Southern Regional Disaster Response System
HHS Region 4

EMORY UNIVERSITY SCHOOL OF MEDICINE

Medical Toxicology
Department of Emergency Medicine

Thinking Ahead of the 2026 FIFA World Cup: Radiological/Nuclear Emergency Preparedness

Preparedness for your Hospital

Disclosure

- We do not have any conflicts of interest to disclose

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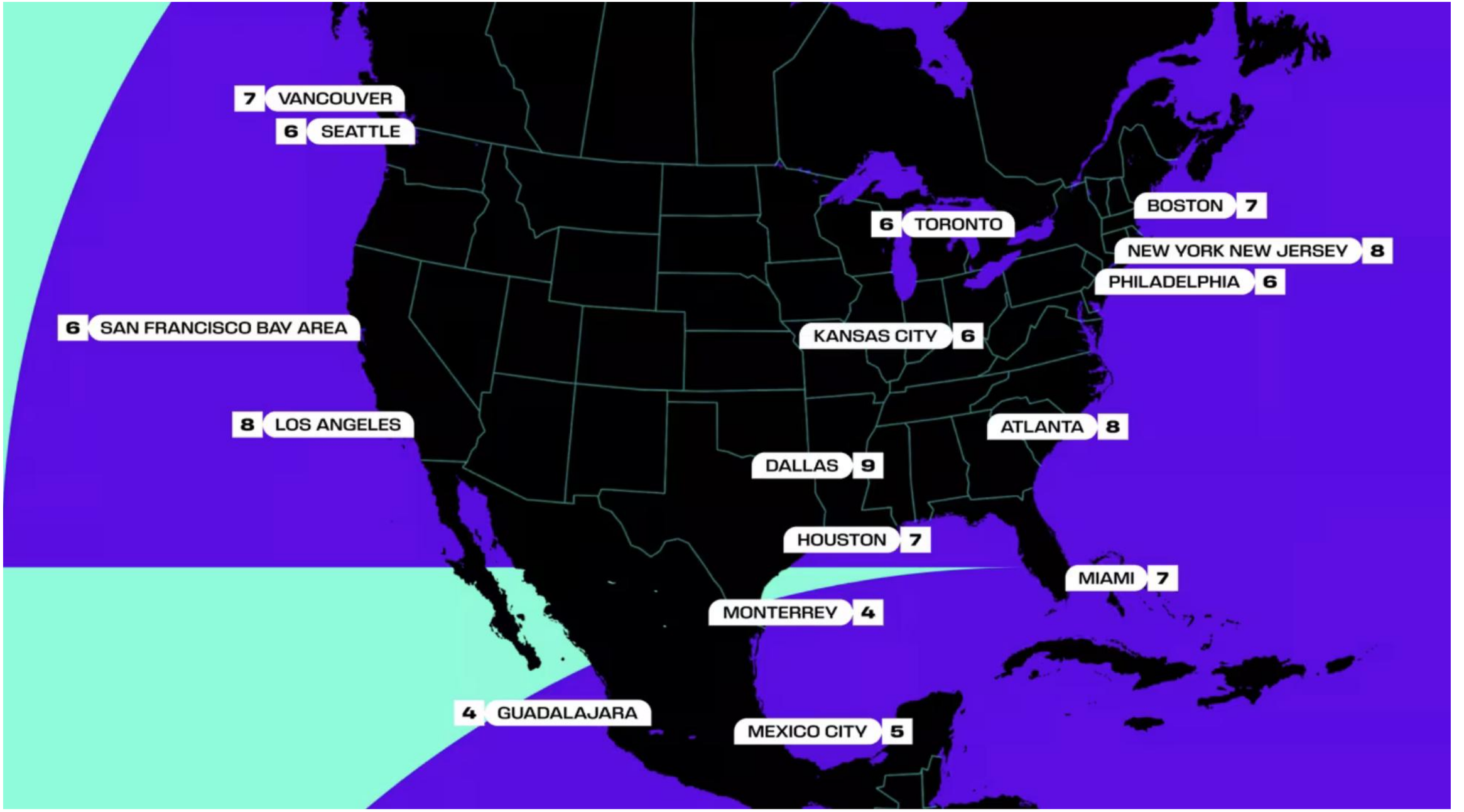

Graphic: www.fifa.com

The Problem at Hand

- Radiation exposure cause non-specific and delayed clinical presentations
- Clinicians lack knowledge/experience about radiation injuries
- People fear radiation
- Laboratory testing may not be available
- Resources may not be available for testing in a mass casualty incident

Explosion at a Stadium (Source CDC)

Our Objective after this Presentation is
That You are Able to

- List the steps you need to take to prepare to receive victims of radiation incident
- Discuss the management of a critical trauma victim who is potentially contaminated with radioactive materials
- Discuss the management of radiation injuries

The Bottom Line Upfront

- Health effects after exposure to ionizing radiation can occur “relatively shortly” after exposure to radiation or can be of delayed onset like cancer

After notification of a mass casualty incident in the Emergency Department:

- Activate the external disaster plan and the Hospital EOC. Set up Incident Command
- Alert internal stakeholders
- Secure the facility
- Maximized available treatment space
  - Expedite discharges
  - Postpone elective surgeries
  - Postpone elective radiographic procedures
- Arrange for staffing including specialized care
- Arrange for supplies including drugs and equipment
- Communicate with external stakeholders (EMS, Fire, Public Health, Emergency Management, Healthcare Coalitions, News Outlets)

Additional items to prepare in a radiological incident

- PPE
- Decontamination
- Radiation detectors
- Expert support
- Testing capabilities
- Antidotes
- Medical countermeasures

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PPE Levels A and B: Typically, not needed in an ED setting

PPE Level C: Needed in an ED setting

Level D:
Default in the ED

The Bottom Line Upfront

- Radioactive material can be localized using a handheld radiation detector like a Geiger-Muller counter.
- The material can be washed with soap and water, once the patient condition is stabilized.
- Radioactive material that has entered the body can distribute in different organs and cause subacute or long-term organ damage like cancer, or leukemia.

Examples of Radiation Detectors

Ionization Chamber

Geiger Muller Counter

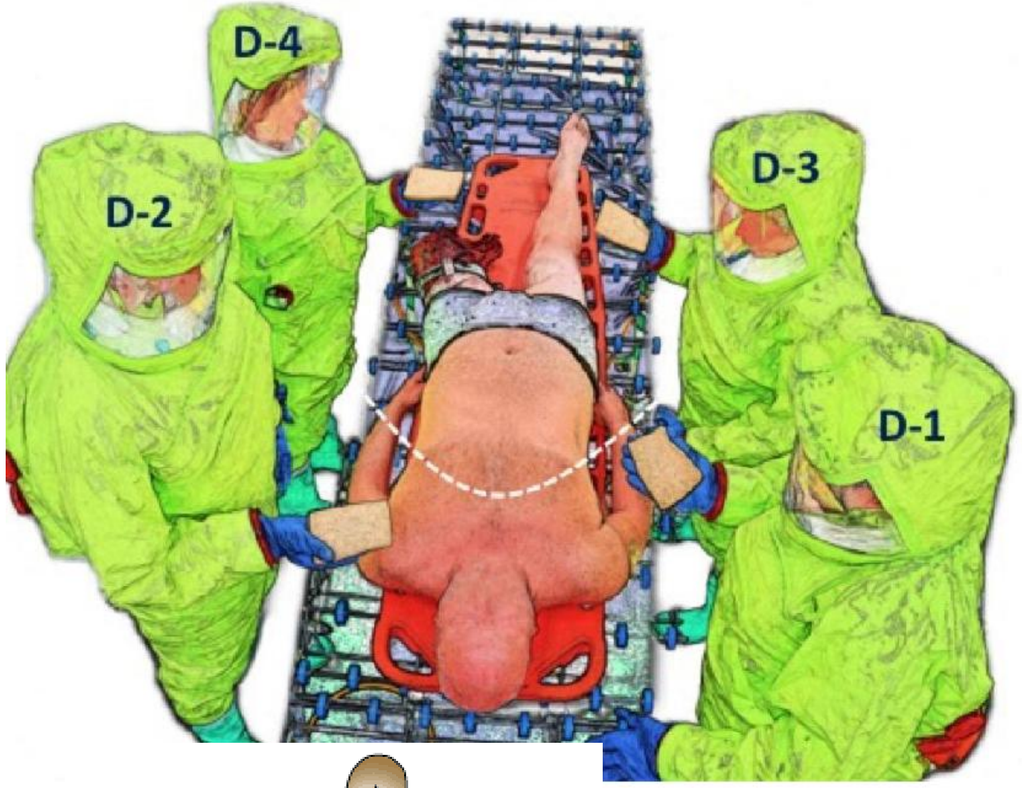
Portal Monitor

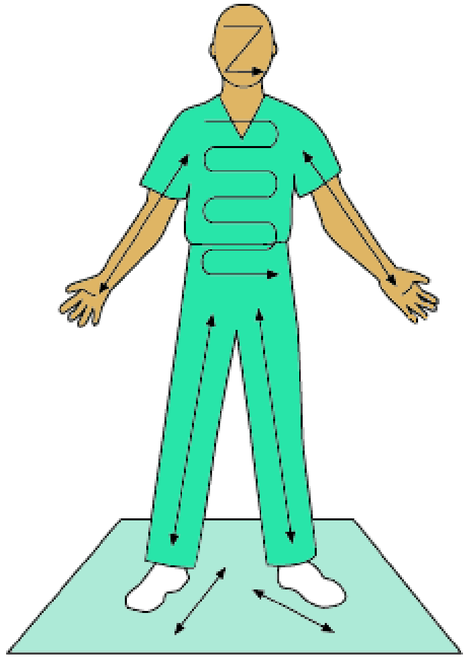
Personal Dosimeter-
Film Badge

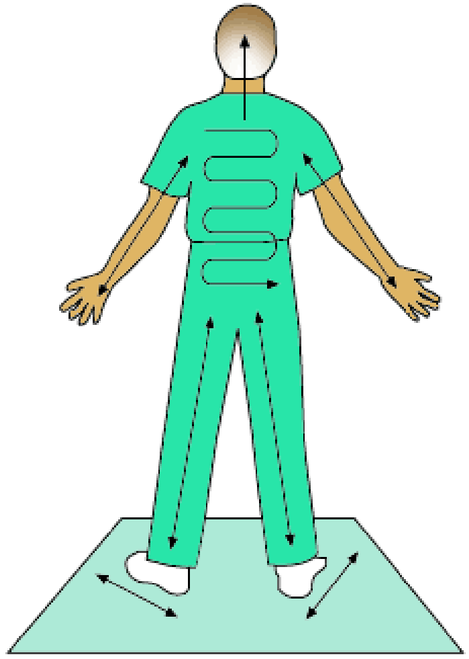
Emergency Decontamination

- Clothes removal
- Wet decontamination

Technical Decontamination: Ambulatory or Non-Ambulatory







The Bottom Line Upfront

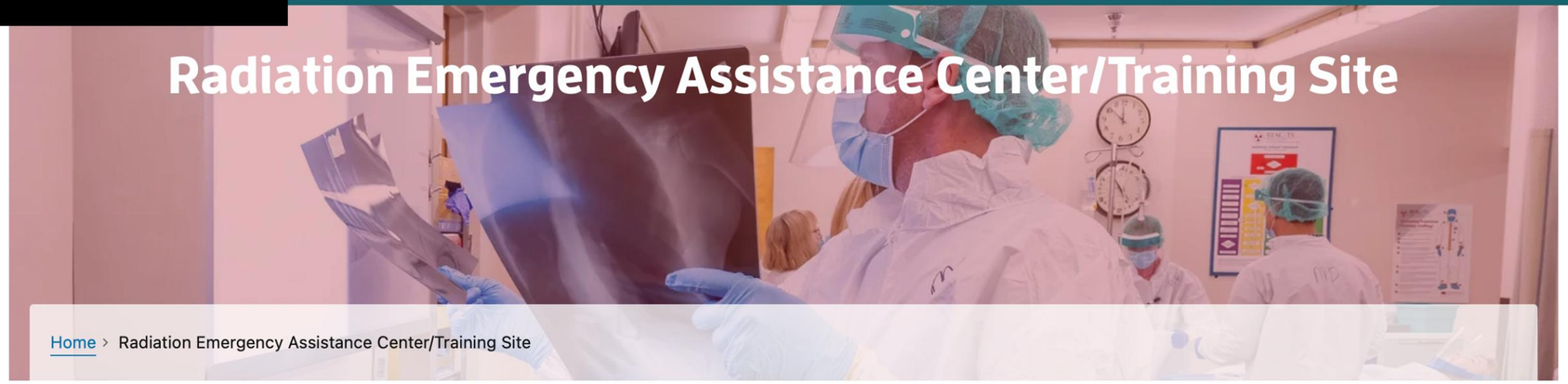
Life-saving interventions like securing the airway, stopping severe bleeding, or decompressing a tension pneumothorax, should be done before a radiation survey and decontamination are completed

WHO AND WHERE ARE THE SUBJECT MATTER EXPERTS?

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Careers | Contact | Events | Search

About | Capabilities | News | People



Radiation Emergency Assistance Center/Training Site

Home > Radiation Emergency Assistance Center/Training Site

View Emergency Treatment Resources

In the event of a radiological emergency, medical professionals can find videos, references, and job aids to assist in the management of individuals injured by ionizing radiation.

Translated materials are also available in Spanish, Turkish, and Ukrainian.

The Radiation Emergency Assistance Center/Training Site (REAC/TS) is a world-renowned, U.S. Department of Energy asset and a leader in emergency medical response to radiological/nuclear incidents. REAC/TS provides emergency response and subject matter expertise on the medical management of radiation incidents for the National Nuclear Security Administration's Office of Counterterrorism and Counterproliferation. REAC/TS is located at the Oak Ridge Institute for Science and Education in Oak Ridge, Tennessee, and is operated for DOE by ORAU [orau.org].

REAC/TS maintains a 24/7 national and international response capability and provides continuing medical education and outreach exercises. REAC/TS courses annually reach thousands of healthcare professionals, emergency responders, and health physicists worldwide. Topics address the medical management of radiological/nuclear incidents, as well as decontamination techniques through instructional and hands-on education.

24/7 response capability for advice and consultation on radiological emergencies

REAC/TS also operates a unique laboratory that helps DOE close a critical gap in our nation's ability to respond to a radiological or nuclear incident. The

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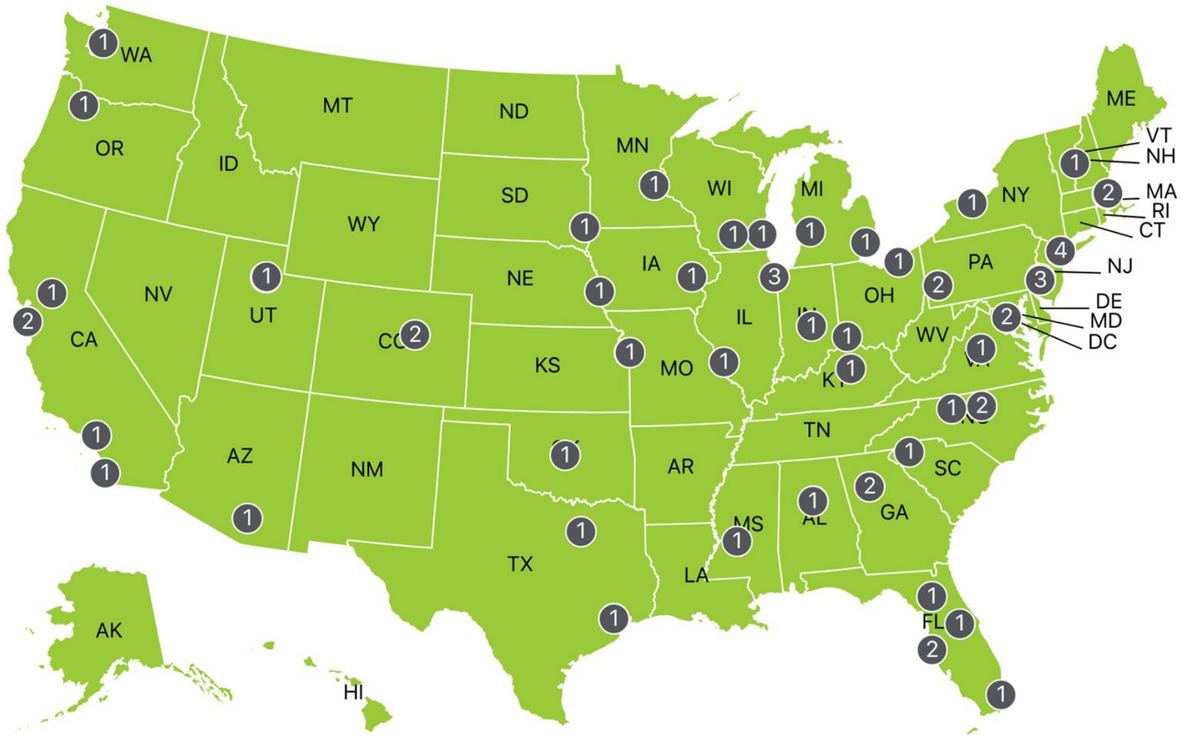
Additional Experts

- Health Physicists, Radiation Safety Officers
- Radiation Oncolgists
- Radiologists and Nuclear Medicine Technologists
- Medical Oncologists, Stem Cell Transplant Specialists
- State Radiation Control Program Director and Staff
- Department of Public Health WMD Coordinators

Radiation Injury Treatment Network (RITN)



74+
Network Hospitals

21,917+
Medical staff trained in radiation preparedness topics

18,000+
Medical countermeasures available for treating H-ARS patients

954+
Preparedness exercises conducted by RITN hospitals

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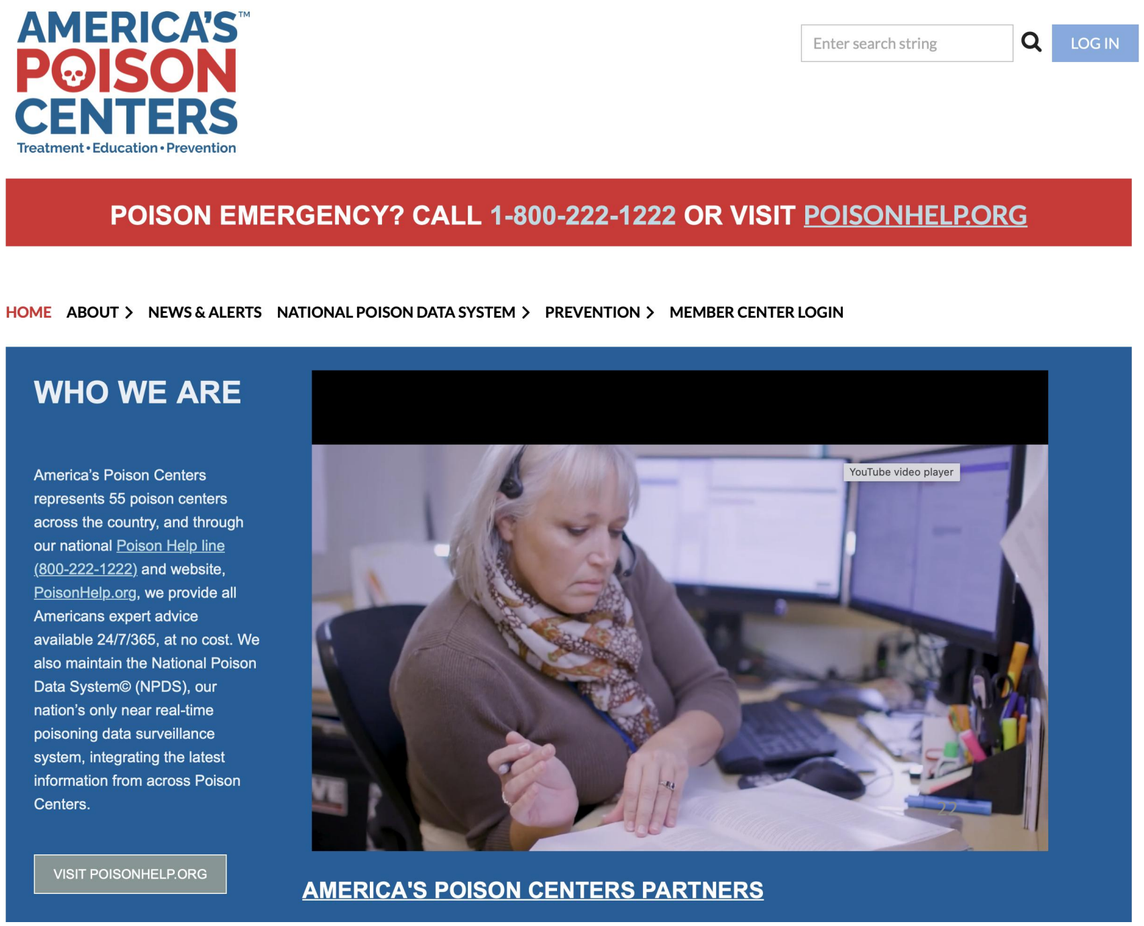
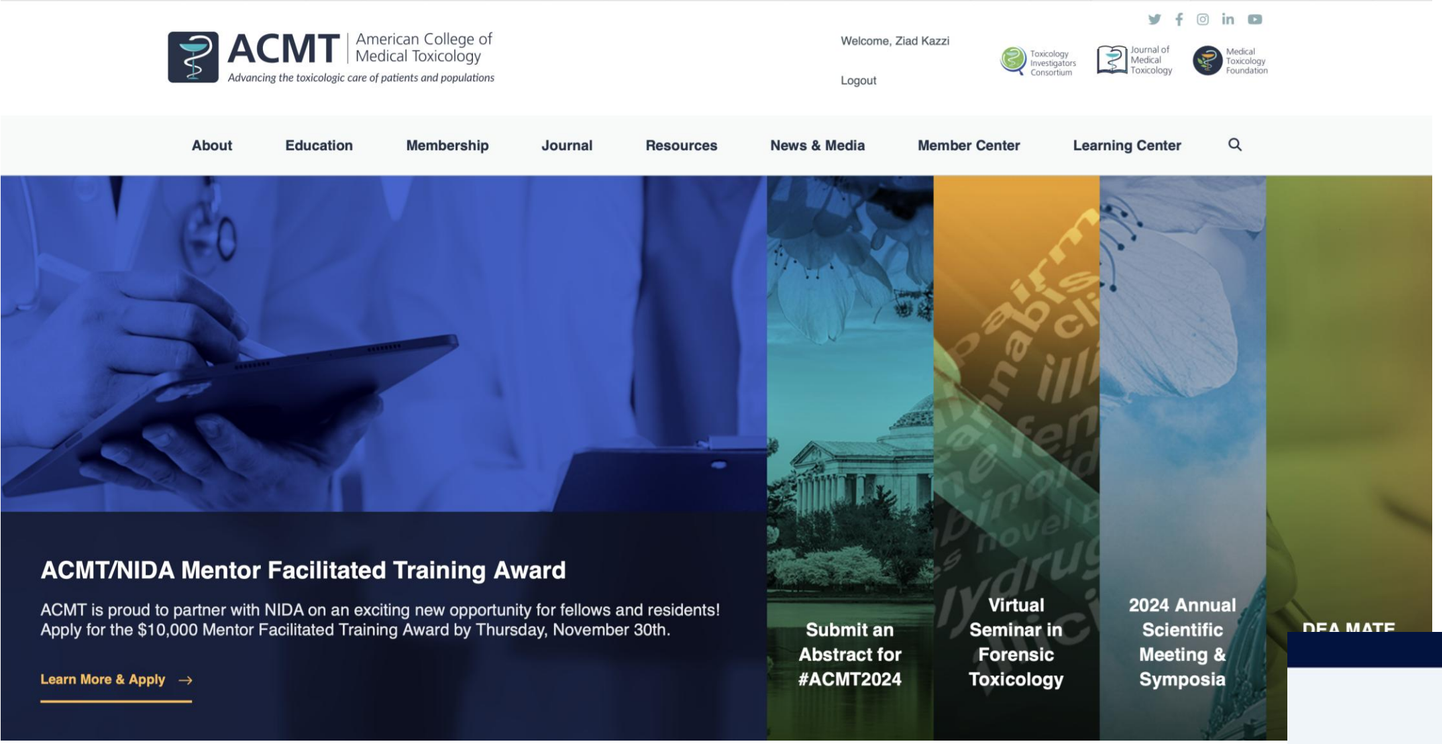


Poison Centers: America's Poison Centers

POISON Help®
1-800-222-1222

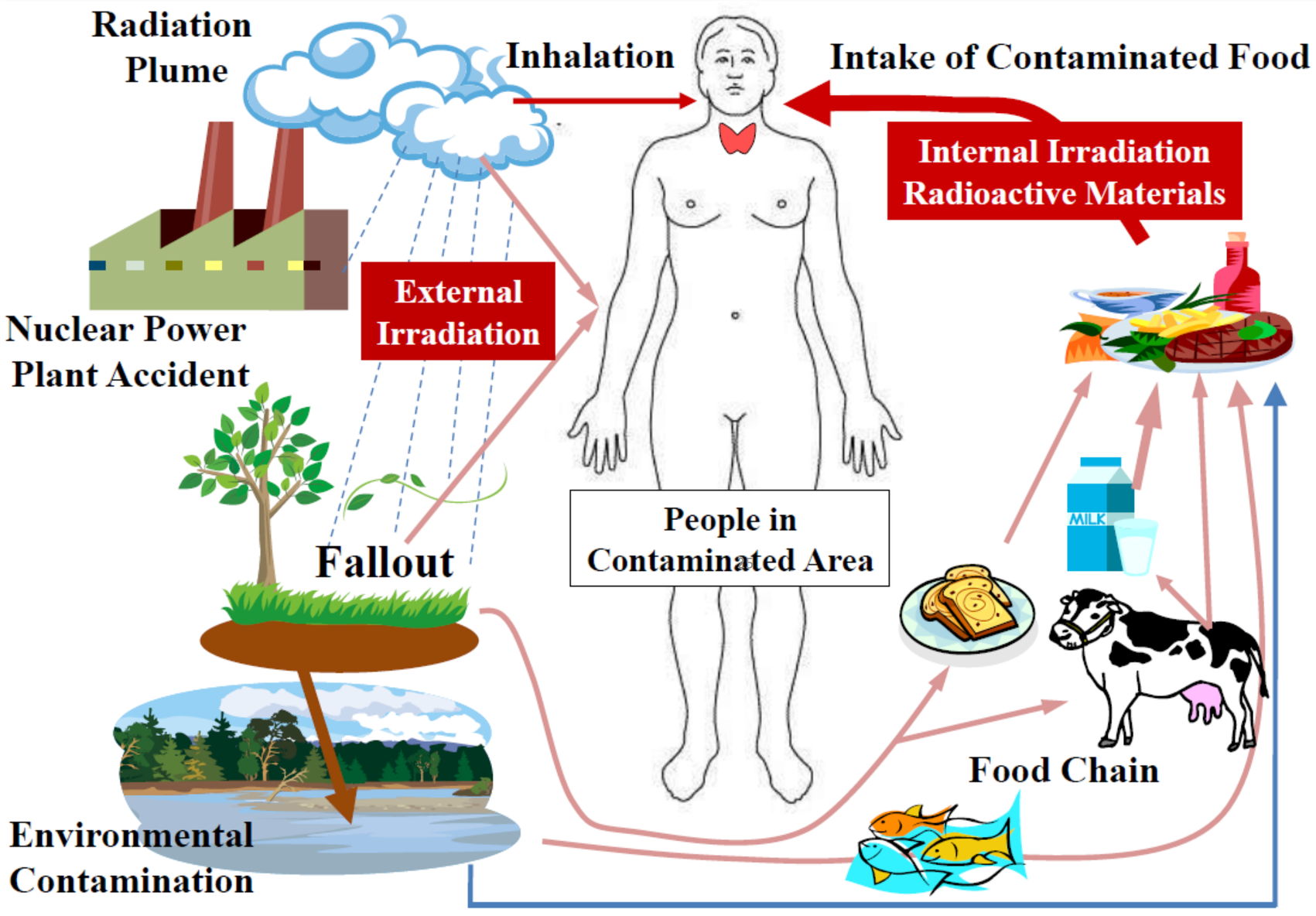


[American College of Medical Toxicology]

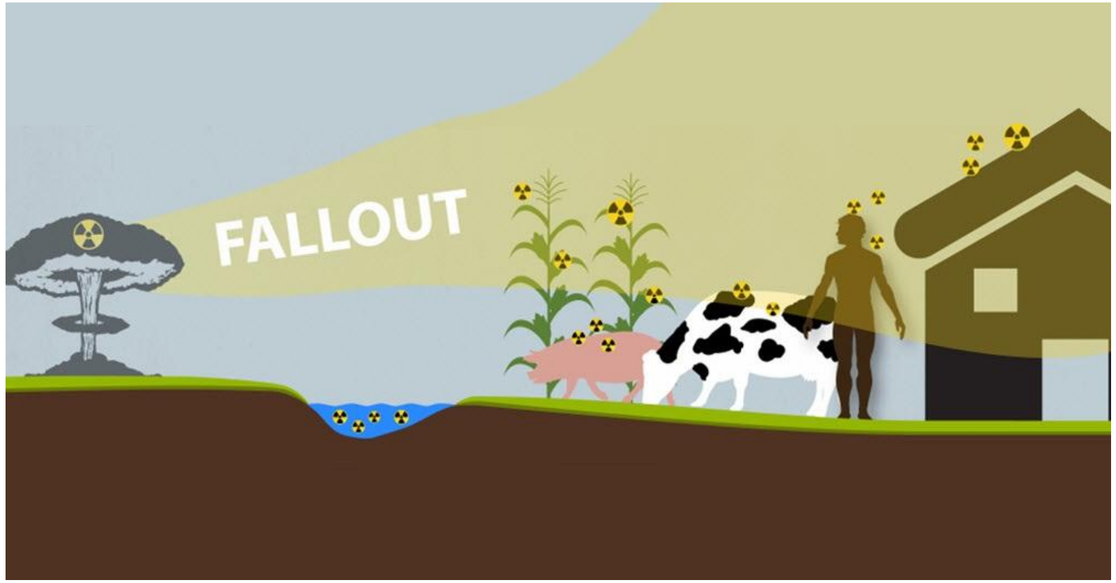
[American Academy of Clinical Toxicology]

How does one recognize a radiological or nuclear incident?

Nuclear Power Plant Emergency



IND Detonation Scenario



Nuclear Weapon Detonation

What is a nuclear weapon?

A nuclear weapon is a device that uses a nuclear reaction to create an explosion. This explosion is much more powerful than that of conventional explosives (like TNT). When a nuclear weapon explodes, it gives off four types of energy: a blast wave, intense light, heat, and radiation. Nuclear weapons can be in the form of bombs or missiles.

When a nuclear weapon explodes, a large fireball is created. Everything inside of this fireball vaporizes and is carried upward. This creates a mushroom-shaped cloud. The material in the cloud cools into dust-like particles and drops back to the earth as **fallout**. Fallout can be carried by the wind and can end up miles from the site of the explosion. Fallout is radioactive and can contaminate anything it lands on.

What are the main dangers of a nuclear weapon?

A nuclear weapon would cause great destruction, death, and injury and have a wide area of impact. People close to the blast site could experience:

Thermal Burns and Instant Radiation Exposures

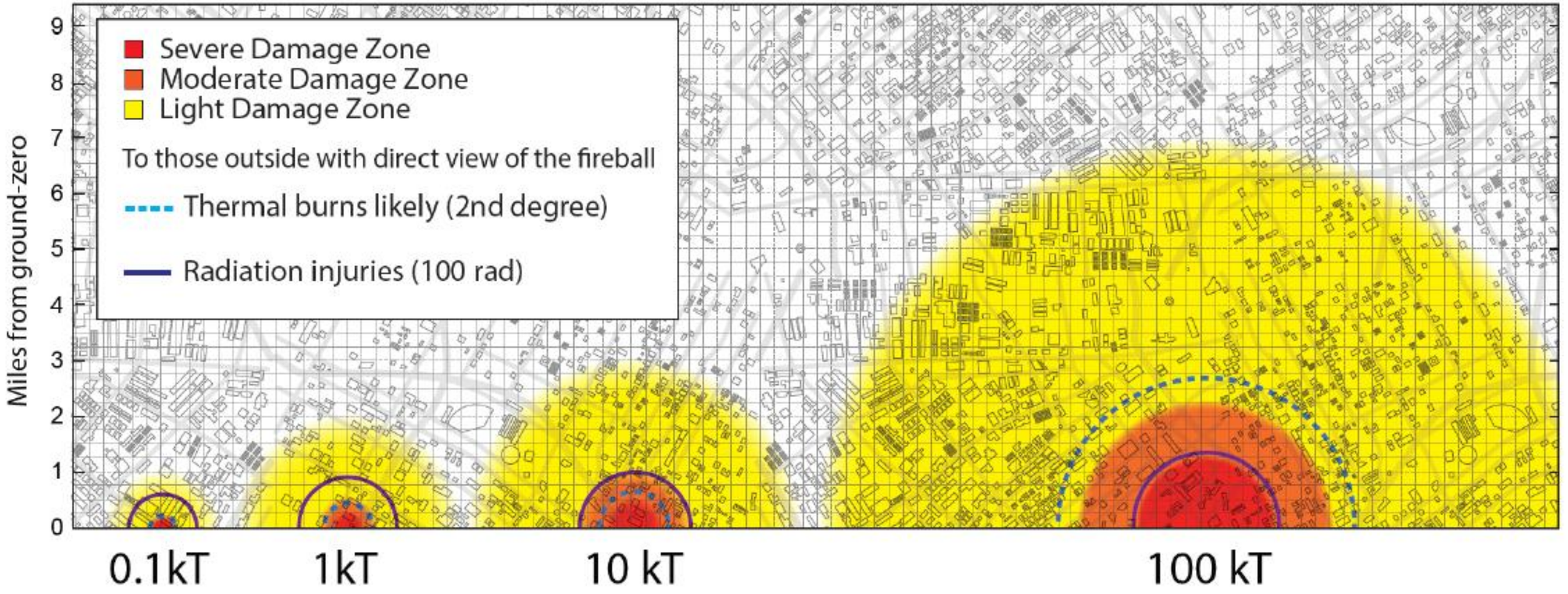


Figure 7: Radiation and burn injury ranges overlaid on damage zones demonstrating the extent of outdoor 1 Gy (100 rad) initial radiation and second-degree thermal burns for unobstructed 0.1, 1, 10, and 100 kT surface detonations.

Flash burns accounted for the overwhelming majority of burns sustained among survivors of Hiroshima

% were flame

Figure 25: Flash burn victims from (a) Hiroshima showing pattern burns due to clothing patterns and (b) Nagasaki showing profile burns from clothing coverage (War Department, 1945).

Radiation Zones:
Dangerous Radiation Zone
&
Hot Zone

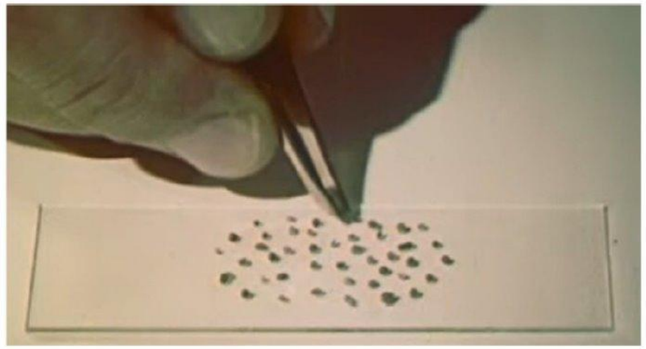


Figure 10: Fallout Particles from Near-Surface Nuclear Tests

After a nuclear detonation near the surface, immediately dangerous fallout will descend back to earth within the first few minutes to hours and can be readily visible as it comes down.

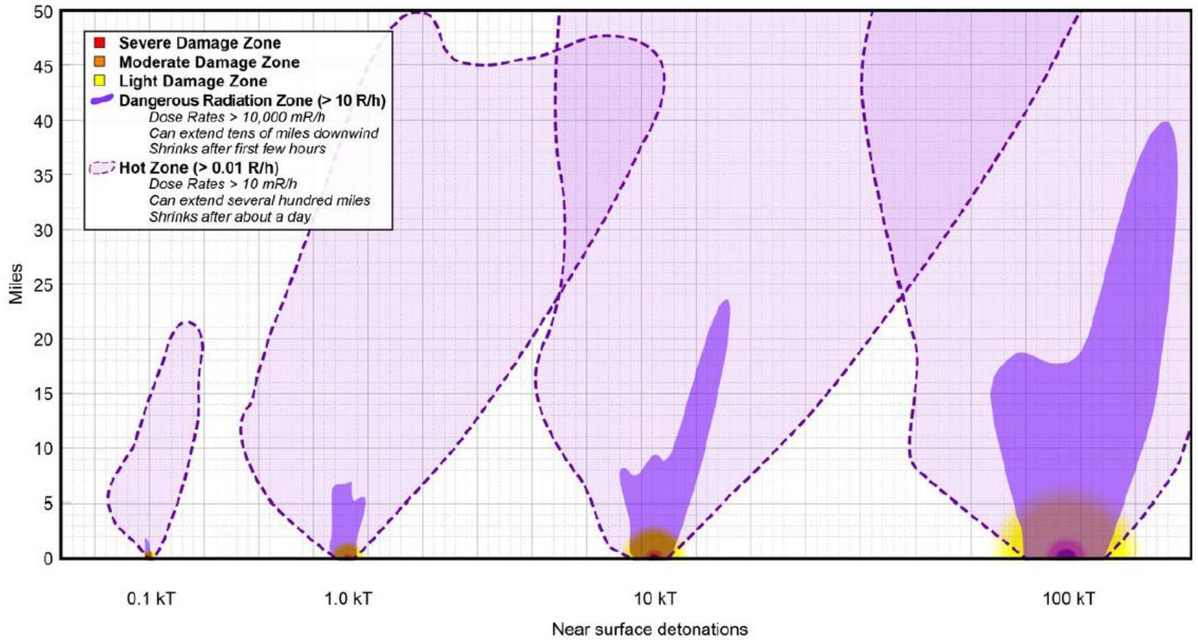


Figure 15: Illustrations of Response Zones for a Variety of Yields

The HZ, like the DRZ, should be established by measured radiation levels. The HZ is bound by 0.01 R/h and higher exposure rates within the 10 R/h boundary. The SDZ is expected to have HZ radiation levels or higher, even for low air bursts. The HZ will overlap with parts of the MDZ and LDZ for near-surface detonations. Figure 15 illustrates the relationship between the HZ, damage zones, and the DRZ for surface detonations of various yields.

Radioactive Dispersal Device:
External with Radioactive Material

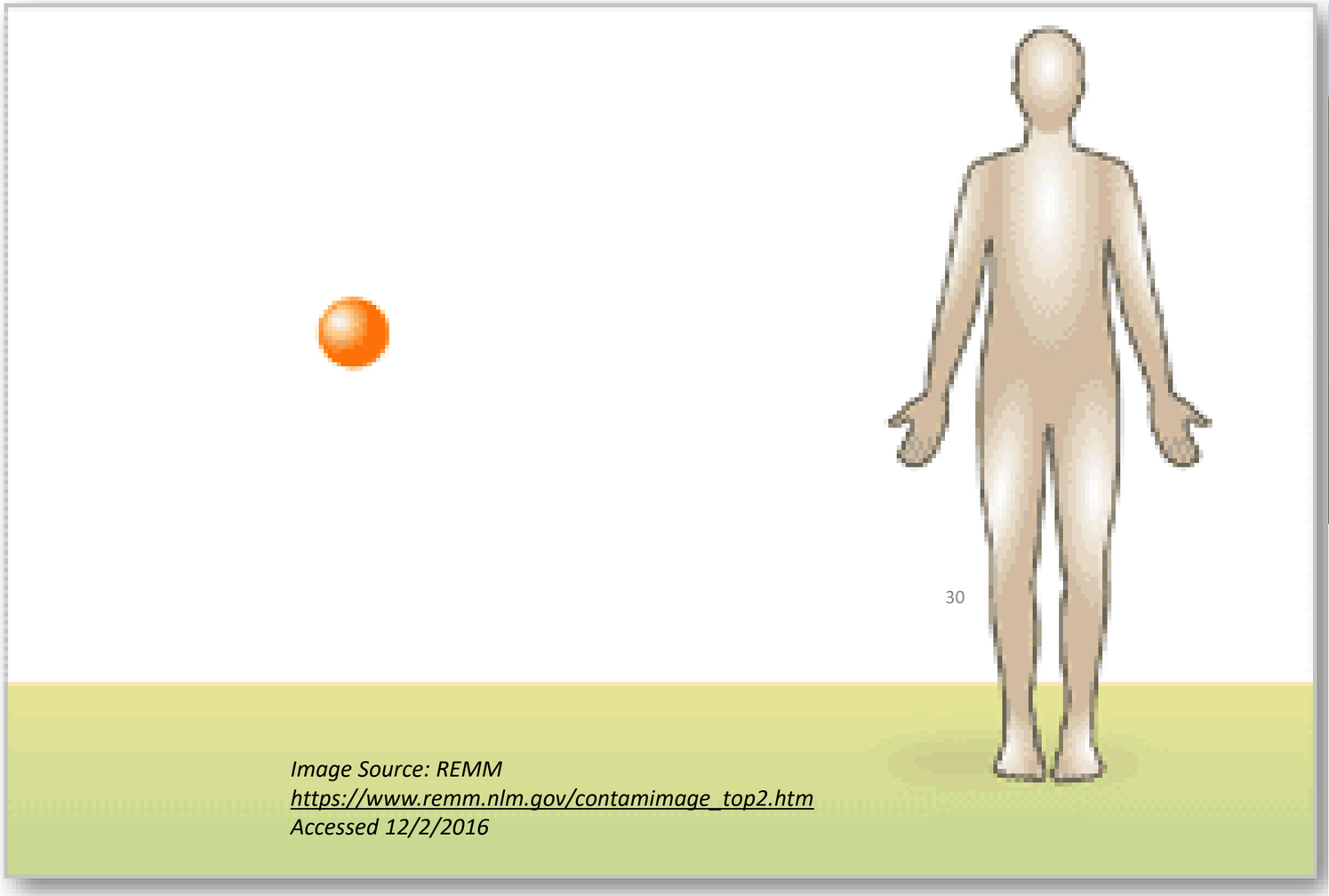
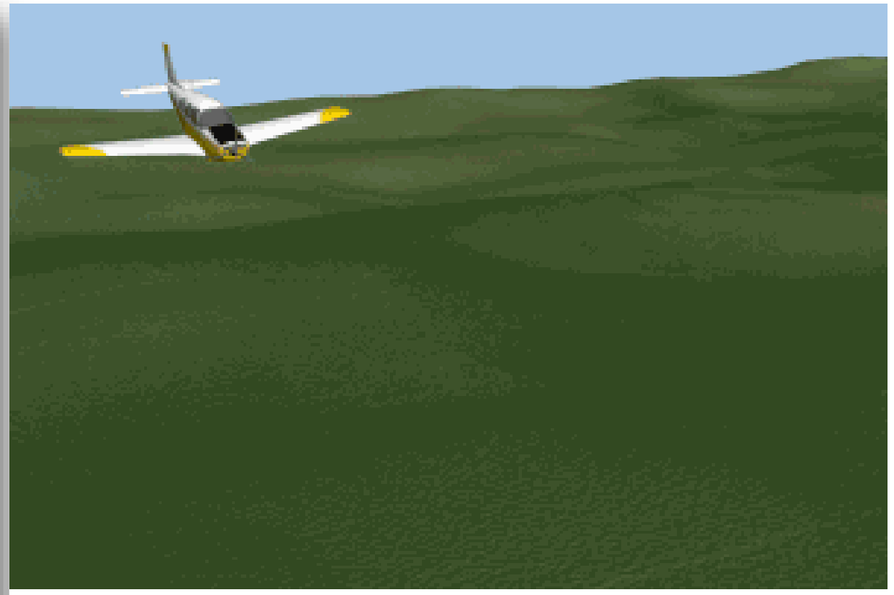
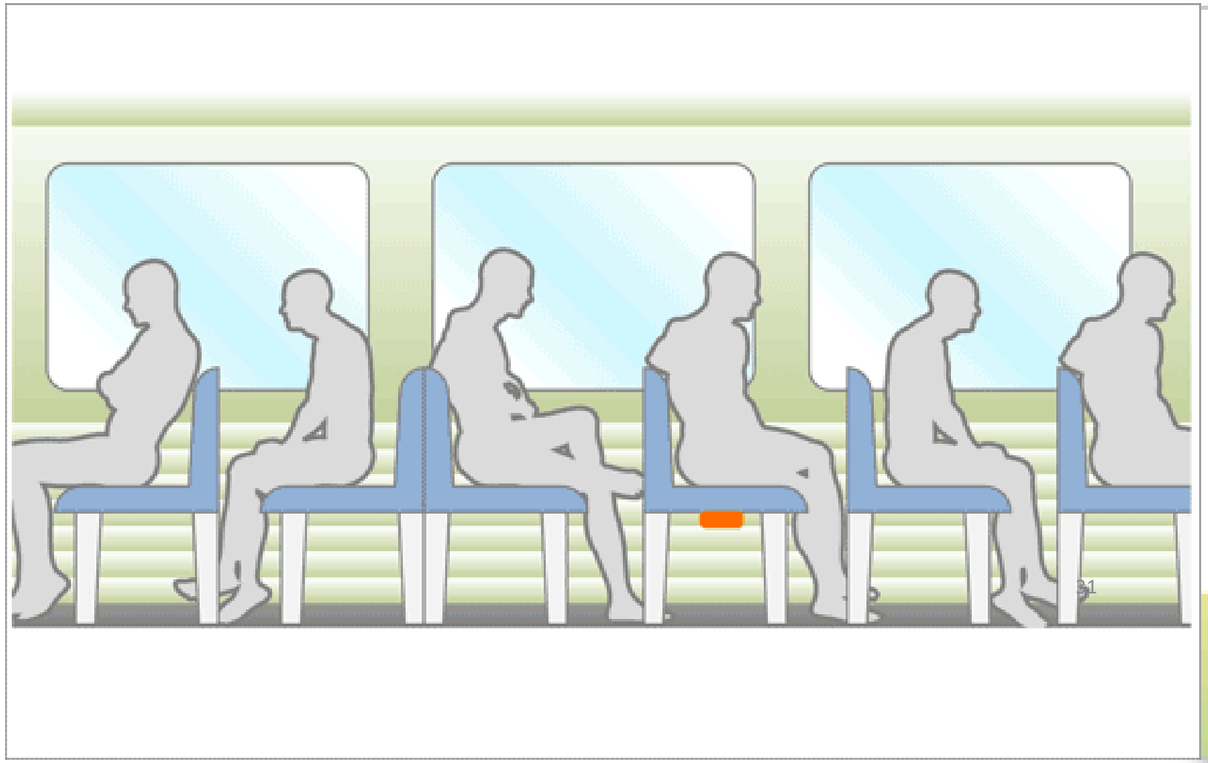


Image Source: REMM
https://www.remm.nlm.gov/contamimage_top2.htm
Accessed 12/2/2016



Radiological Exposure Device: Exposure to Radiation Without Contamination



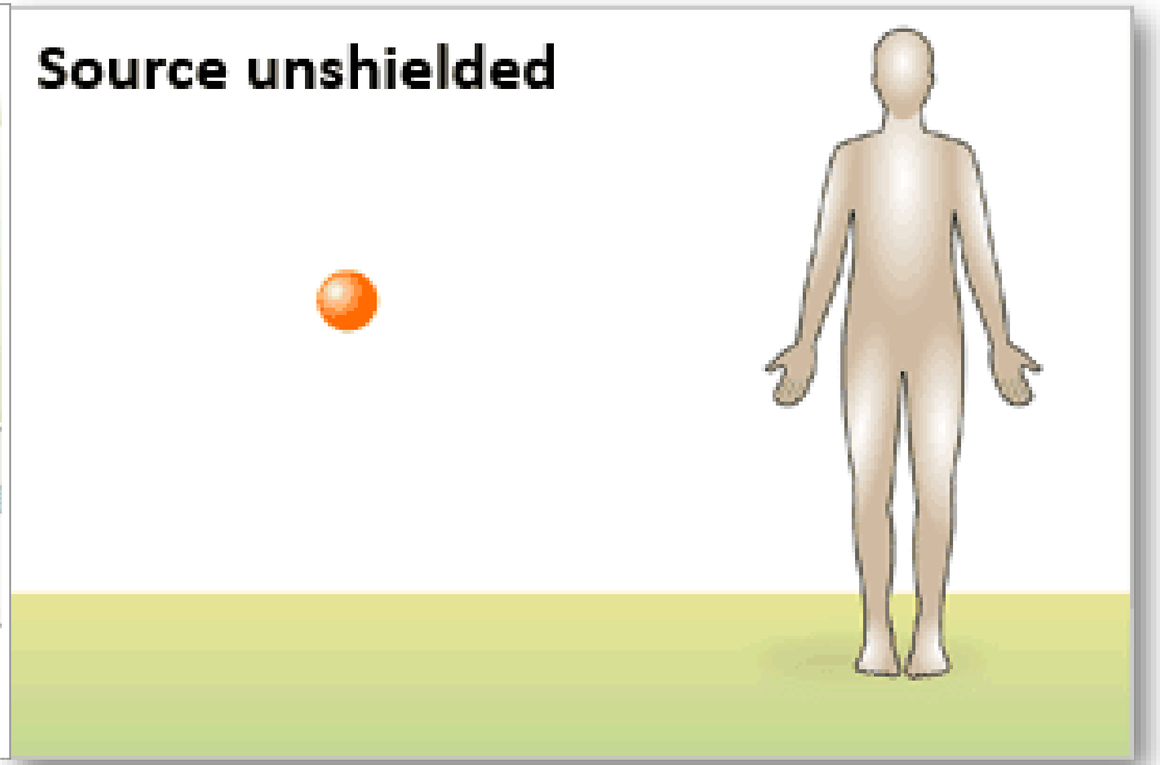


Image Source: REMM https://www.remm.nlm.gov/exposureimage.htm accessed 12/2/2016

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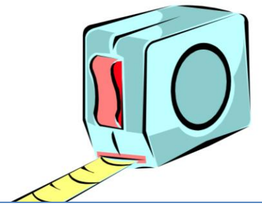
The Bottom Line Upfront

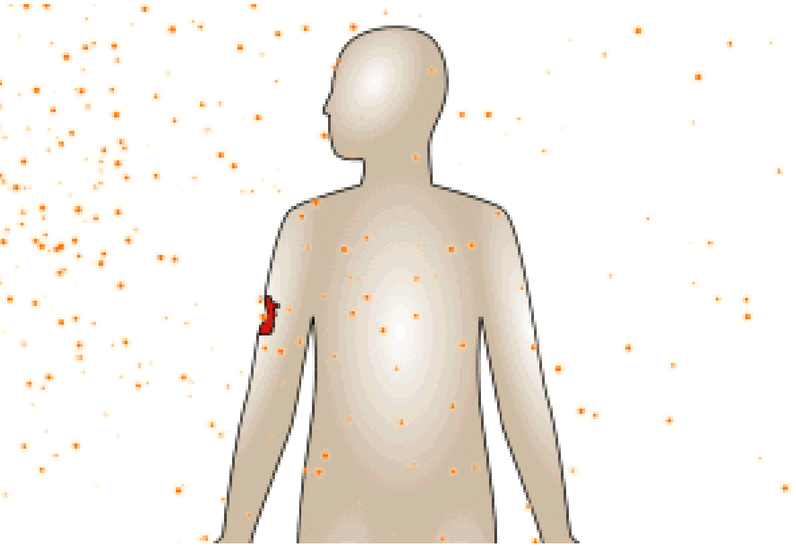


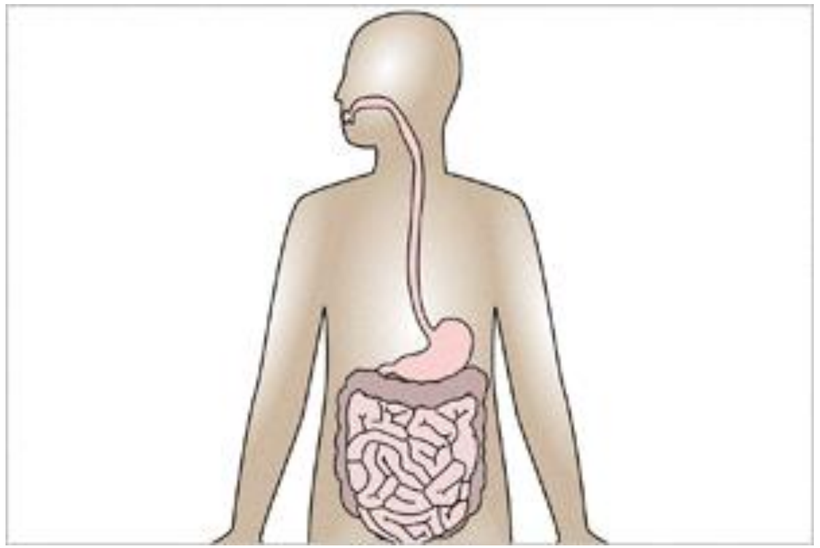
Distance

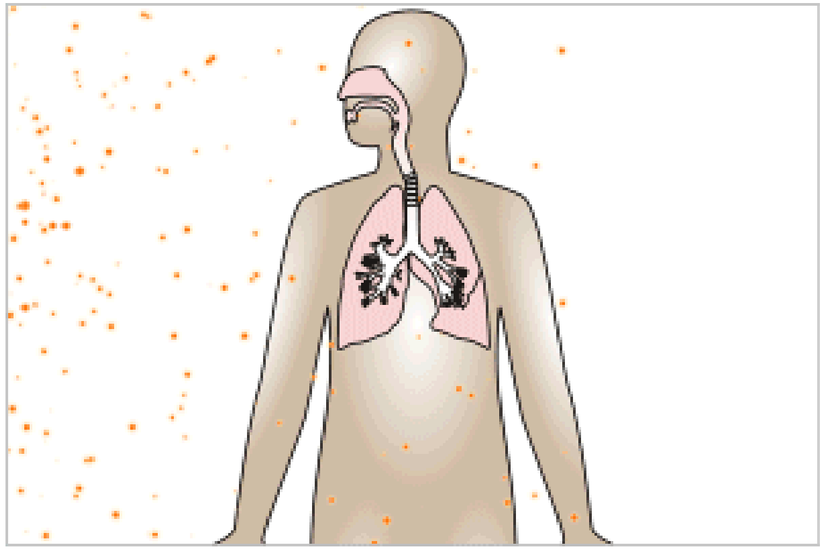
Time

- Radiation protection principles
  - –Time and Distance
  - –Decontamination of patients contaminated with radioactive materials
- Patients can have their body externally contaminated with radioactive material.
  - –`They can also take up this material by inhaling it or ingesting it. If they have an open wound, the material could enter the body that way, as well.

Source REMM







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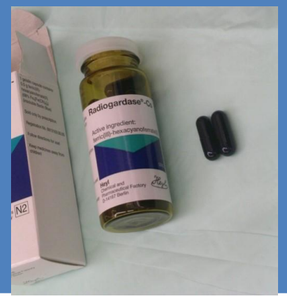
Medical Countermeasures that can potentially decrease risk of health effects after internal contamination

Prussian Blue	Calcium or Zinc DTPA	Potassium Iodide	Sodium Bicarbonate
			
Cesium Thallium	Plutonium Americium Curium	Iodine (within 4-6 hours)	Uranium to prevent chemical toxicity

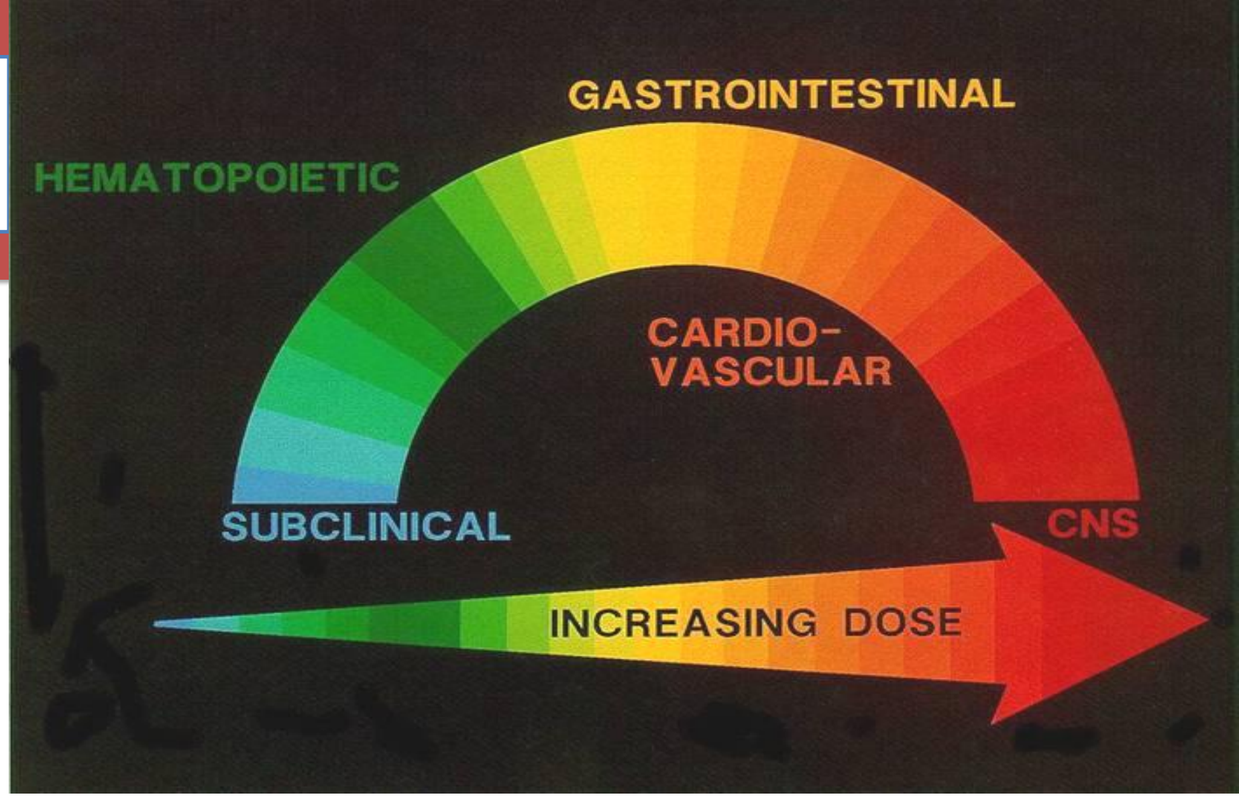
The Rule of 4s:

4 stages

- Prodrome
- Latent
- Manifest
- Recovery or death

4 Conditions

- Exposure to penetrating radiation like gamma rays
- Whole body exposure or near whole body
- Dose ≥ 2 Gray
- Dose received over a short period of time (minutes to few hours)



4 Potential Subsyndromes

- Hematopoietic subsyndrome
- Gastrointestinal subsyndrome
- Cerebrovascular subsyndrome
- Cutaneous subsyndrome

The Bottom Line Upfront

- Patients with ARS develop prodromal symptoms like nausea, vomiting, diarrhea, fever, and fatigue.
- The time to onset and severity of these prodromal signs and symptoms like time to onset of vomiting and diarrhea, can help a clinician estimate the severity of the patient condition.
- The rate of drop of the absolute lymphocyte counts can also be used by the clinician to assess severity and prognosis.
- Newer technologies are being developed to predict the severity of a patient disease.

The Bottom Line Upfront

- Care of ARS is primarily supportive and like the care of a patient who is neutropenic after chemotherapy for cancer.
- Cytokines like filgrastim, pegfilgrastim, sargramostim, and romiplostim can be used to help the bone marrow recover faster, shorten the duration of neutropenia, and decrease the severity of thrombocytopenia, and risk of death.
- Victims with combined injuries or comorbid conditions will have a more severe illness and worse prognosis for survival.

Care for ARS

IVF	Neutropenic Precautions	Blood Products
Nutrition	Antiemetics	Antidiarrheals
Analgesics	Antibacterials	Antivirals Antifungals
Colony Stimulating Factors	Psychological Support	Stem Cell Transplant

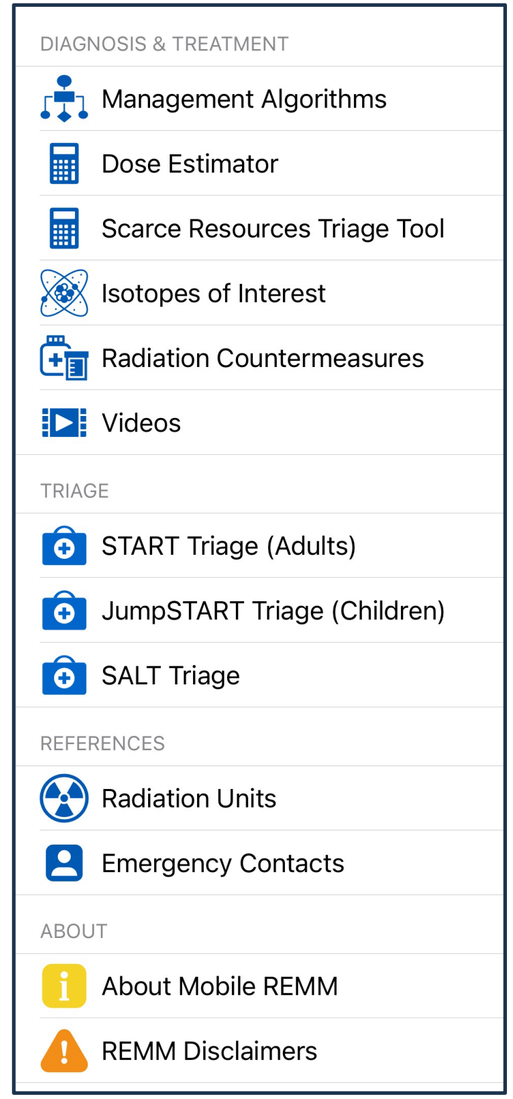
MEDICAL COUNTERMEASURES

Medical Countermeasures

Filgrastim	Sargramostim	Peg-Filgrastim	Romiplostim

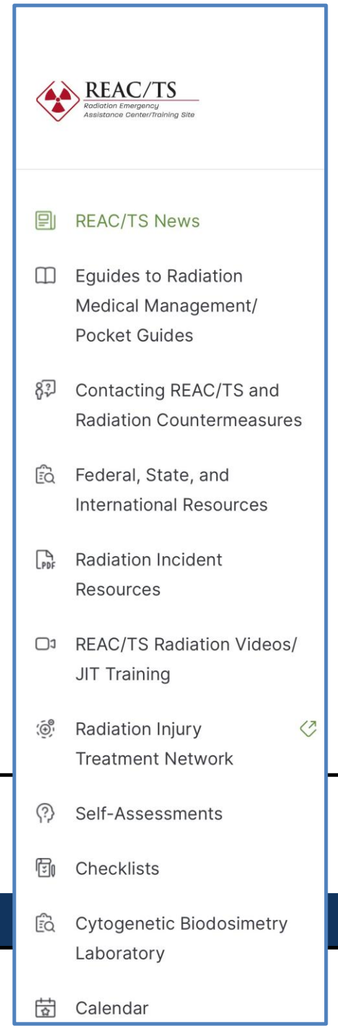
Online Resources

- Radiation Emergency Medical Management
- Centers for Disease Control and Prevention

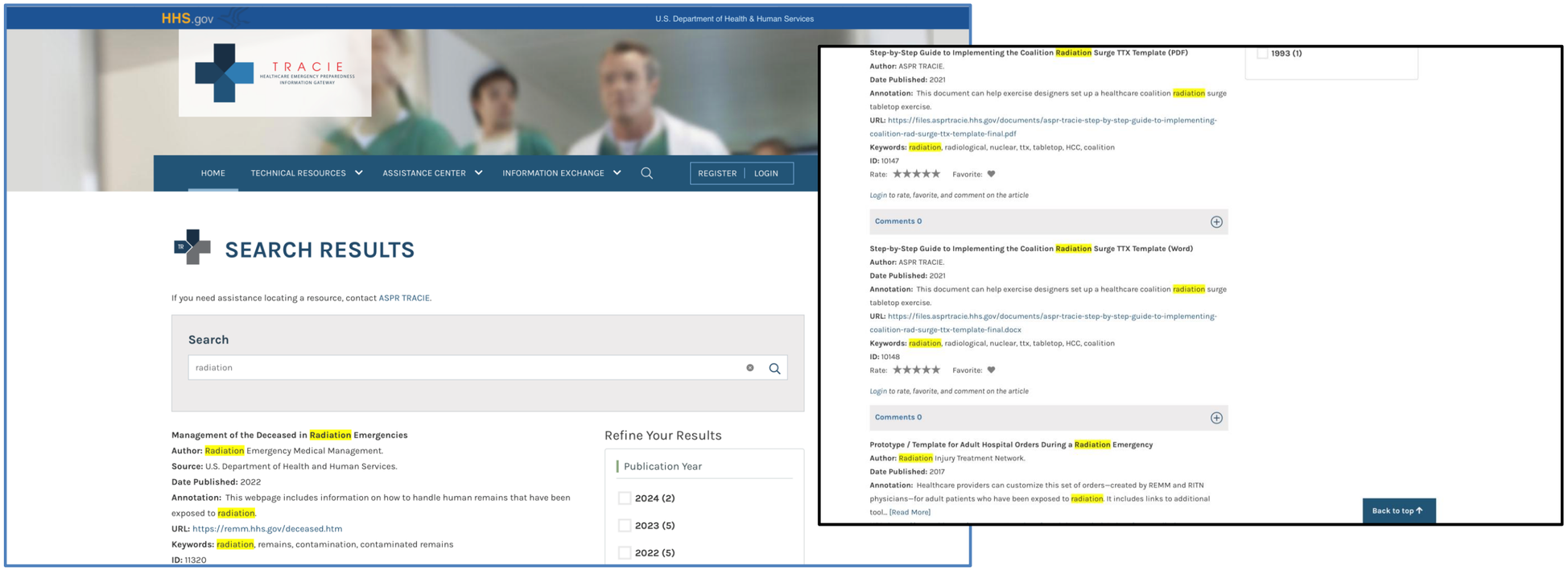


Online Resources

- Radiation Emergency Assistance Center/Training Site (REAC/TS)
- Radiation Injury Treatment Network
- Federal Emergency Management Agency (example guidance)
- World Health Organization



ASPR TRACIE-Radiation Resources



Online Resources

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