Limits**
  - **Dose Rates**
  - **Exposure**
  - **When to Work**
  - **When to Leave**

- **Short-Term or Long- Term Incidents**

Radiation Protection – Protect the Workforce

- **ALARA – As Low As Reasonably Achievable**

- **Fundamentals of Radiation Protection**
  - **Time -** Dose = Minimize time in a radioactive environment (dose rate x time)
  - **Distance -** Maximize the distance from the radioactive environment (Inverse Square Law)
  - **Shielding –** Incorporate shielding between the radioactive source and the worker



Radiation Exposure Limits

Activity	Dose Limit Recommendation
Life-saving	Whole body dose should not exceed **50 rem (NCRP)** •Voluntary basis only •Personnel must be fully aware of risk involved
Protection of Property	Whole body dose should not exceed **10 rem (EPA)**
Recovery Efforts	Whole body dose should not exceed •**5 rem** for radiation workers •**100 mrem** for general public

Radiological Detection – Protect the Workforce

Survey Meters

- "Geiger Counters"
- Detect and measure the presence of radiation

Survey meters

Dosimeters

- Measure personal radiation exposure
- Worn when providing care to potentially contaminated victims as part of PPE

Dosimeters

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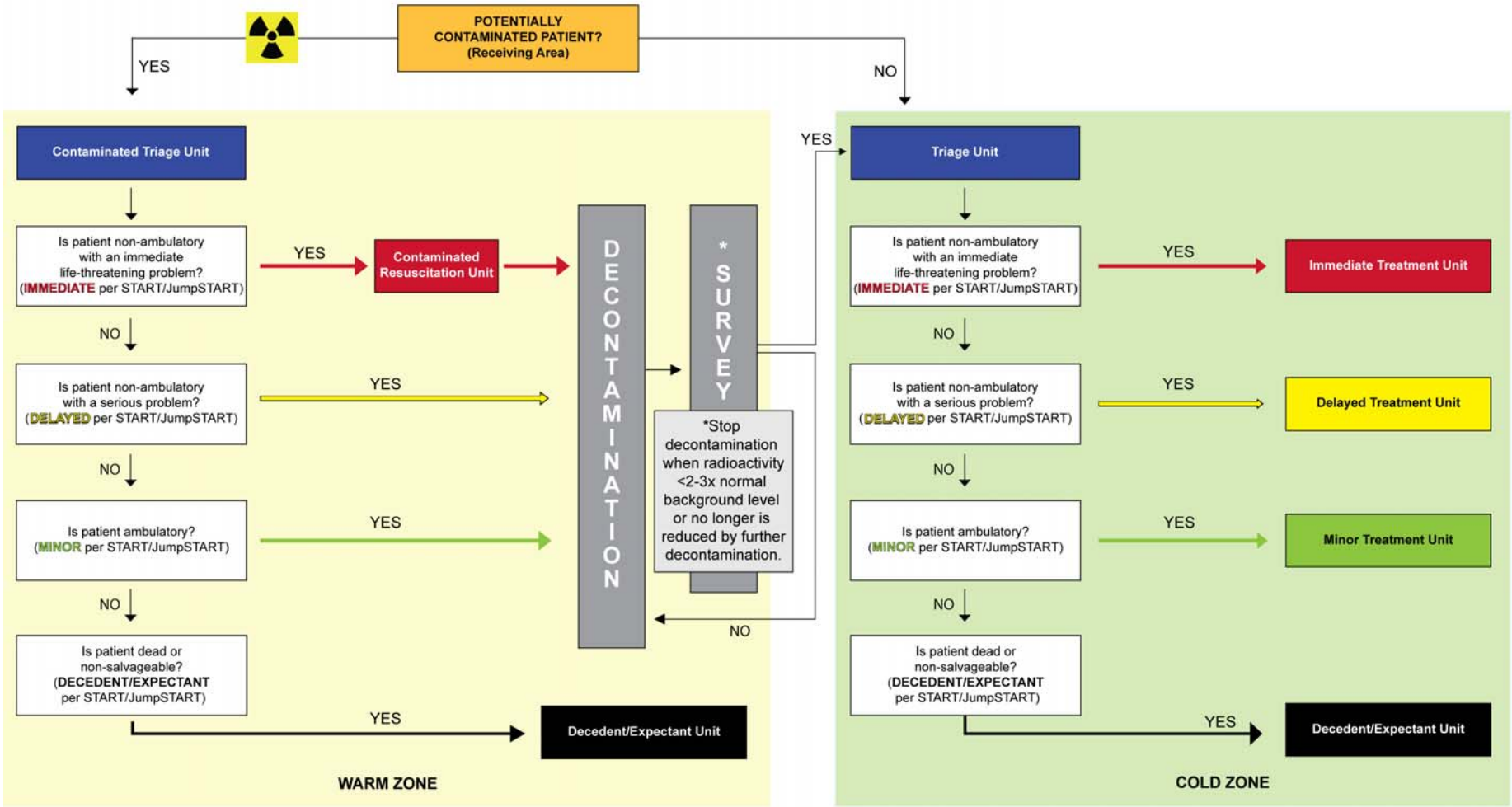
Hospital Response

Establish receiving Areas – Conventional injuries first



Contaminated Patient Treatment Areas

Non-Contaminated Patient Treatment Areas

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Personal Protective Equipment for Hospital Personnel

- Hospital Surgical Gown (waterproof)
- Cap, Face Shield, Booties (waterproof)
- Double Gloves (inner layer taped)
- Personal Dosimeters
- Plastic Bags
- Butcher Paper
- Large Garbage Cans
- Radiation Signs and Tape

In all past accidents, no health care worker has suffered adverse effects from treating contaminated patients.

Properly handled contaminated patients present minimal risk to responding health care providers.

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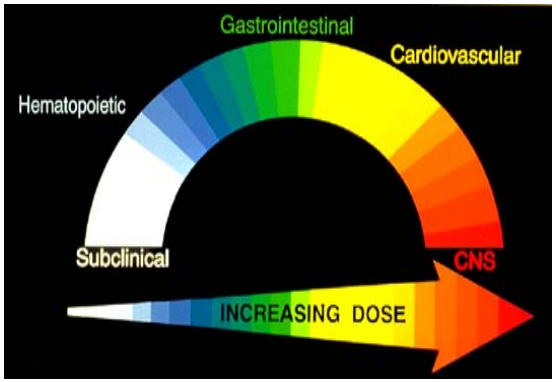
Recognition of Acute Radiation Syndrome



↑Vomiting (50 – 100%)
↓↓ WBC
Fatigue

Low blood pressure
Severe fluid loss
LoC
Convulsions
Coma

< 0.37 rem/yr
(background radiation)

100 rem **250 rem**
Nausea (5 -50%)
Vomiting
↓ WBC

650 rem **> 1000 rem**
Severe Vomiting (100%)
Diarrhea
Cramps
Bleeding - mouth, kidneys

Prognosis

- Excellent
- Very Good
- Good - poor
- Death

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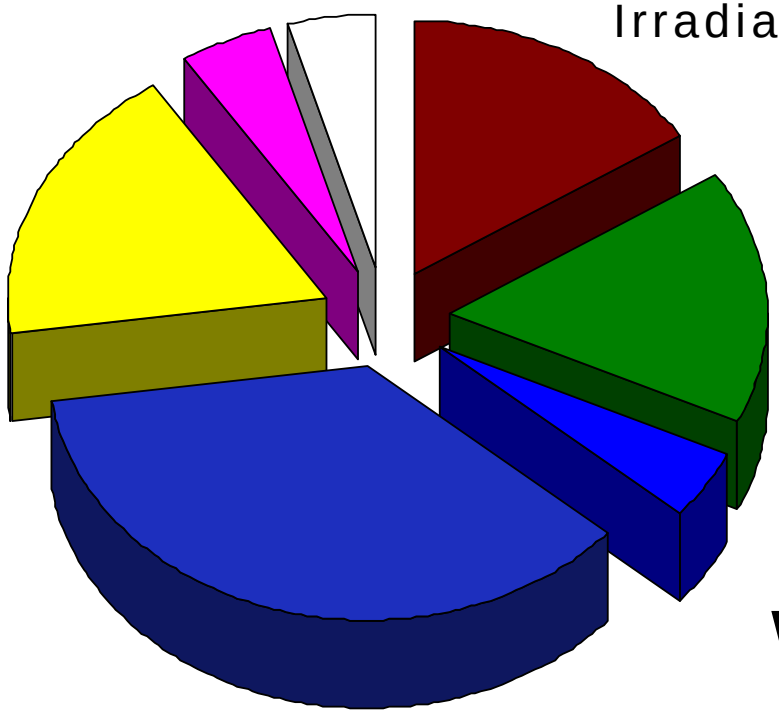
Distribution of Injuries in a Nuclear Detonation



Single Injuries

(30% - 40%)

Combined Injuries

(65% - 70%)

Data from Walker RI, Cerveny TJ Eds., *Medical Consequences of Nuclear Warfare,* TMM Publications, Falls Church, 1989. p 11.

Priorities in Combined-Injury Triage- Radiation Doses

Conventional Triage (No Radiation Exists)	Changes in Expected Triage Following Radiation Exposure		
	Onset >3 hr (<1.5Gy)	Onset 1 – 3 hr (1.5 – 4.5Gy)	Onset < 1 hr (>4.5Gy)
Immediate	Immediate	Immediate	Expectant
Delayed	Delayed	Expectant	Expectant
Minimal	Minimal	Expectant	Expectant
Expectant	Expectant	Expectant	Expectant

Modified from Medical Consequences of Nuclear Warfare, 1989, p. 39

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Primary Treatment Strategy

- **Treat life-threatening trauma first**
- Remove clothing (EMS ?) / Decontaminate
- Treat radiation effects
  - Burn care
  - Pharmaceutical therapies
- If surgery is needed
  - first 1-2 days OR
  - 50 days post-exposure

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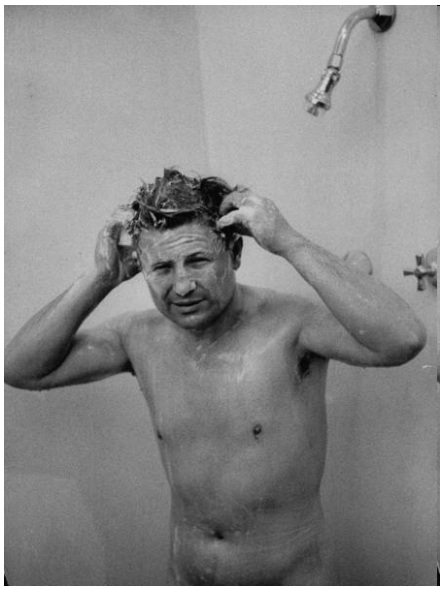
Decontamination

- Dry Decontamination
  - Disrobing removes 80 – 90% of contaminants
- Shower with Soap/shampoo and warm water most effective
- Other Agents
  - Powder detergent, povidone iodine
- Avoid abrading skin



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Causes of Burn Deaths

Direct result of accident	13%
Infection	45%
Organ system failure	41%
Iatrogenic intervention	1%

- Use of antimicrobials
- Support of immune mechanisms
- Aggressive infection control
  - Elimination of infection reservoirs
  - Suppression of infection transfer

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Roles and Responsibilities of Public Health Agencies

- Local, State and Federal Public Health agencies
  - Involvement will be dictated by size of the incident
  - Nuclear incidents mandates involvement of federal agencies (i.e., CDC, EPA, HHS)
- Obligations
  - Short-term (first 100 hr)
    - monitor workers' health and safety
    - provide safe shelters, healthy food and water supplies
    - coordinate sampling and laboratory analyses of samples
  - Long-term
    - conduct field investigations
    - monitor people for potential internal contamination or exposure to radiation
    - define criteria for entry and operations at the incident site
    - establish disease control and prevention measures.

Summary

- On-scene Response
  - Priorities: Protect Responders and the population
    - Shelter in place, evacuation, decontamination, control zones
    - Radiation limits for responders, PPE
- Hospital Response
  - Receiving areas
  - PPE
  - Medical and radiological triage
  - Decontamination
  - Distribution of injuries
  - Surge Capacity
- Short-term and long-term roles for Public Health Agencies

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