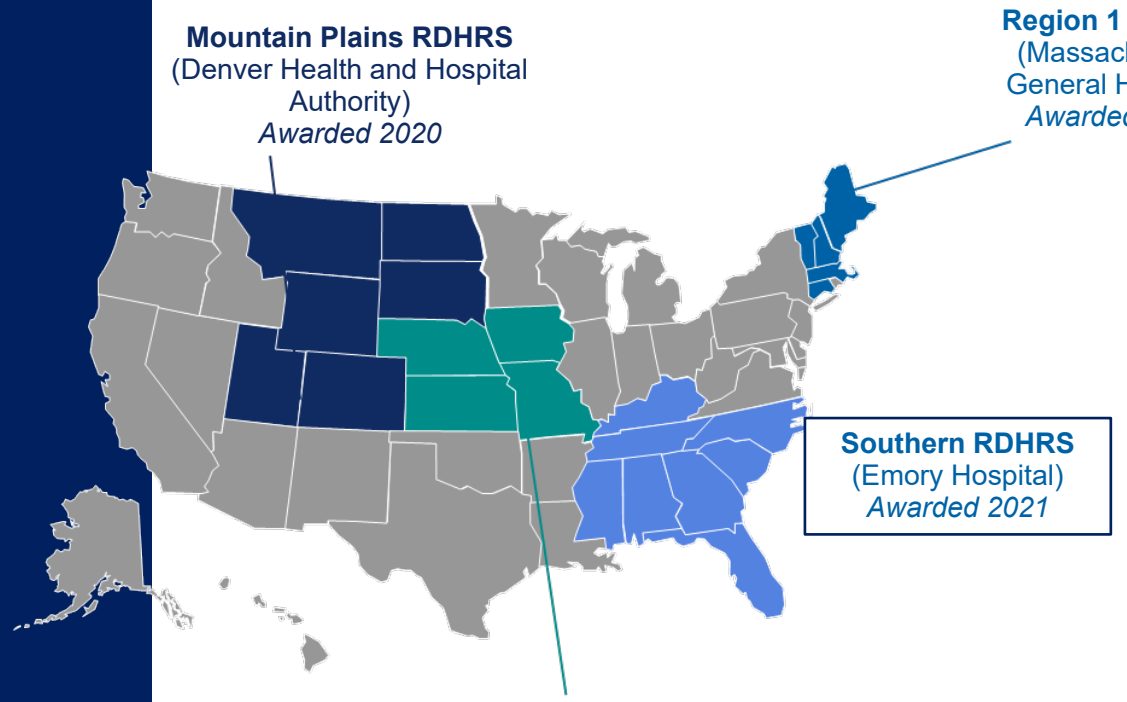
PRACTICAL INFORMATION WHEN WRITING YOUR RADIATION EMERGENCY ANNEX

Southern Regional Disaster Response System

HHS Region 4

INTRODUCTION TO SRDRS

- 4th region funded by HHS/ASPR
- Complement existing preparedness and response frameworks
- Integrating 1) clinical subject matter expertise and 2) health systems' operational expertise into existing preparedness and response structures at the local regional and state level



SRDRS AIMS

Augment

Augment horizontal and vertical integration of key stakeholders

- champion public-private partnerships
- align preparedness and response plans, policies, and procedures

Improve

Improve bidirectional communication and situational awareness

- CBRNE response
- health care organizations and government partners

Facilitate

Facilitate greater access to highly specialized clinical expertise and capabilities to improve medical surge capacity


Who is included in Tier 3?
URGENT CARE
NURSING HOME
ADIA
DPH
DPH

ZIAD KAZZI, MD, FACMT, FAACT, FAAEM, FACEP

- Associate Medical Director, Southern Regional Disaster Response System
- Professor and Director, International Medical Toxicology Fellowship, Emory University
- Assistant Medical Director, Georgia Poison Center
- Director, Grady Occupational and Environmental Toxicology Outpatient Clinic
- Immediate Past-President, MENATOX
- Vice President, ACMT
- Member, National Council on Radiation Protection and Measurements
- Executive Committee Member, Radiation Injury Treatment Network

LORI WOOD, DHA, MBA, MSEM, EMHP

- Executive Director Emergency Management, Grady Health System
- Region D Healthcare Coalition Coordinator
- Executive Committee Member, Southern Regional Disaster Response System

Southern Regional Disaster Response System
HHS Region 4

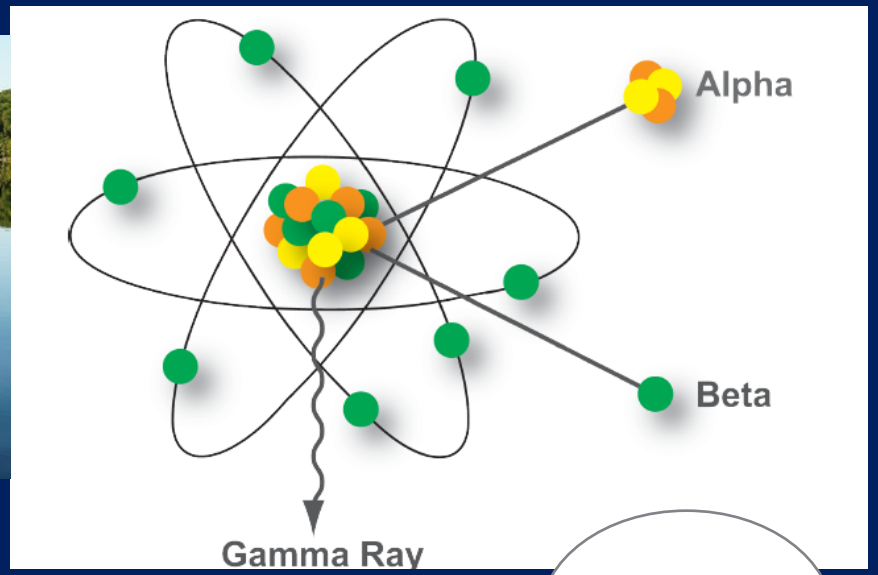
CONFLICT OF INTEREST DISCLOSURE

- No relevant conflicts of interest to disclose

BOTTOM LINE UPFRONT

- Difference between annexes for rad and non-rad events

Ionizing Versus Non-Ionizing



- Possible health outcomes of exposure to ionizing radiation
  - Cell dies
  - Cell repairs itself
  - Cancer risk increases
  - Birth defects

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HHS Region 4

OBJECTIVES

- After participating in this session, you will be able to:
  - List preparedness needs that are particular to a radiological or nuclear emergency
  - Draft your radiation annex with more ease

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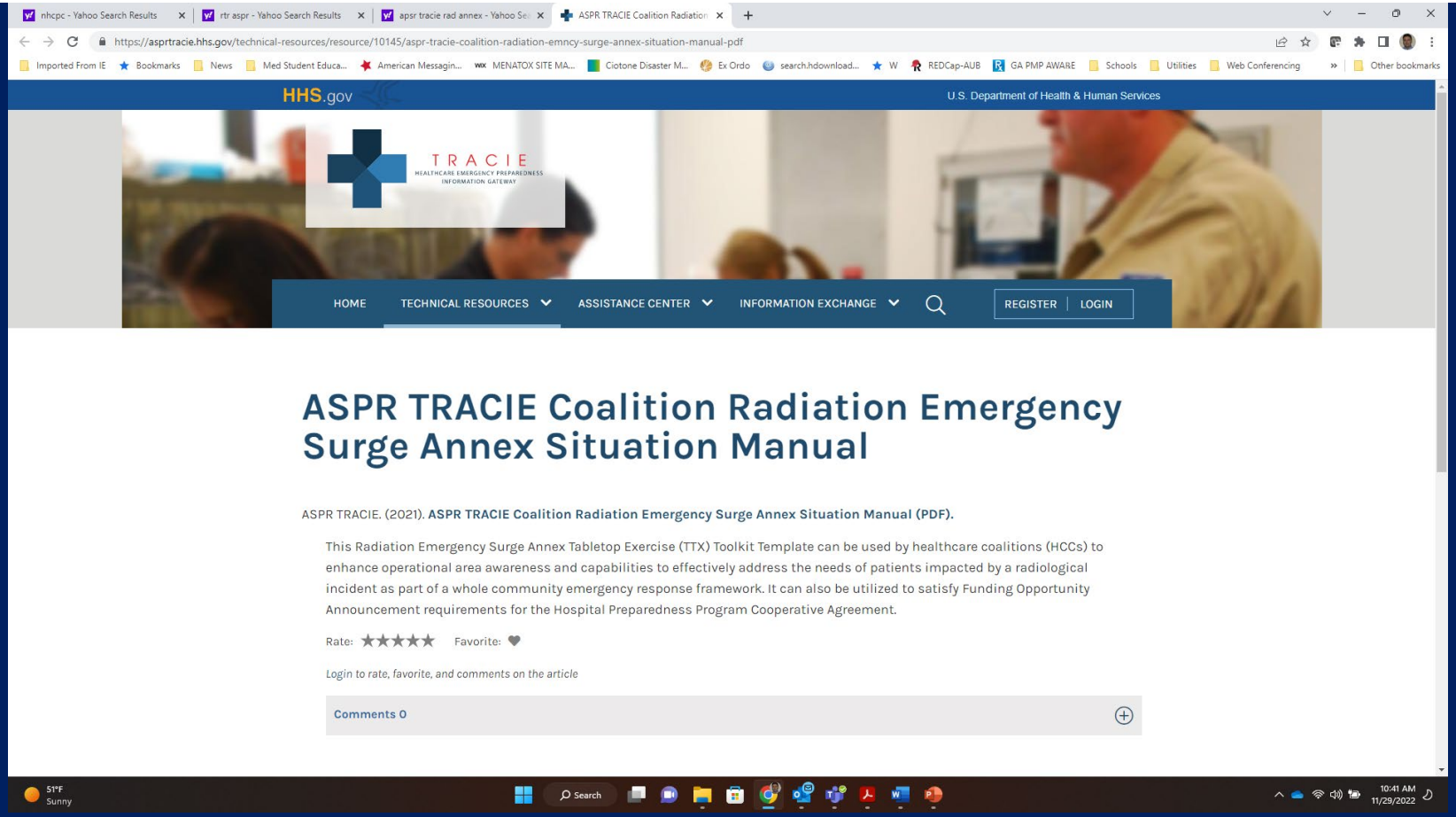
HHS Region 4

EXCELLENT TEMPLATE THAT I FOLLOWED FOR MY PRESENTATION TODAY



LOCAL RISKS OF RADIATION MASS CASUALTY EVENTS

- Risk assessment and Hazard Vulnerability Assessment (HVA)
- Resources gap analysis

POSSIBLE SCENARIOS

- Radiological dispersal device
- Radiation exposure device
- U.S. nuclear facilities
- Research and test reactors
- Lost/found/orphaned radioactive material sources
- Transportation incidents involving radioactive materials
- Domestic nuclear weapons accidents
- International incidents involving nuclear or radioactive material that impact or threaten to impact the United States

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OVERVIEW OF UNIQUE, COMMON MEDICAL AND PUBLIC HEALTH ISSUES RESULTING FROM DIFFERENT RADIATION EMERGENCIES, AND POTENTIAL SCENARIOS

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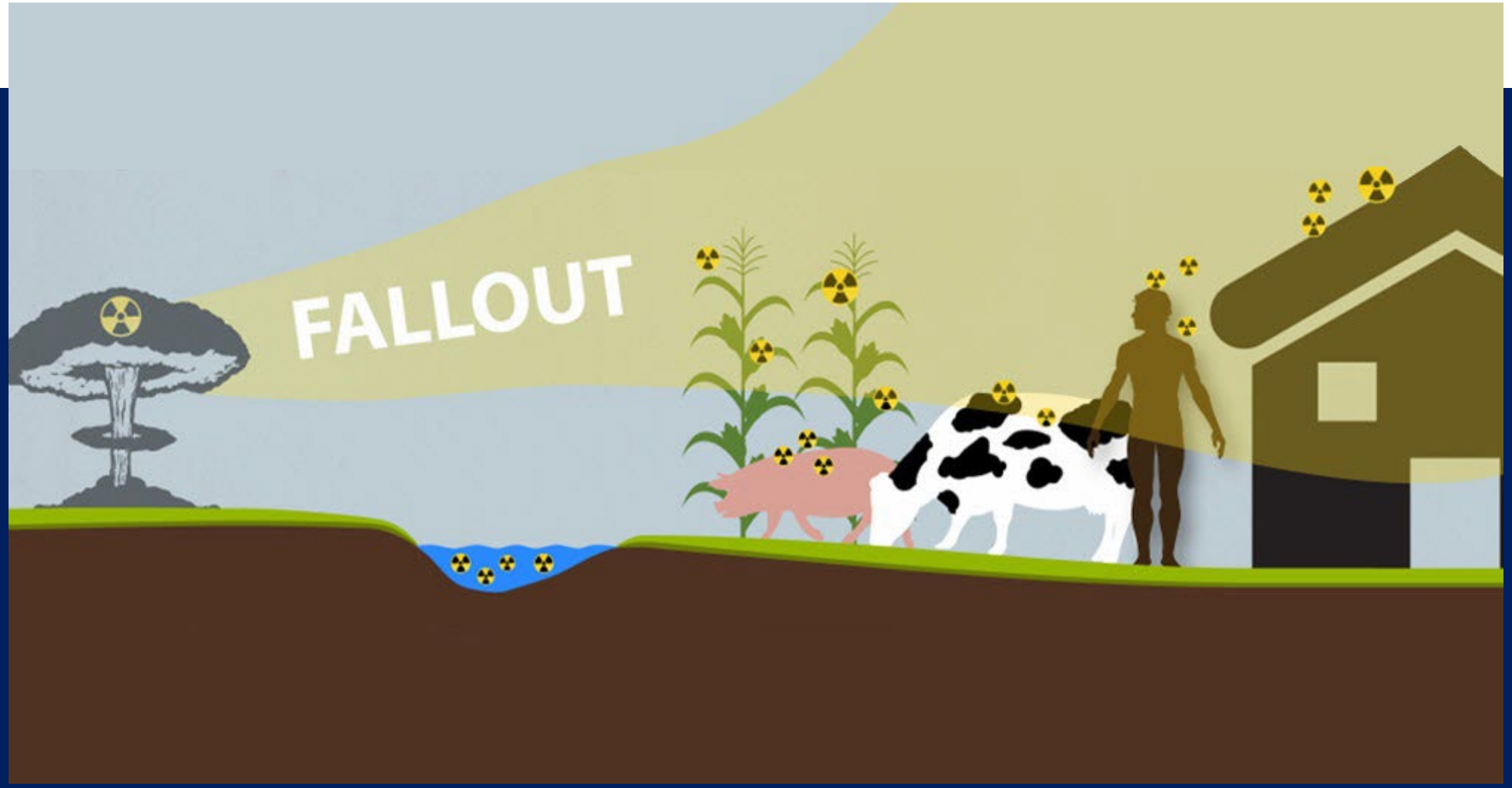
HHS Region 4

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:

IMPORTANT UPDATES

- Includes scenarios of larger weapons delivered by ballistic missiles or planes
  - Air burst versus ground burst

Table 3: Planning Guidance Scenarios

Yield	Height Above Ground
0.1 kT	Ground burst
1.0 kT	Ground burst
10 kT	Ground burst
100 kT	Ground burst
100 kT	Air burst, 1000 ft
100 kT	Air burst, 5000 ft

What are detonation yields?

Even a small nuclear detonation produces an explosion far surpassing that of conventional explosives. It would take 1,000 tons of TNT to release the same energy created by the fission of all the atoms in just 2 ounces of uranium.

The magnitude, or yield, of a nuclear explosion is quantified in terms of the equivalent amount of TNT (a chemical explosive) it would take to create the same energy release. It is usually expressed in the thousands of tons (kT) of TNT. Therefore a 1 kT nuclear device would produce an explosive yield equivalent to 1,000 tons of TNT. For comparison, this is the approximate amount of energy released in the 2020 Beirut ammonium nitrate port explosion (Rigby, 2020).

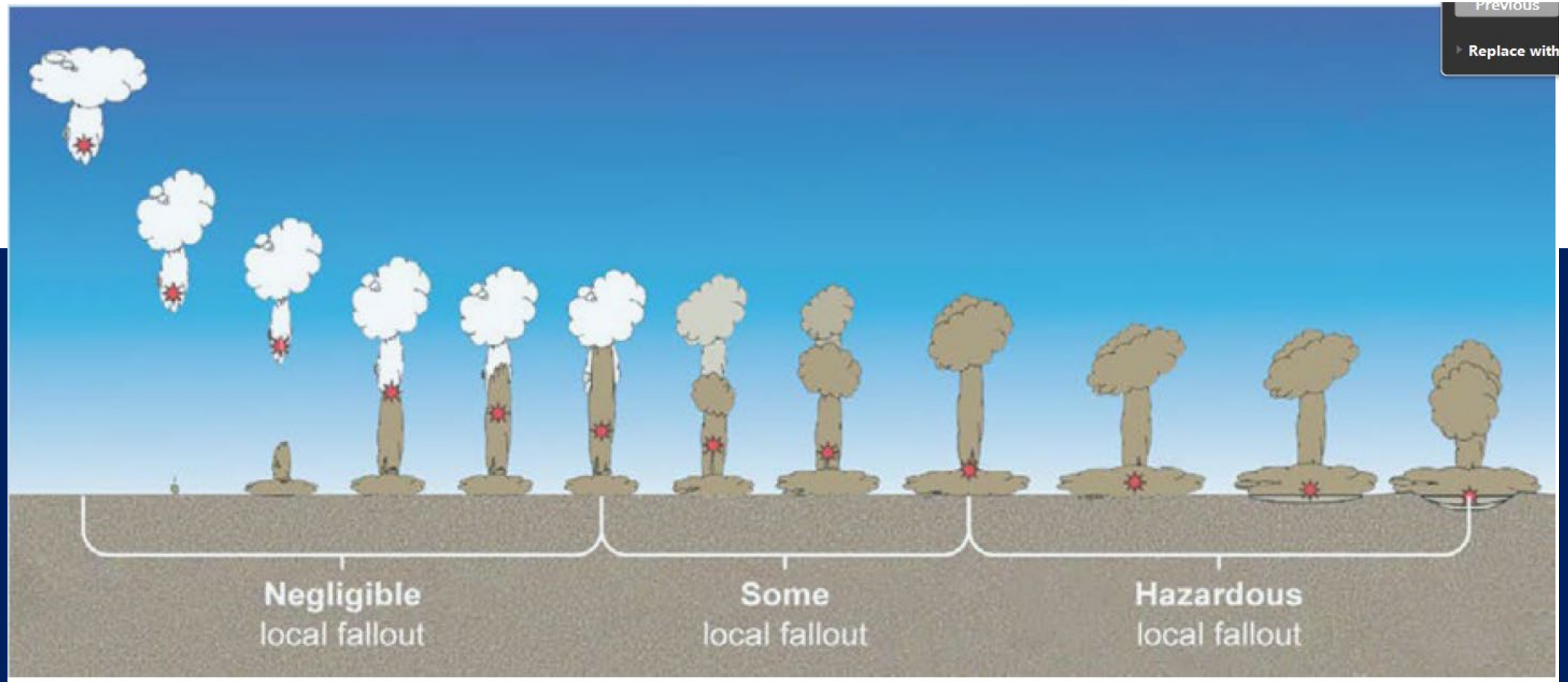
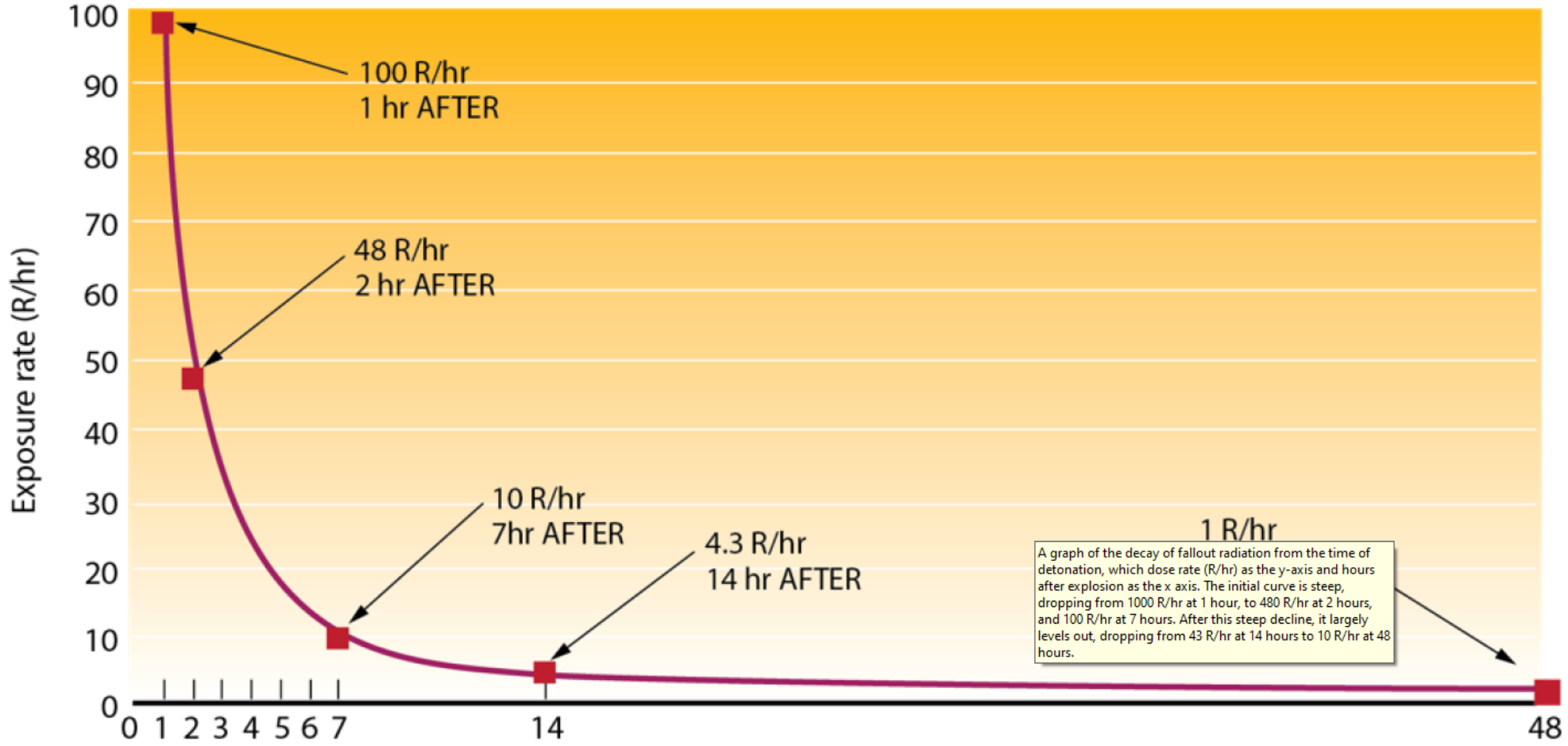


Figure 12: Examples of cloud shapes and shading for various heights of burst. Color of cloud indicates the amount of environmental materials, like dirt, in the cloud; brown clouds have the most materials and white clouds have the least (derived from Spriggs et al., 2020).



Decay of the dose rate of radiation from fallout, from the time of the explosion, not from the time of fallout deposition.

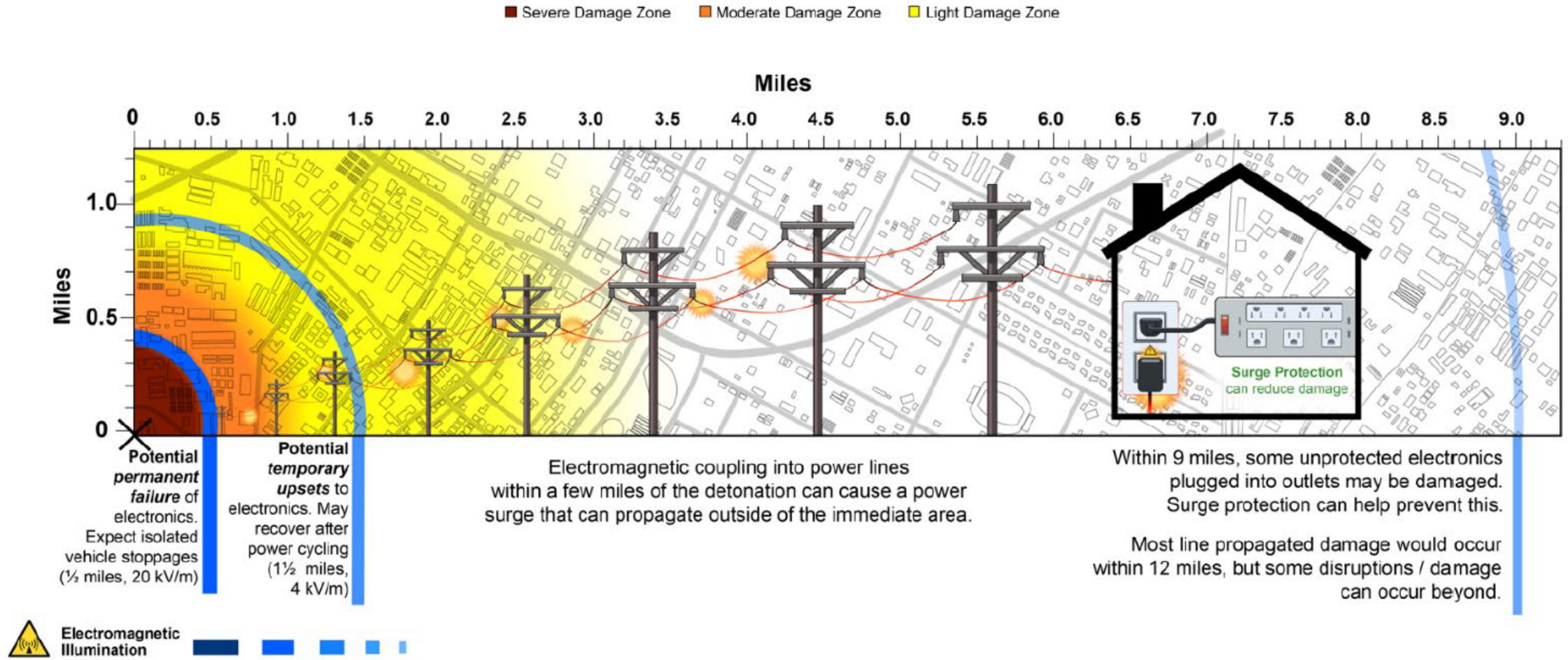
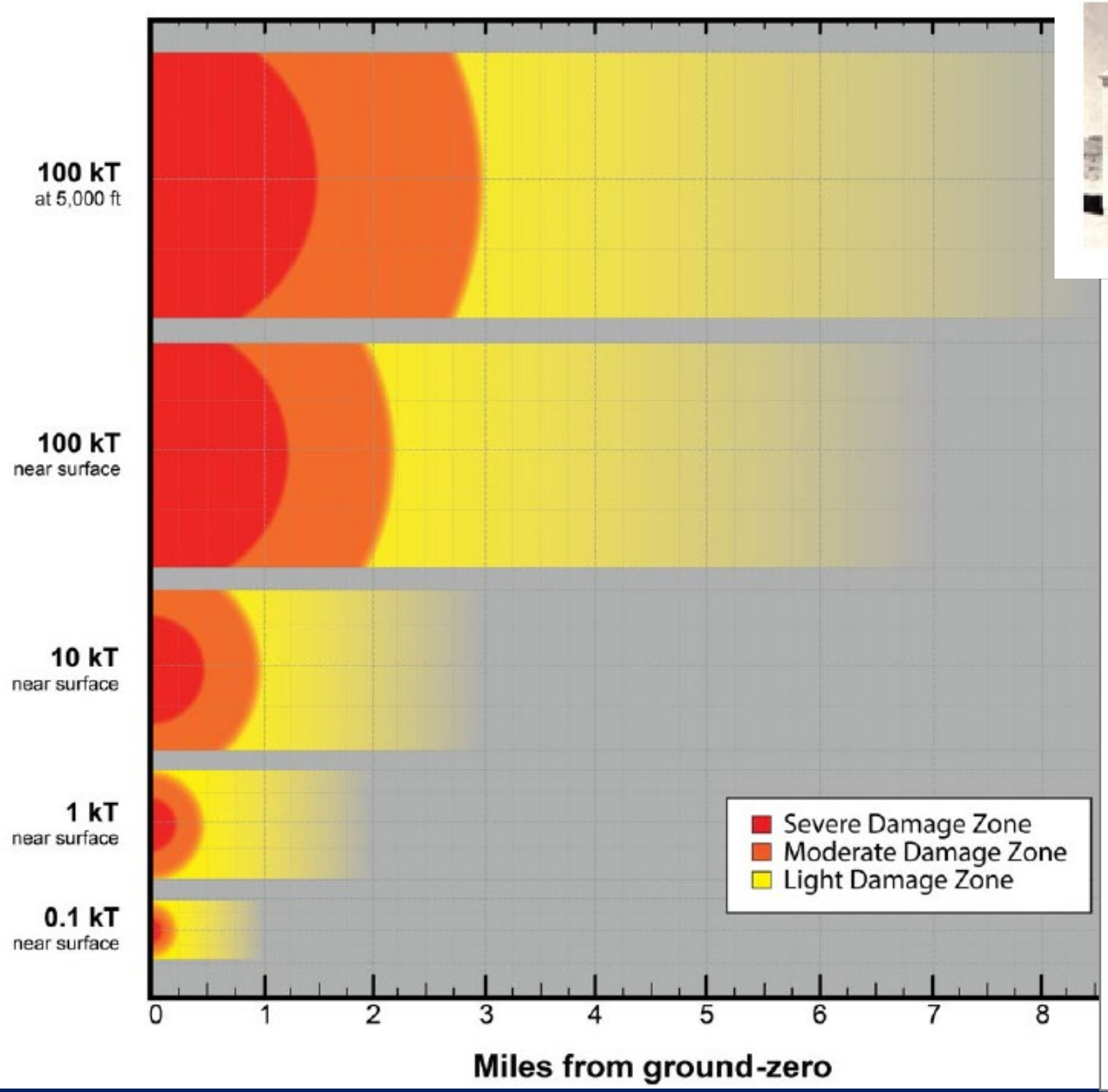
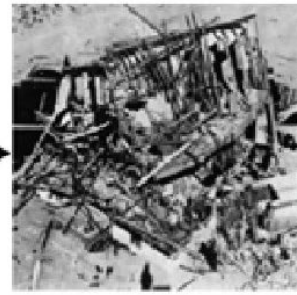


Figure 17: Source Region EMP (SREMP) Illumination Range and Power Grid Coupling Disruptions

EMP from a low-altitude[17] detonation differs from high-altitude[18] EMP (HEMP) (these differences are described in Appendix 1.1). EMP from a low-altitude detonation is generally limited to a Source Region EMP (SREMP).



Blast wave destroys
wood frame house
0.6 miles (1 km)
from a 16 kT explosion



Theoretical damage zones shown side by side, comparing projected zones for 100 kT air detonations and for 100, 10, 1, and 0.1 kT near-surface detonations.

For every factor of ten yield increase, the effect ranges typically only increase by a factor of two. For example, the MDZ for 0.1, 1, 10, and 100 kT near-surface detonations extend out a ¼ mile, ½ mile, 1 mile, and 2 ¼ miles, respectively.

FLASH BURNS ACCOUNTED FOR THE OVERWHELMING MAJORITY OF BURNS SUSTAINED AMONG SURVIVORS OF HIROSHIMA AND NAGASAKI; 83–91% WERE DUE TO FLASH ALONE, 6–15% WERE BOTH FLASH AND FLAME, AND 2–3% WERE FLAME ALONE (LEBOW ET AL., 1981).

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

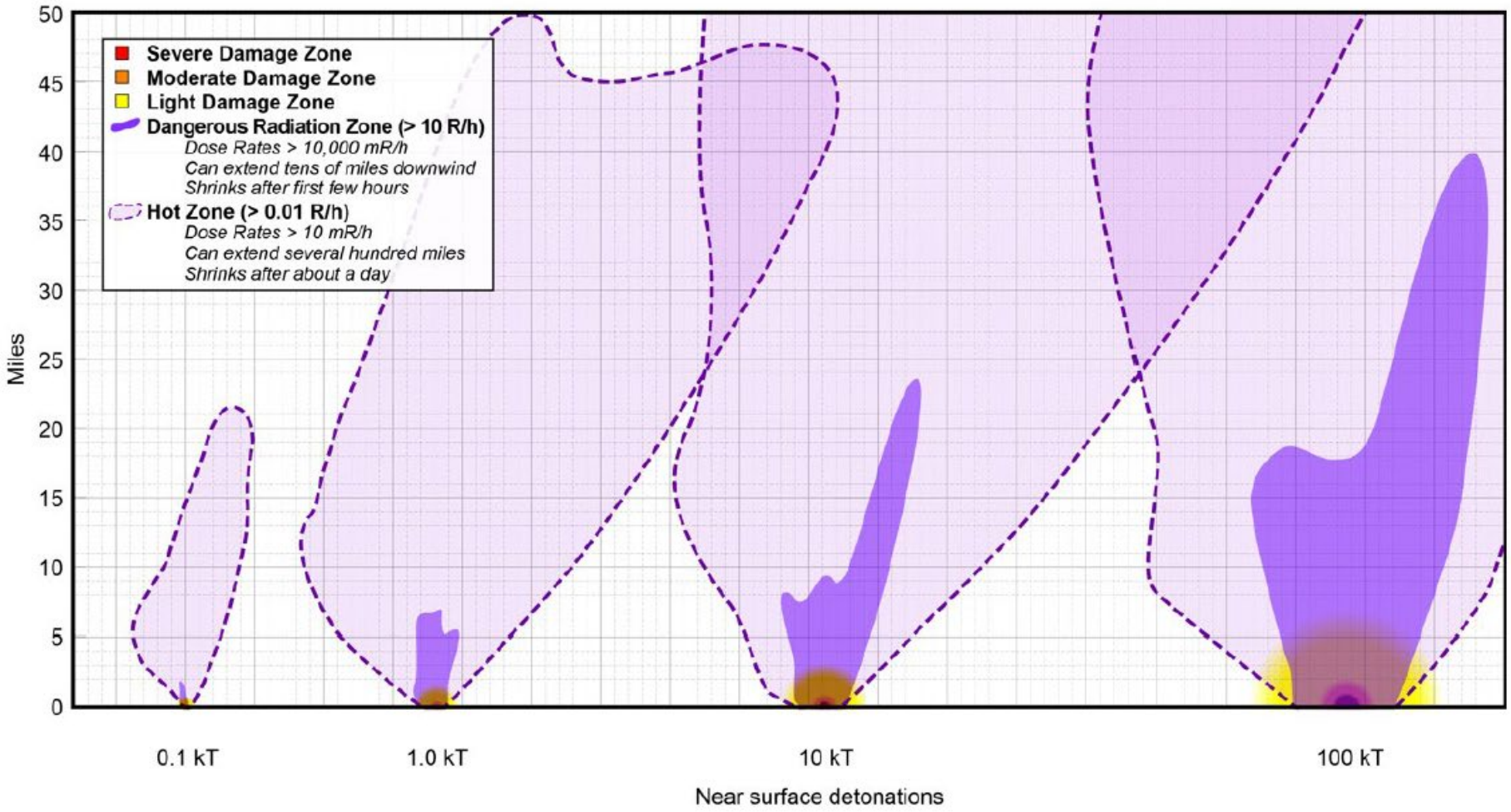


Figure 15: Illustrations of Response Zones for a Variety of Yields

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.

PROTECTIVE MEASURES IMMEDIATELY POST DETONATION

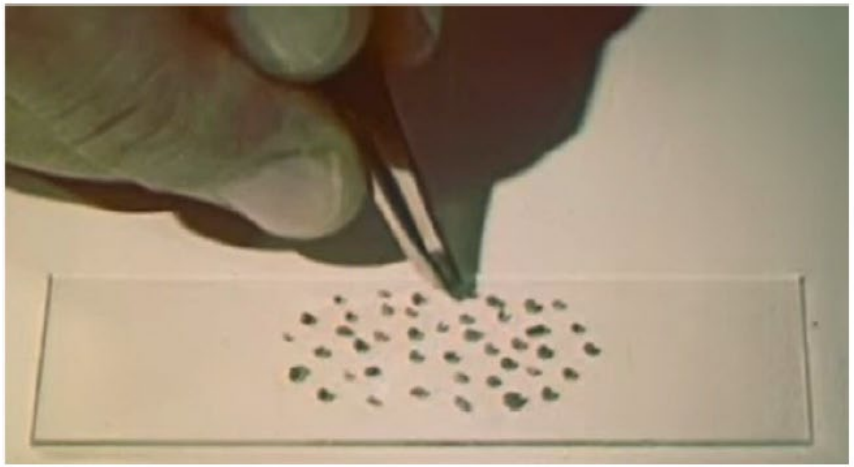


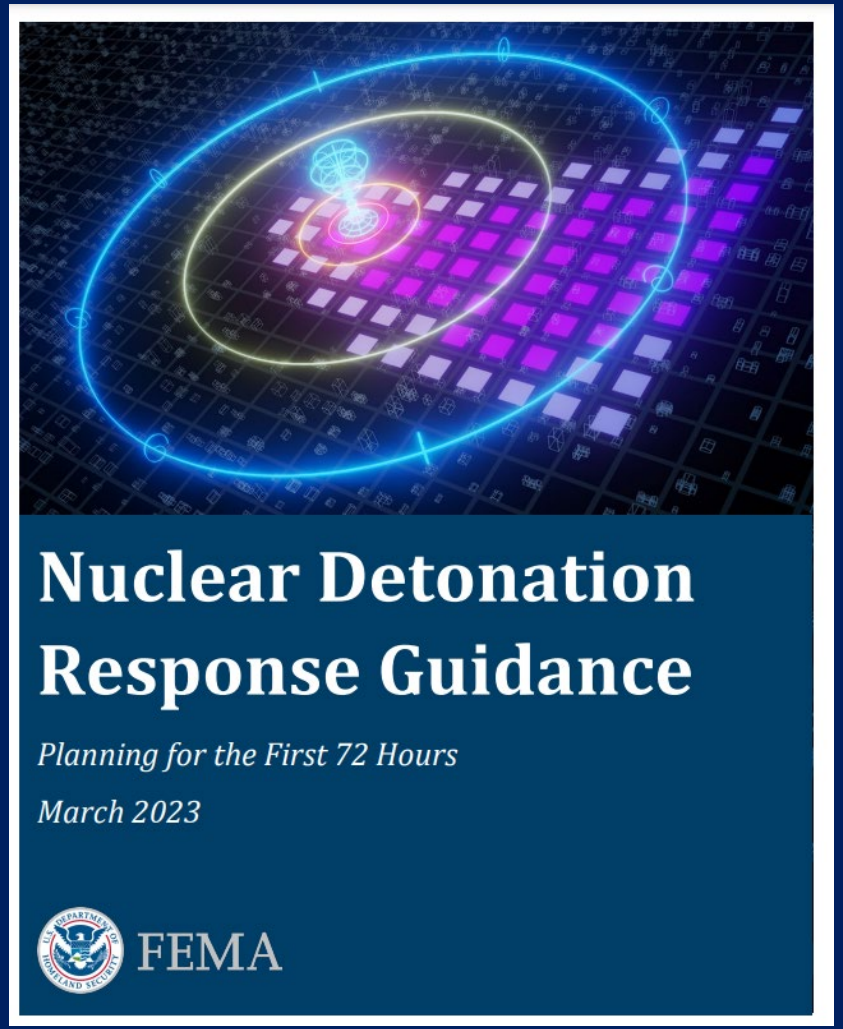
Figure 10: Fallout Particles from Near-Surface Nuclear Tests

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.

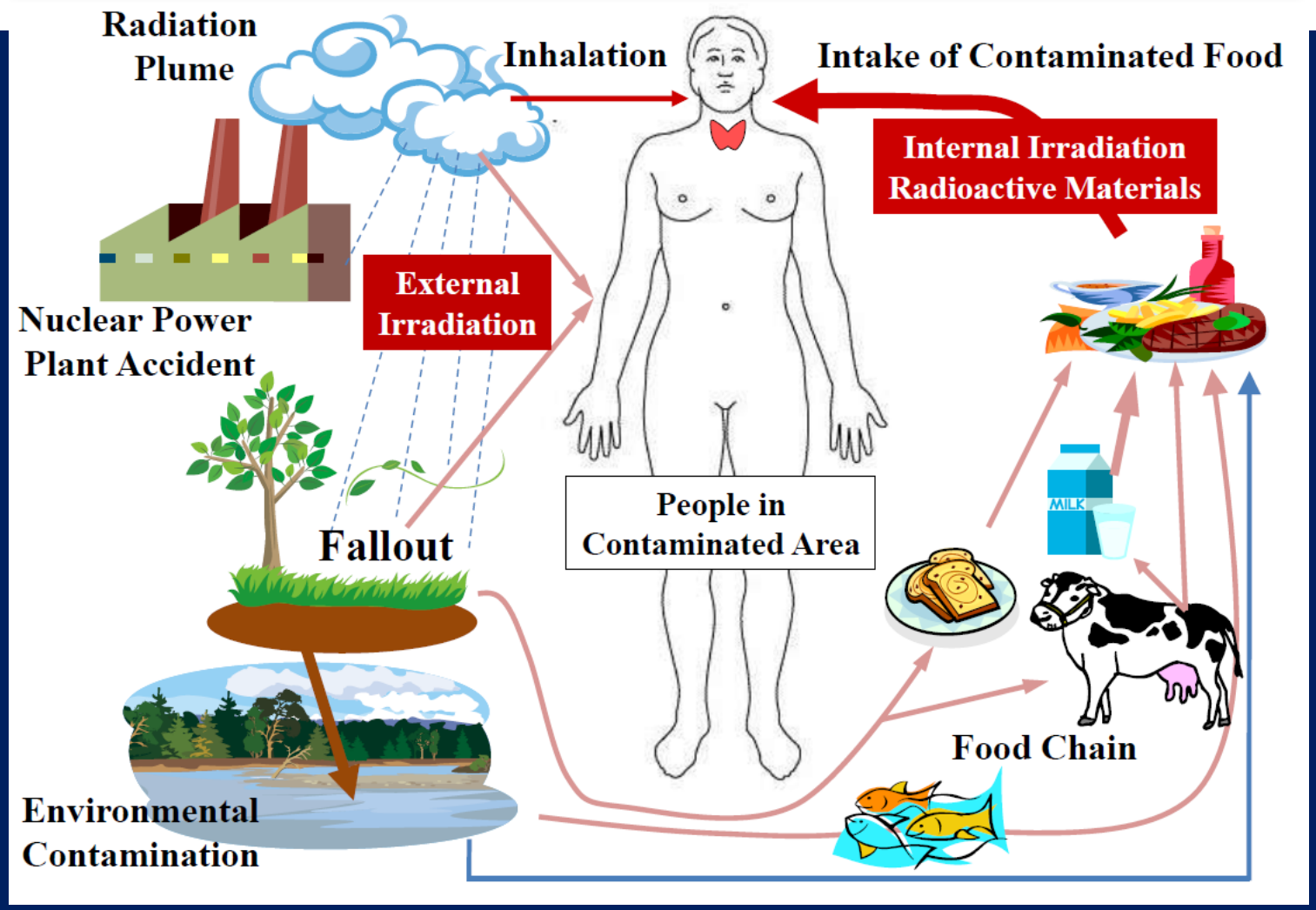
ADDITIONAL ASSUMPTIONS

- Emergency response is principally a local function
  - No significant federal on-scene response is assumed for 24–72 hours.
- Acute radiation exposure dose is primarily from exposure to the immediate radiation and that emitted from fallout
  - Not from internal contamination with radioactive material due to size of the particle
    - The size may decrease in locations distant form ground zero

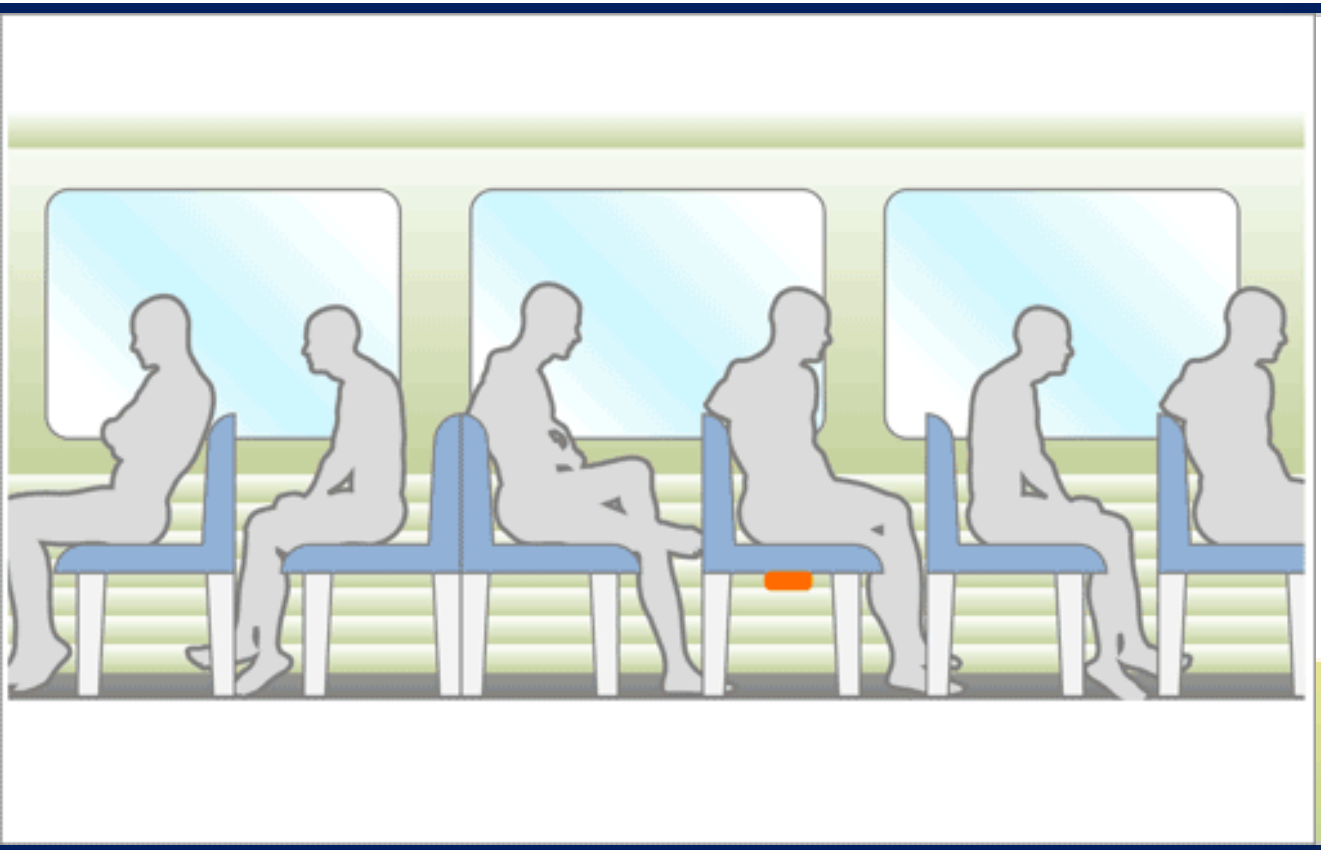
HOT OFF THE PRESS: NUCLEAR DETONATION RESPONSE GUIDANCE PLANNING FOR THE FIRST 72 HOURS (2023)



NUCLEAR POWER PLANT EMERGENCY



RADIOLOGICAL EXPOSURE DEVICE: EXPOSURE TO RADIATION WITHOUT CONTAMINATION



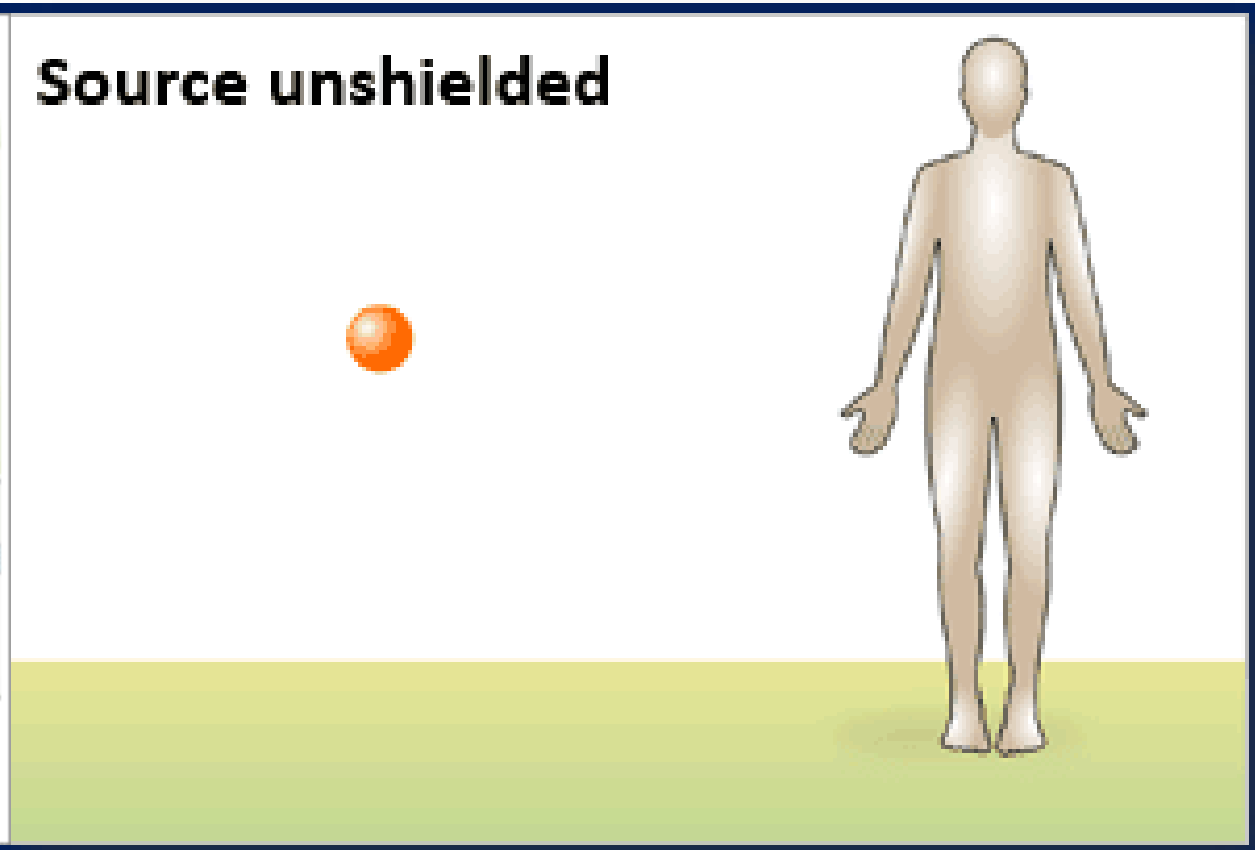


Image Source: REMM https://www.remm.nlm.gov/exposureimage.htm accessed 12/2/2016

RADIOACTIVE DISPERSAL DEVICE: EXTERNAL WITH RADIOACTIVE MATERIAL

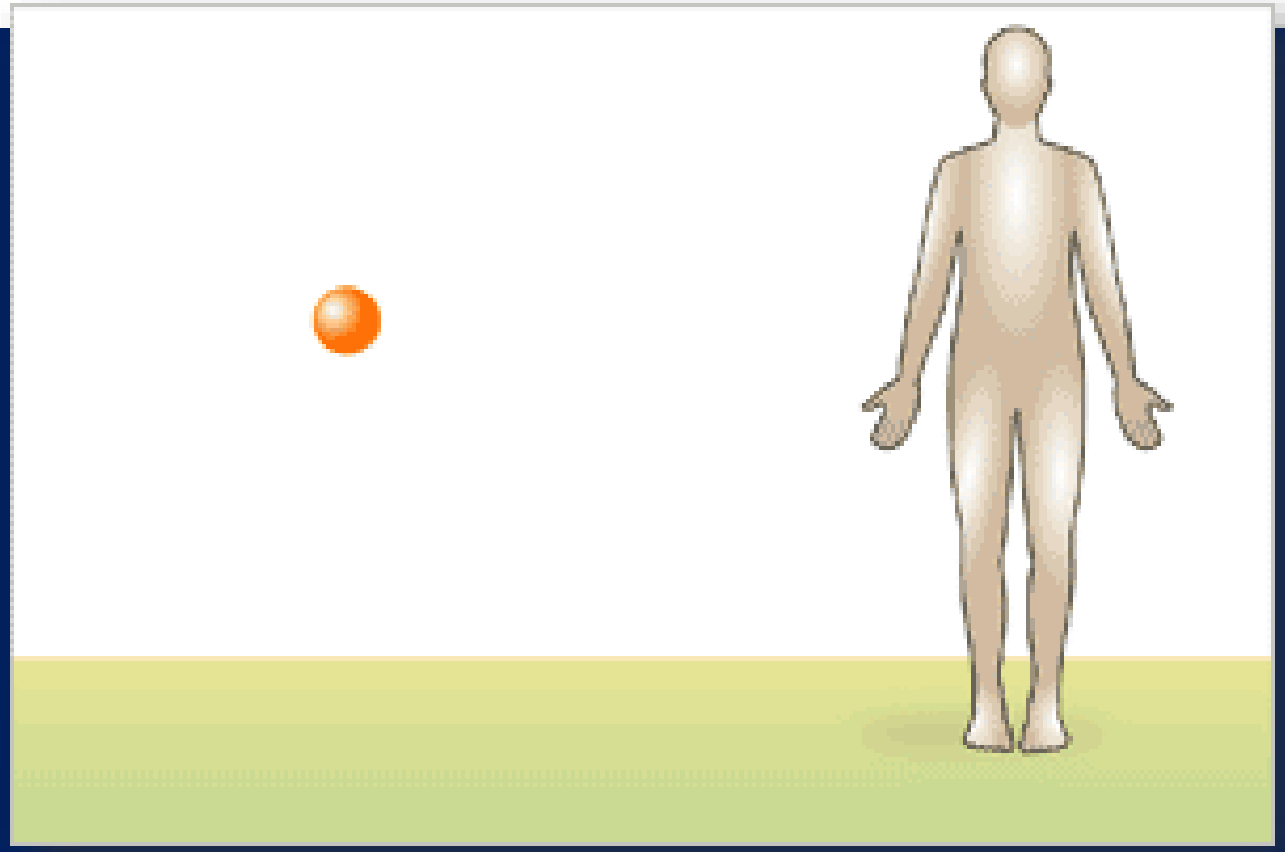


Image Source: REMM
https://www.remm.nlm.gov/contamimage_top2.htm
Accessed 12/2/2016

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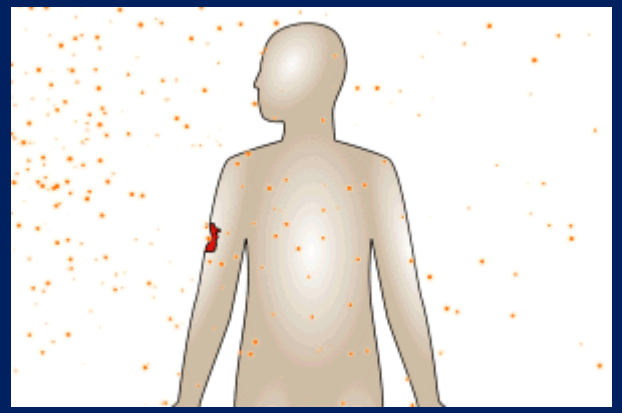
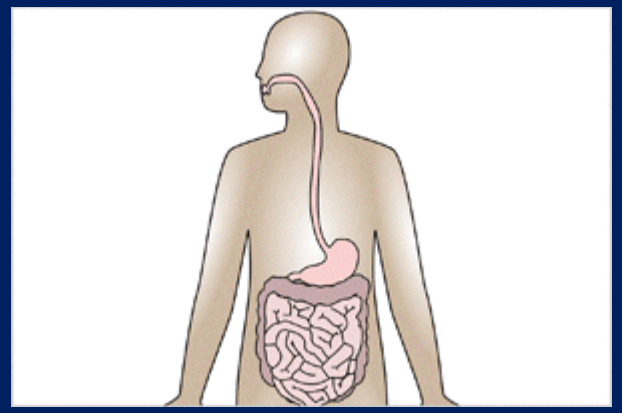
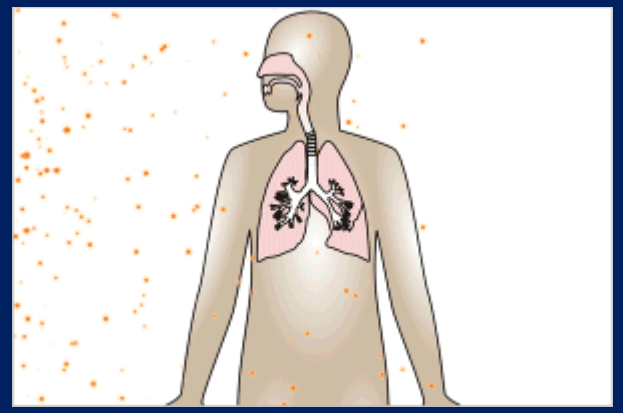
HHS Region 4

INTERNAL CONTAMINATION WITH RADIOACTIVE MATERIAL







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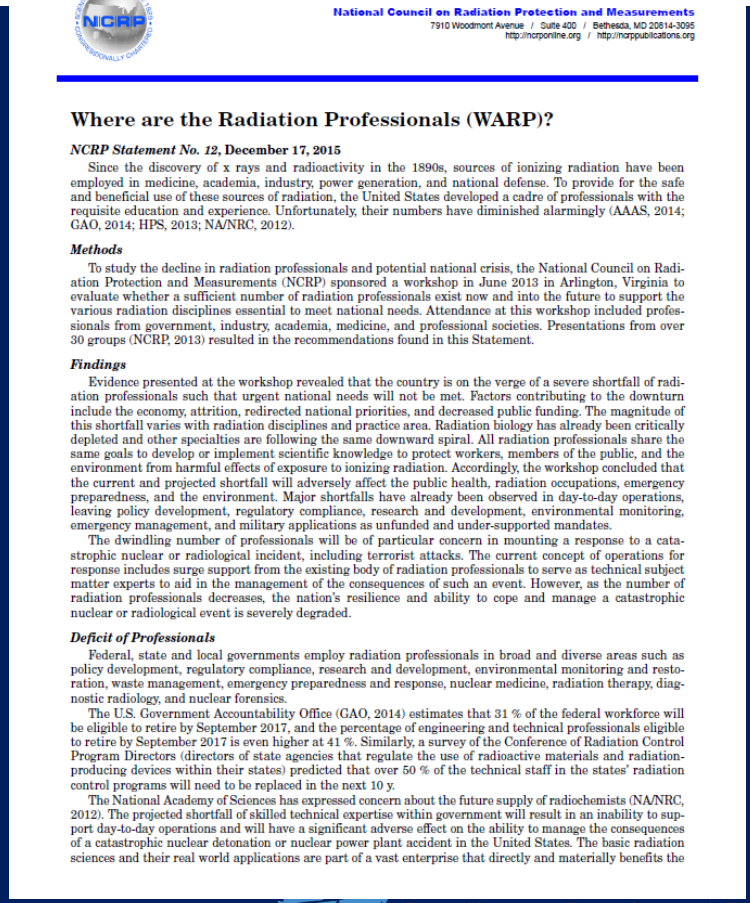
HHS Region 4

WHERE/WHO ARE THE RADIATION PROFESSIONALS?

- Local/Regional/National/International
  - Radiation Control Program Director at the State Level
  - National resources
    - Conference of Radiation Control Program Directors (CRCPD)
    - Health Physics Society
  - National Council on Radiation Protection and Measurements
  - Nuclear Medicine Technologists, Medical Physicists, Nuclear Engineers
- Civil Support Teams



National Council on Radiation Protection and Measurements
7910 Woodmont Avenue / Suite 400 / Bethesda, MD 20814-3095
http://ncrponline.org / http://ncrppublications.org

Where are the Radiation Professionals (WARP)?

***NCRP Statement No. 12*, December 17, 2015**

Since the discovery of x rays and radioactivity in the 1890s, sources of ionizing radiation have been employed in medicine, academia, industry, power generation, and national defense. To provide for the safe and beneficial use of these sources of radiation, the United States developed a cadre of professionals with the requisite education and experience. Unfortunately, their numbers have diminished alarmingly (AAAS, 2014; GAO, 2014; HPS, 2013; NA/NRC, 2012).

Methods

To study the decline in radiation professionals and potential national crisis, the National Council on Radiation Protection and Measurements (NCRP) sponsored a workshop in June 2013 in Arlington, Virginia to evaluate whether a sufficient number of radiation professionals exist now and into the future to support the various radiation disciplines essential to meet national needs. Attendance at this workshop included professionals from government, industry, academia, medicine, and professional societies. Presentations from over 30 groups (NCRP, 2013) resulted in the recommendations found in this Statement.

Findings

Evidence presented at the workshop revealed that the country is on the verge of a severe shortfall of radiation professionals such that urgent national needs will not be met. Factors contributing to the downturn include the economy, attrition, redirected national priorities, and decreased public funding. The magnitude of this shortfall varies with radiation disciplines and practice area. Radiation biology has already been critically depleted and other specialties are following the same downward spiral. All radiation professionals share the same goals to develop or implement scientific knowledge to protect workers, members of the public, and the environment from harmful effects of exposure to ionizing radiation. Accordingly, the workshop concluded that the current and projected shortfall will adversely affect the public health, radiation occupations, emergency preparedness, and the environment. Major shortfalls have already been observed in day-to-day operations, leaving policy development, regulatory compliance, research and development, environmental monitoring, emergency management, and military applications as unfunded and under-supported mandates.

The dwindling number of professionals will be of particular concern in mounting a response to a catastrophic nuclear or radiological incident, including terrorist attacks. The current concept of operations for response includes surge support from the existing body of radiation professionals to serve as technical subject matter experts to aid in the management of the consequences of such an event. However, as the number of radiation professionals decreases, the nation's resilience and ability to cope and manage a catastrophic nuclear or radiological event is severely degraded.

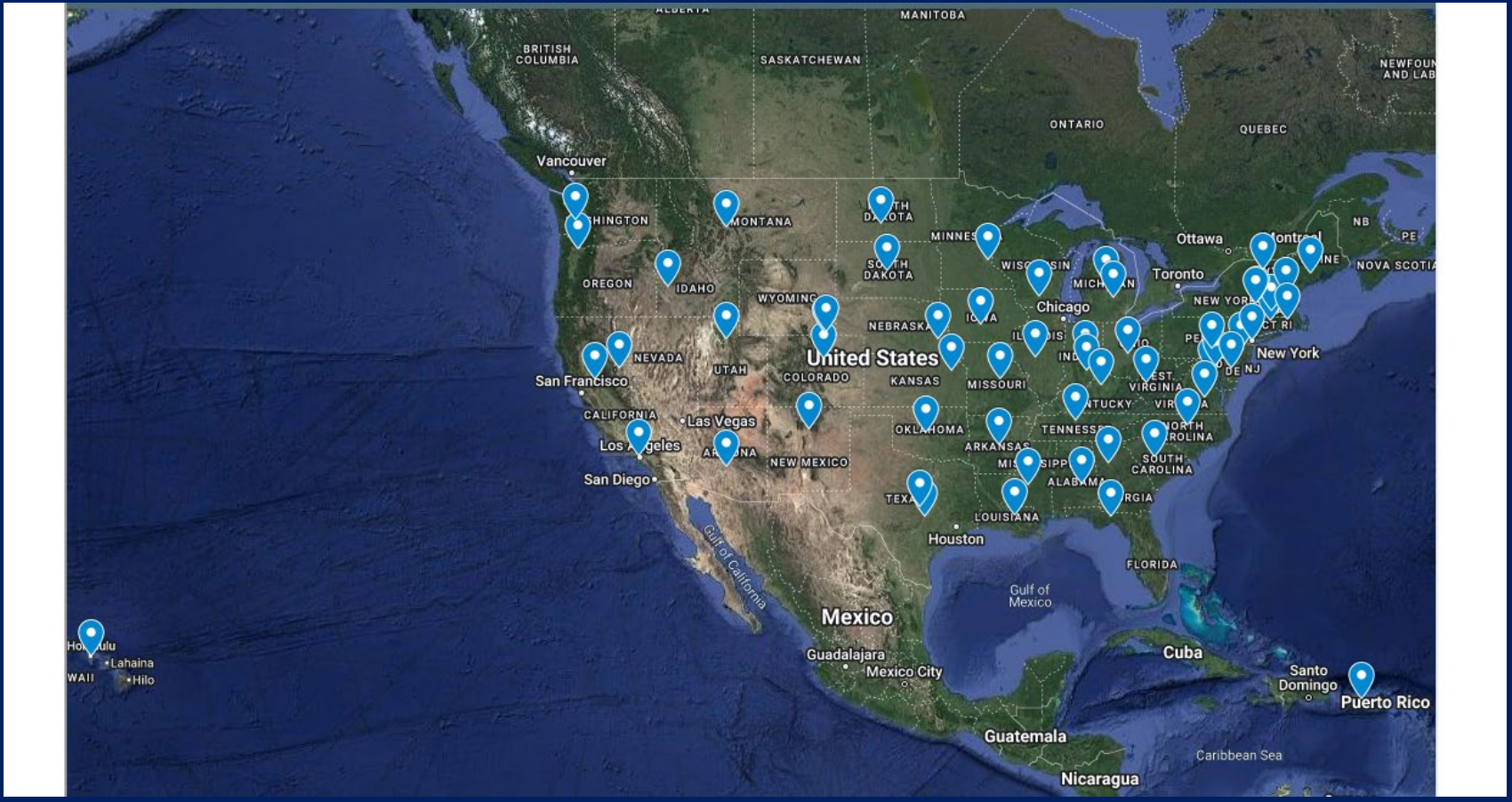
Deficit of Professionals

Federal, state and local governments employ radiation professionals in broad and diverse areas such as policy development, regulatory compliance, research and development, environmental monitoring and restoration, waste management, emergency preparedness and response, nuclear medicine, radiation therapy, diagnostic radiology, and nuclear forensics.

The U.S. Government Accountability Office (GAO, 2014) estimates that 31 % of the federal workforce will be eligible to retire by September 2017, and the percentage of engineering and technical professionals eligible to retire by September 2017 is even higher at 41 %. Similarly, a survey of the Conference of Radiation Control Program Directors (directors of state agencies that regulate the use of radioactive materials and radiation-producing devices within their states) predicted that over 50 % of the technical staff in the states' radiation control programs will need to be replaced in the next 10 y.

The National Academy of Sciences has expressed concern about the future supply of radiochemists (NA/NRC, 2012). The projected shortfall of skilled technical expertise within government will result in an inability to support day-to-day operations and will have a significant adverse effect on the ability to manage the consequences of a catastrophic nuclear detonation or nuclear power plant accident in the United States. The basic radiation sciences and their real world applications are part of a vast enterprise that directly and materially benefits the

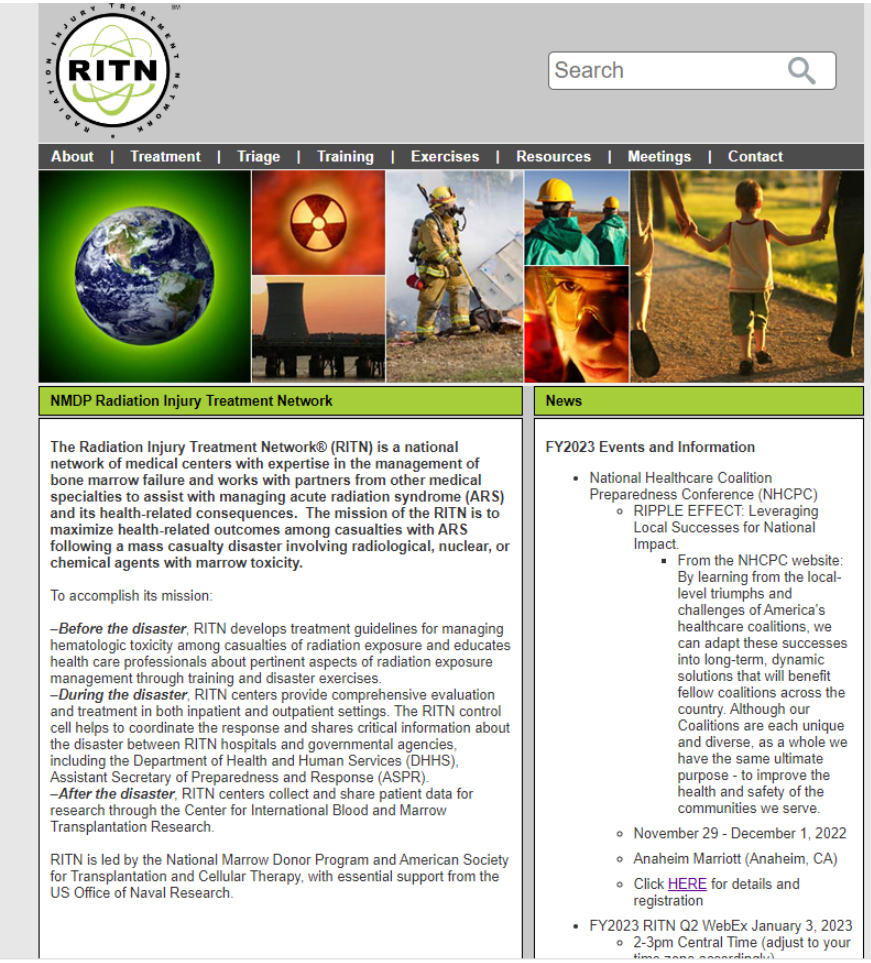
LOCAL/REGIONAL/NATIONAL/INTERNATIONAL RADIATION CONTROL PROGRAM DIRECTOR AT THE STATE LEVEL

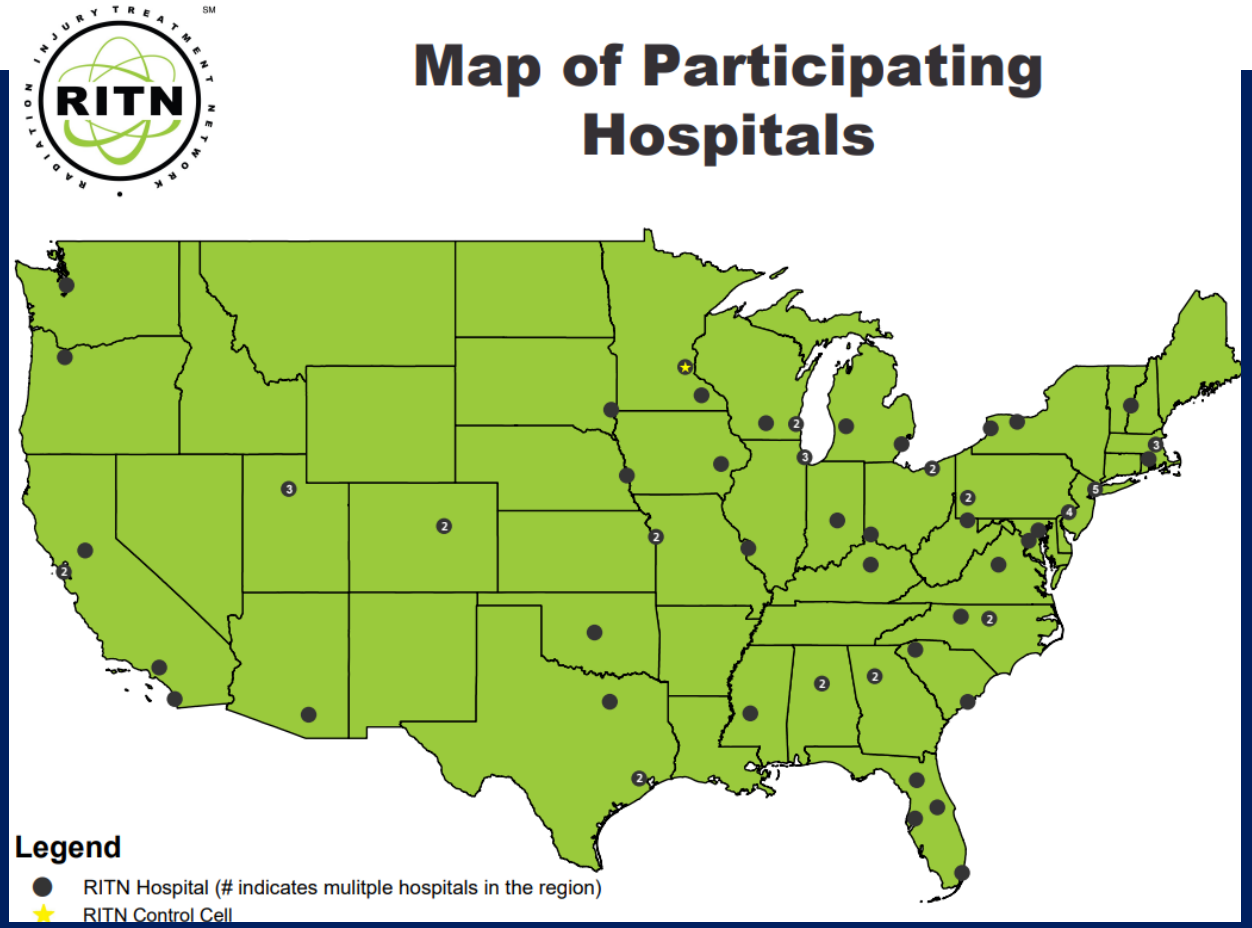


WHERE/WHO ARE THE RADIATION PROFESSIONALS?

- Specialized care at RITN centers: what do they do and how do you contact them?
- Poison Centers
  - America's Poison Centers
- Medical Toxicologists
  - American College of Medical Toxicology (ACMT)
  - American Academy of Clinical Toxicology (AACT)
- Radiation Oncologists, Hematology-Oncology Specialists, Radiologists

RADIATION INJURY TREATMENT NETWORK (RITN)

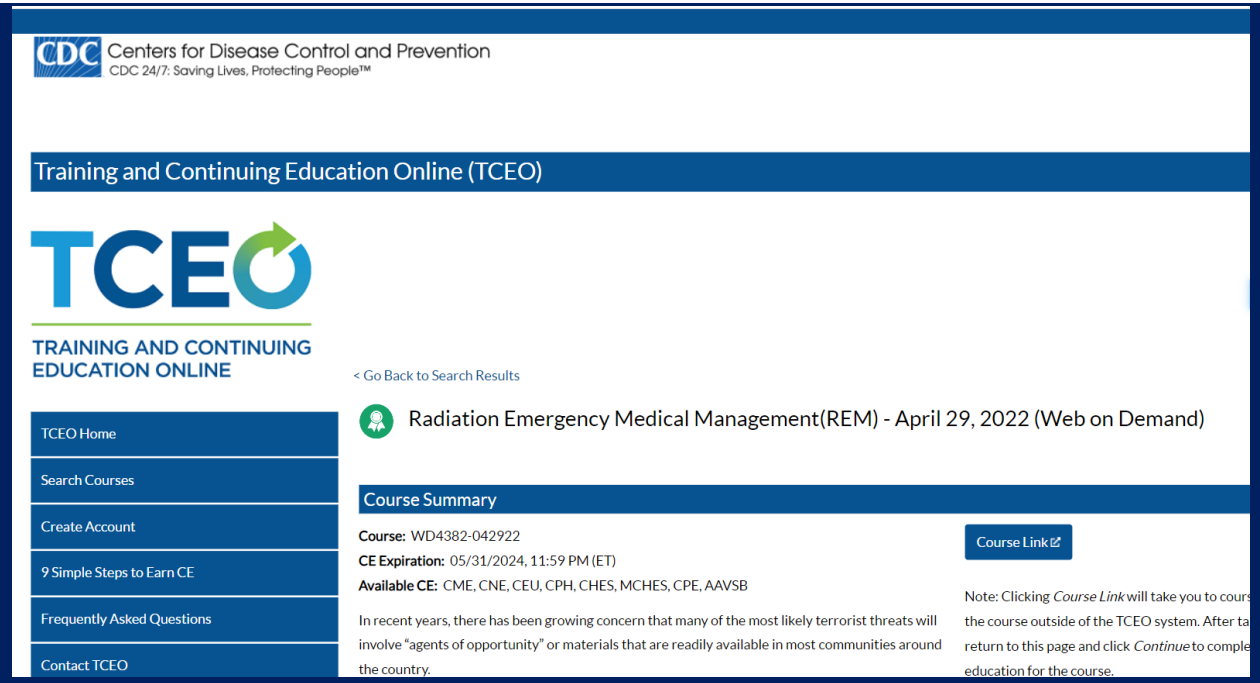




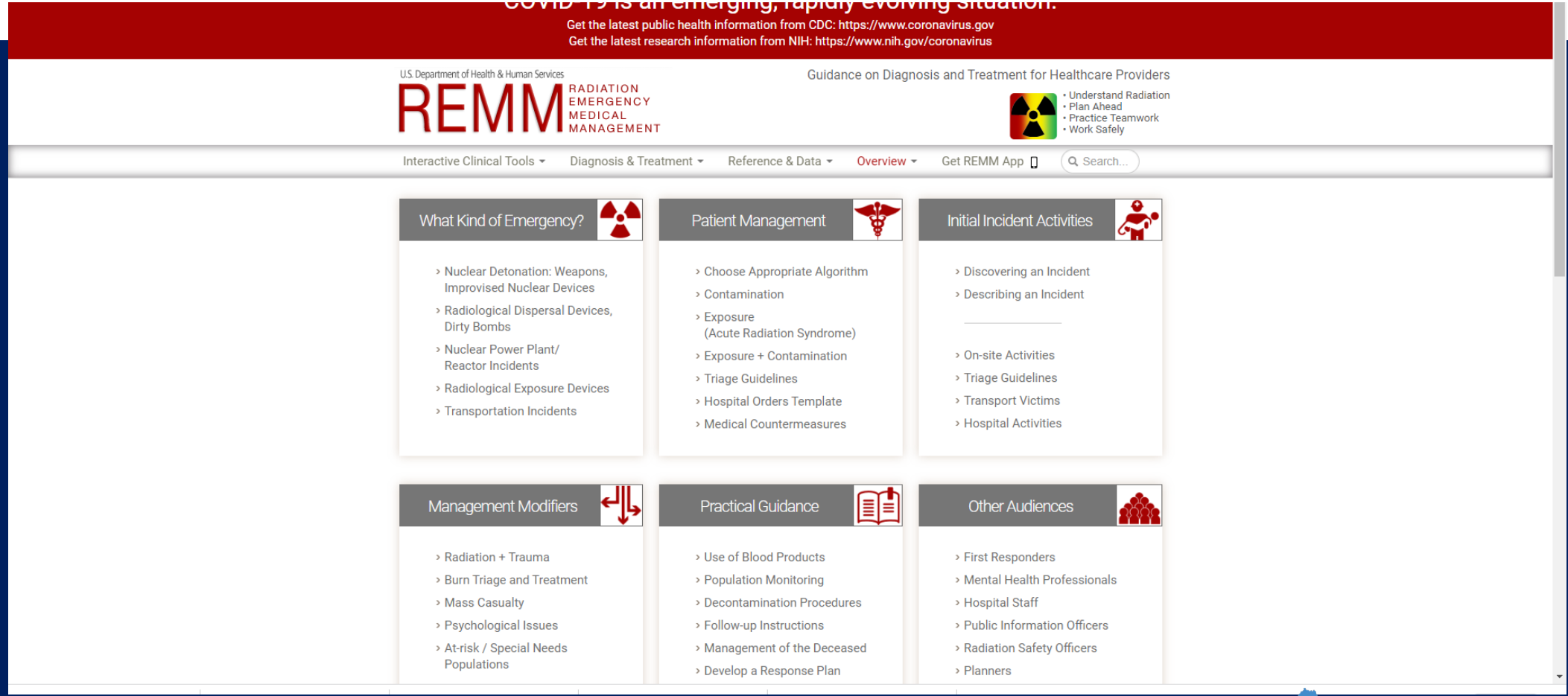
RELEVANT BASELINE OR JUST-IN-TIME, FREE, TRAINING RESOURCES

CDC training resources

- www.emergency.cdc.gov/radiation
- Agents of Opportunity for Terrorism 2-day course funding by CDC and that includes one day of training from REAC/TS faculty



RADIATION EMERGENCY MEDICAL MANAGEMENT (REMM)



REAC/TS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Radiation Emergency Assistance Center/Training Site
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Emergency preparedness and subject matter expertise on the medical management of radiation incidents
View Radiation Emergency 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.
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

REAC/TS

Radiation Emergency Assistance Center/Training Site

REAC/TS microREM December 2022

December 6, 2022 – December 8, 2022

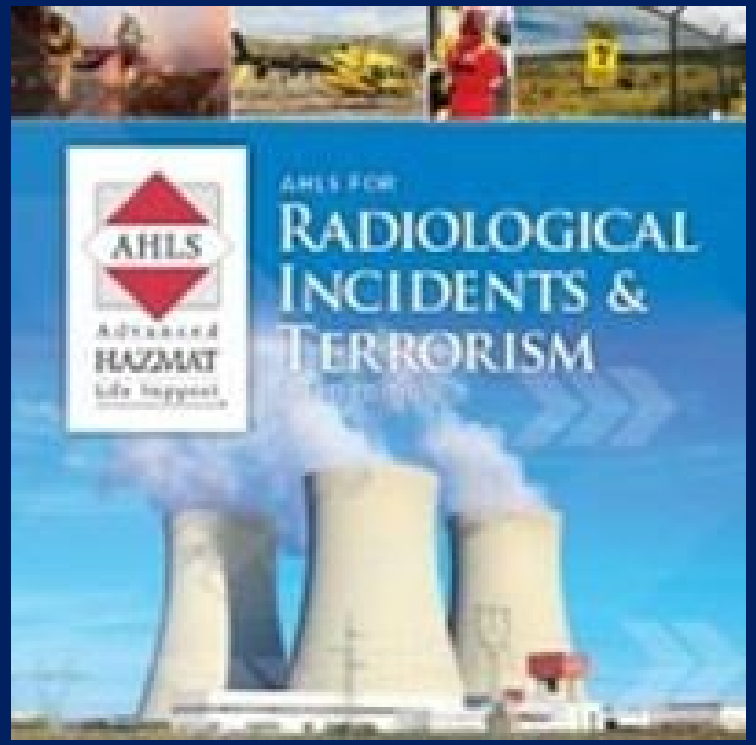
9:00 AM-1:00 PM

REAC/TS course teaches treatment and care of patients involved in radiological or nuclear incidents

This virtual course is an abridged version of REAC/TS' Radiation Emergency Medicine (REM) class. It focuses on the fundamentals of medical care and

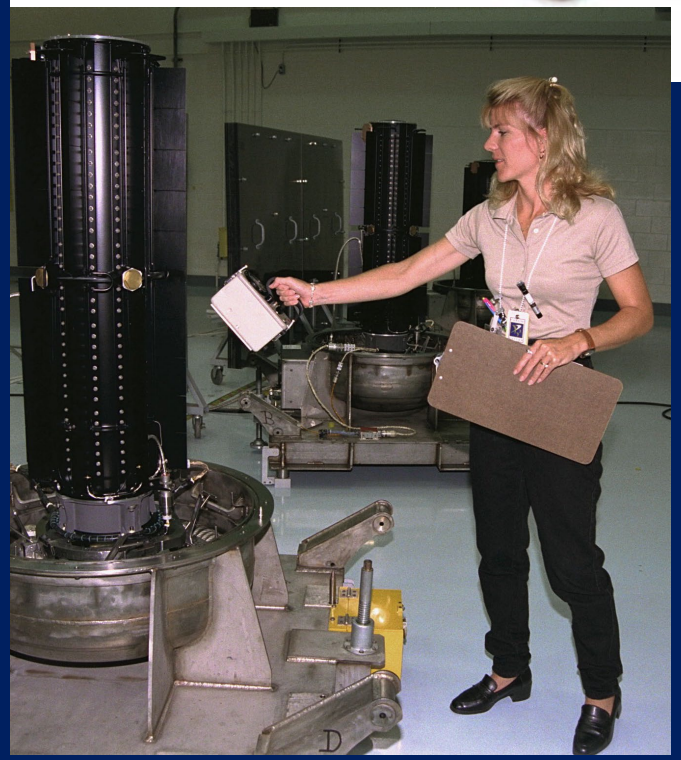
RELEVANT BASELINE OR JUST-IN-TIME TRAINING
RESOURCES ASSOCIATED WITH A FEE

- Advanced Hazmat Life Support for Radiological Incidents and Terrorism (www.ahls.org)



RADIATION DETECTORS MADE SIMPLE

- Survey meters to identify or screen for contamination of a surface or a person with radioactive material
- Ionization chamber to identify radiation exposure hazard on the scene of an incident
- Portal monitors
- Personal dosimeters
- Alpha Particles Detectors
- Instruments that help you identify the specific radionuclide
  - Gamma Spectroscopy




Thermo
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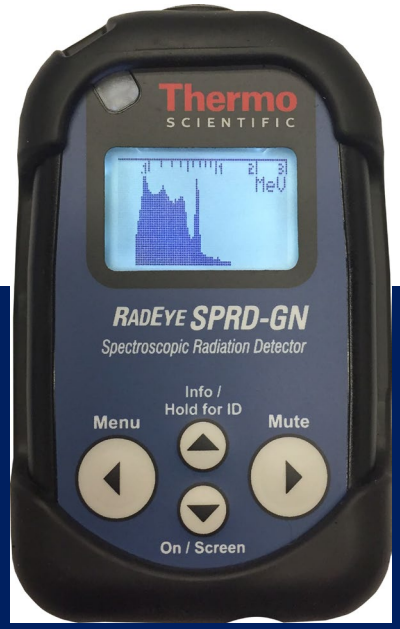
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DR ERIC
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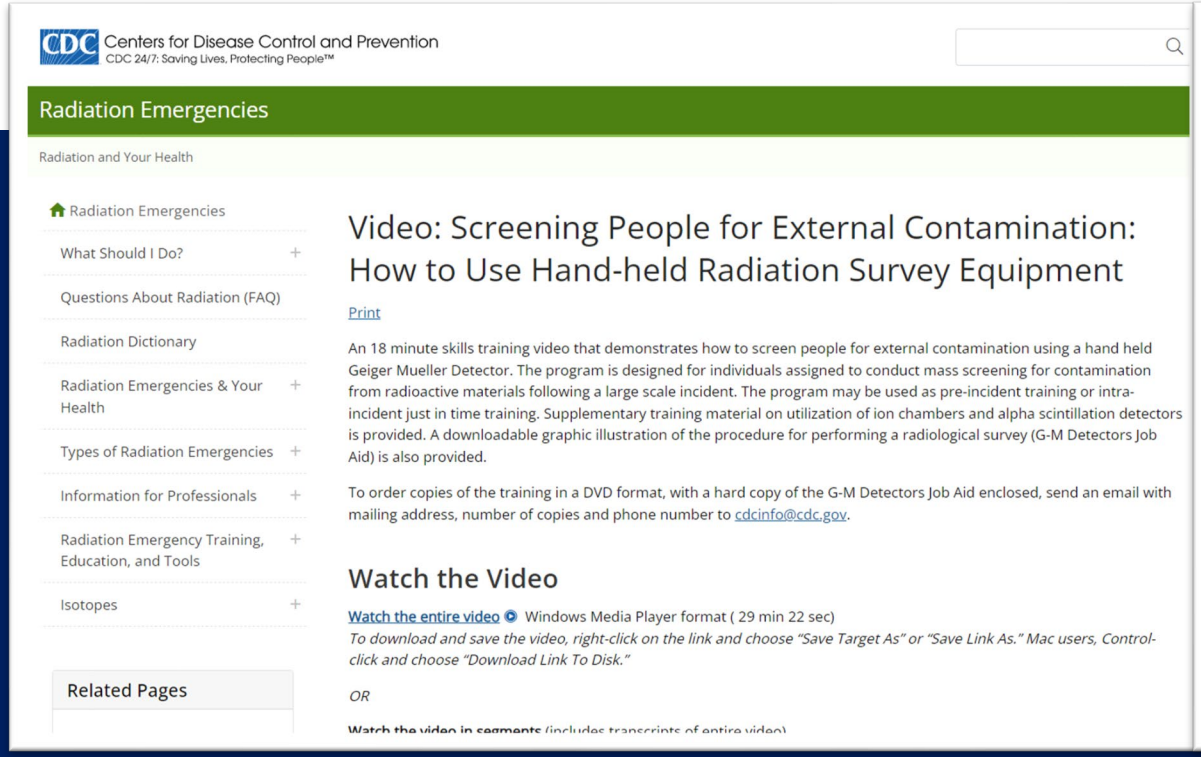
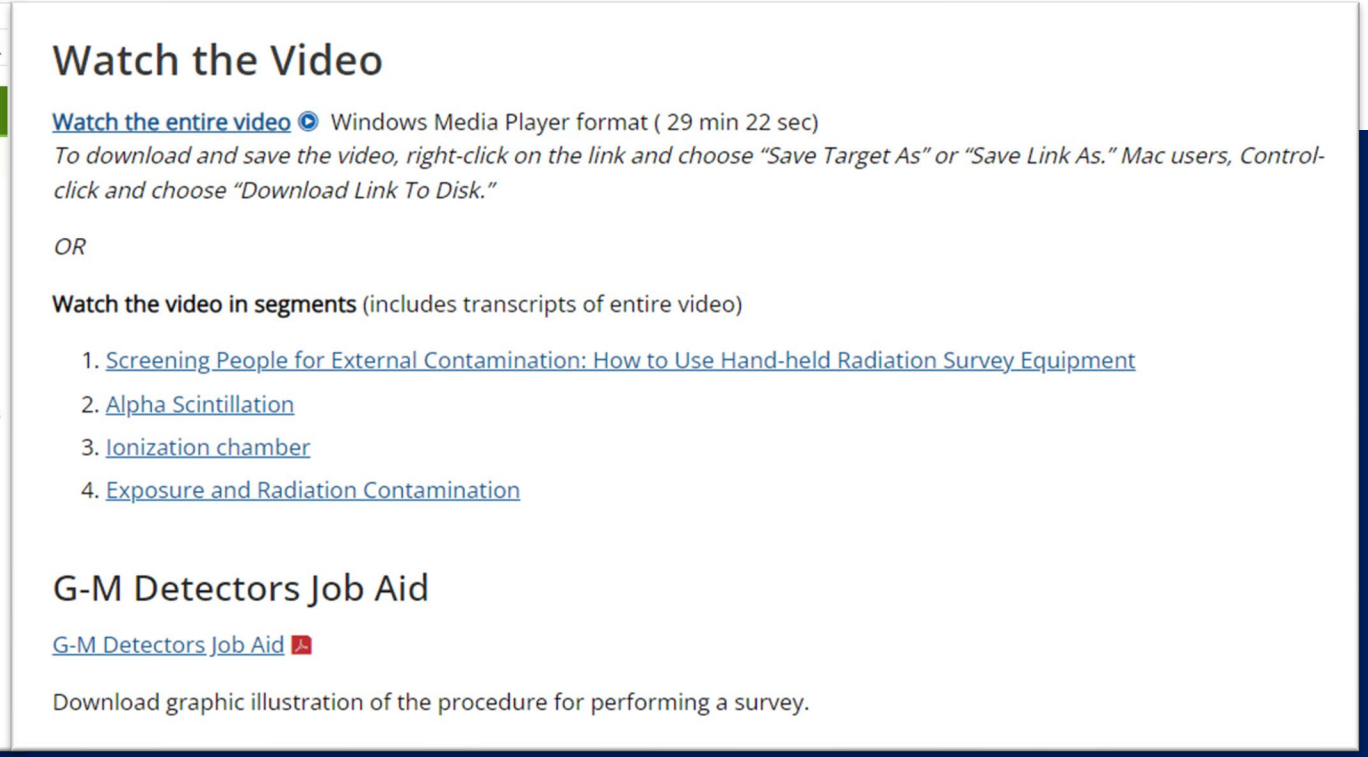
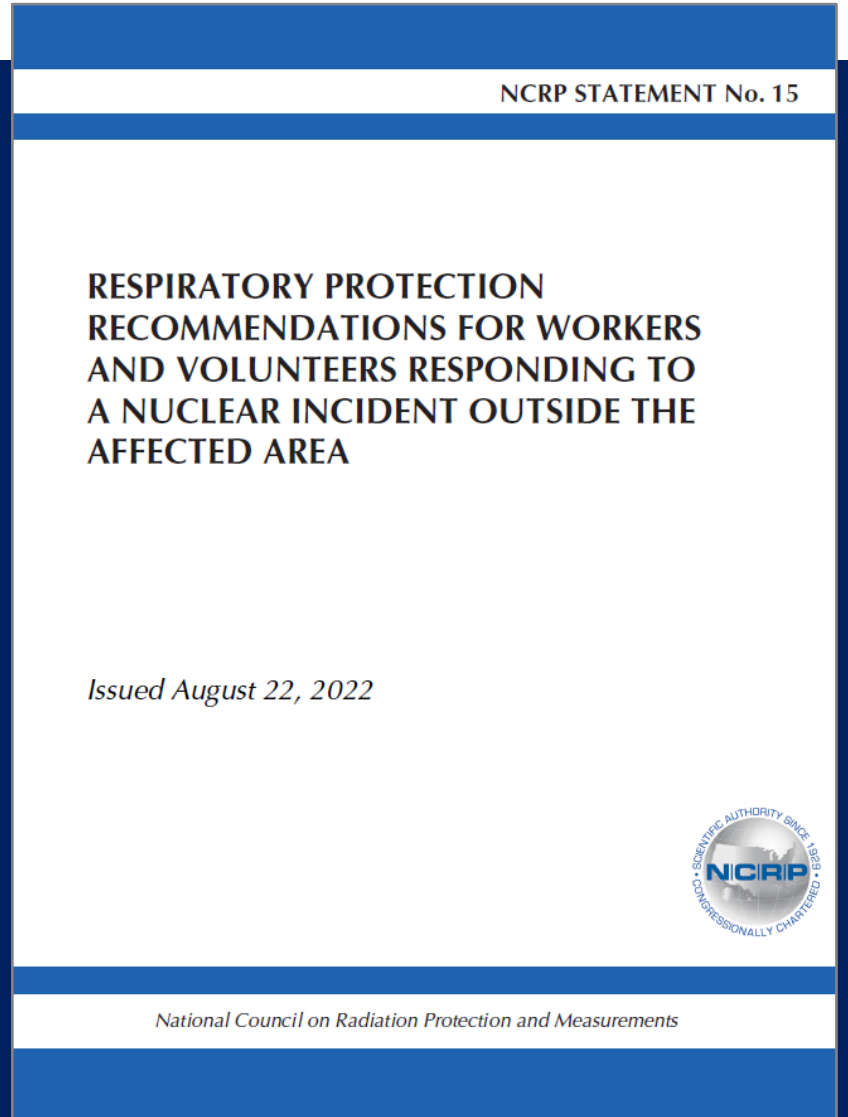




https://www.cdc.gov/nceh/radiation/emergencies/screeningvideos/index.htm

PERSONAL PROTECTIVE EQUIPMENT

- Level D PPE
  - Versus
- Level C PPE
  - Air purifying respirator or Powered Air Purifying Respirator or N95/KN95
    - NCRP Statement Number 15
- Double glove
- Personal dosimeter
  - Team dosimeter
- Time-Distance and Shielding
  - Lead aprons not adequate



DECONTAMINATION PROTOCOLS

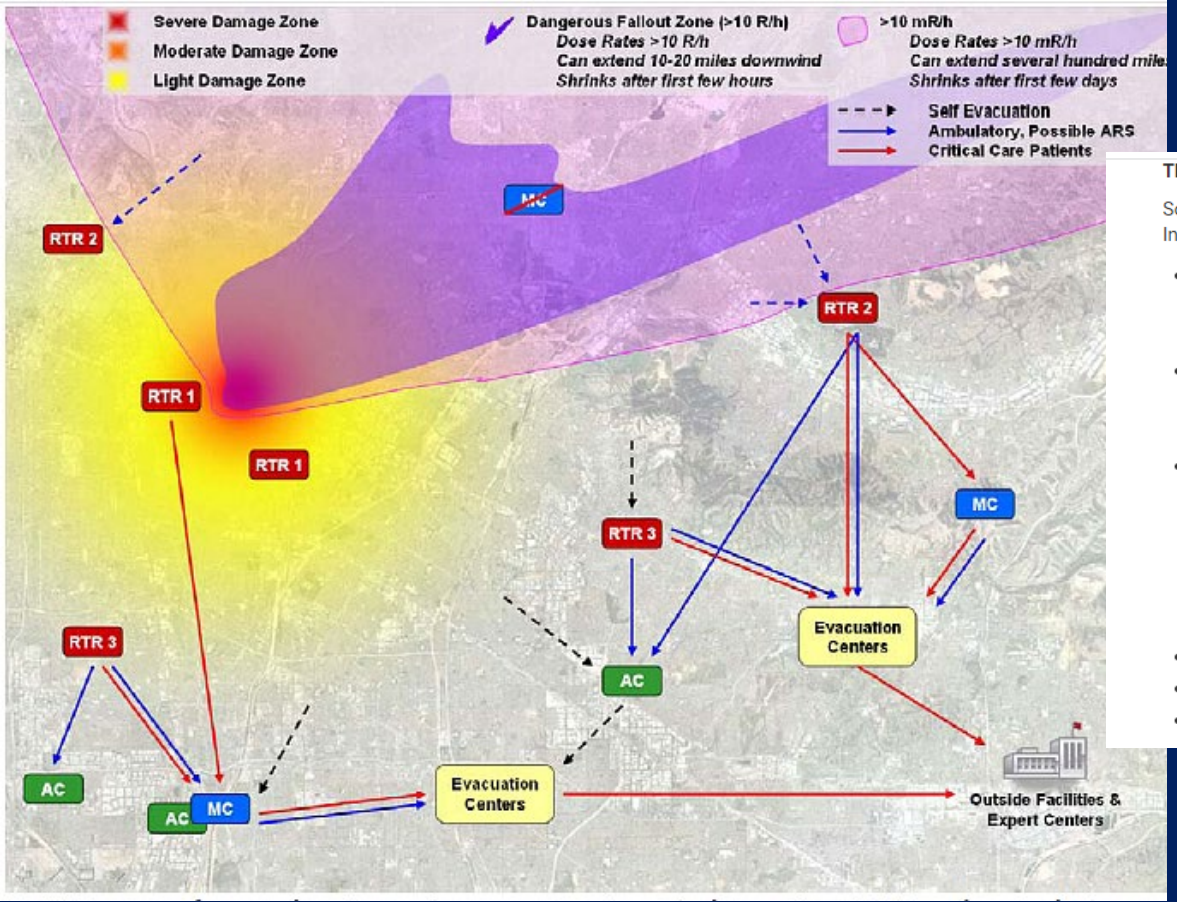
- Life-saving interventions should be performed first
- Soap and Water
- Dry-Wet-Dry™

Southern Regional Disaster Response System
HHS Region 4

LOCATIONS OF ASSESSMENT AND CARE

- Assembly centers
- Alternative care sites
- Community Reception Centers
- Shelters
- Emergency Departments
- Hospitals
- Specialized hospitals

RADIATION TRIAGE, TREAT, AND TRANSPORT SYSTEM (RTR) AFTER A NUCLEAR DETONATION: VENUES FOR THE MEDICAL RESPONSE

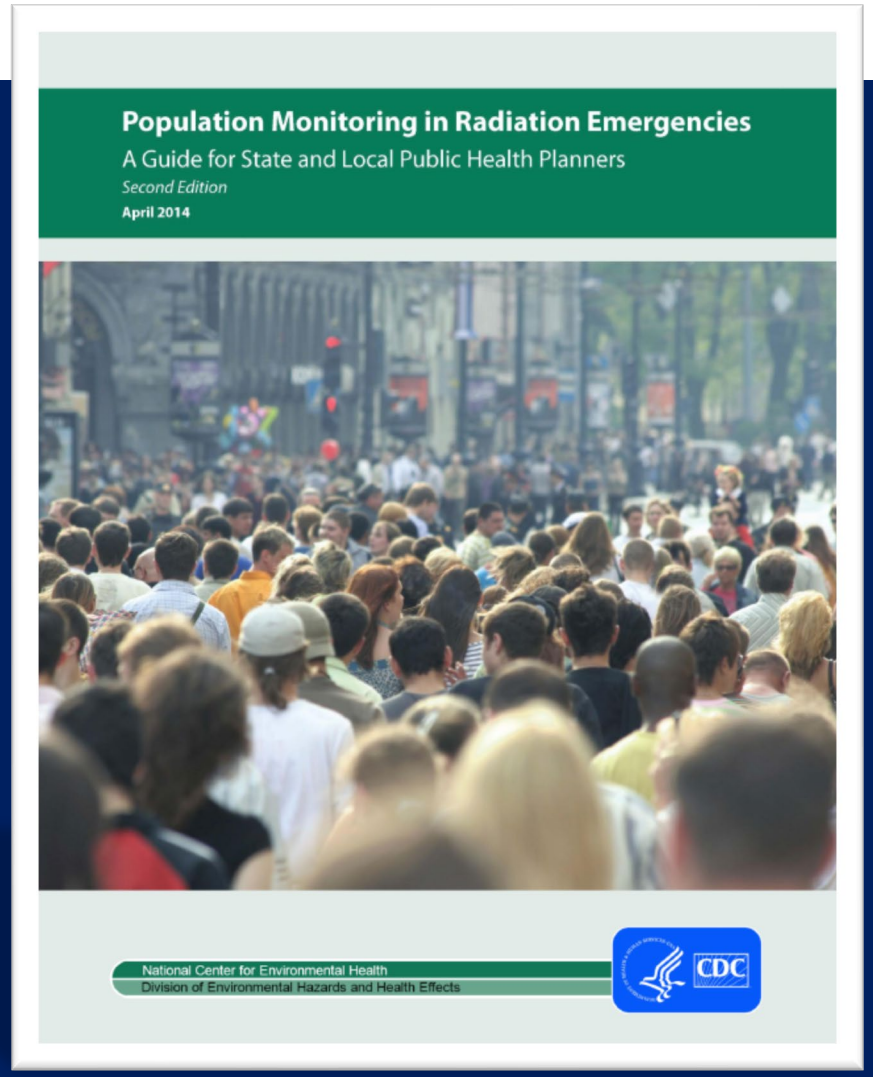


The RTR system for a nuclear detonation response: theoretical zones in a 10 KT nuclear explosion at ground level

Source: Planning Guidance for Response to a Nuclear Detonation, Second edition, 6/2010 (PDF - 2.62 MB) (National Security Staff, Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats, Figure 4.1)

- **RTR1 -** Sites would have victims with major trauma and relatively high levels of radiation. This limits responder time and would be associated with relatively severe victim injuries; many victims may be expectant. The location will be near the severe damage (SD) zone external border and/or in the moderate damage (MD) zone. Rubble may prevent entry into this zone.
- **RTR2 -** Sites will be for triaging victims with radiation exposure only or possibly with minor trauma. The location will be along the outer edges of the Dangerous Fallout (DF) zone and the Light Damage (LD) zone and will have some elevated levels of radiation. Most victims are expected to be ambulatory.
- **RTR3 -** Sites are collection points where radiation is **not** present and will allow occupation for many hours or more. Victims are anticipated to have limited trauma, such as glass injury, and most victims will be ambulatory, including people displaced by the explosion who have no injury or exposure. Extensive self-evacuation is likely to be observed at these sites. These may occur in the LD zone and beyond. RTR3 sites are likely to form in various locations spontaneously or by direction of the Incident Commander as opposed to preplanned Assembly Center (AC) sites. Changes in the fallout pattern due to wind shifts may require some RTR3 sites to change roles (to RTR2) or possibly be abandoned.
- **Medical care (MC) sites -** includes hospitals, healthcare facilities and alternative care sites for those who need immediate medical care
- **Assembly centers (AC) -** collection points for displaced persons or those who do not need immediate medical attention.
- **Evacuation centers (EC) -** for organized transportation

COMMUNITY RECEPTION CENTERS



- First Aid
- Contamination Screening
- Wash
- Pet Services (for pet-friendly CRCs)
- Registration
- Radiation Dose Assessment
- Discharge

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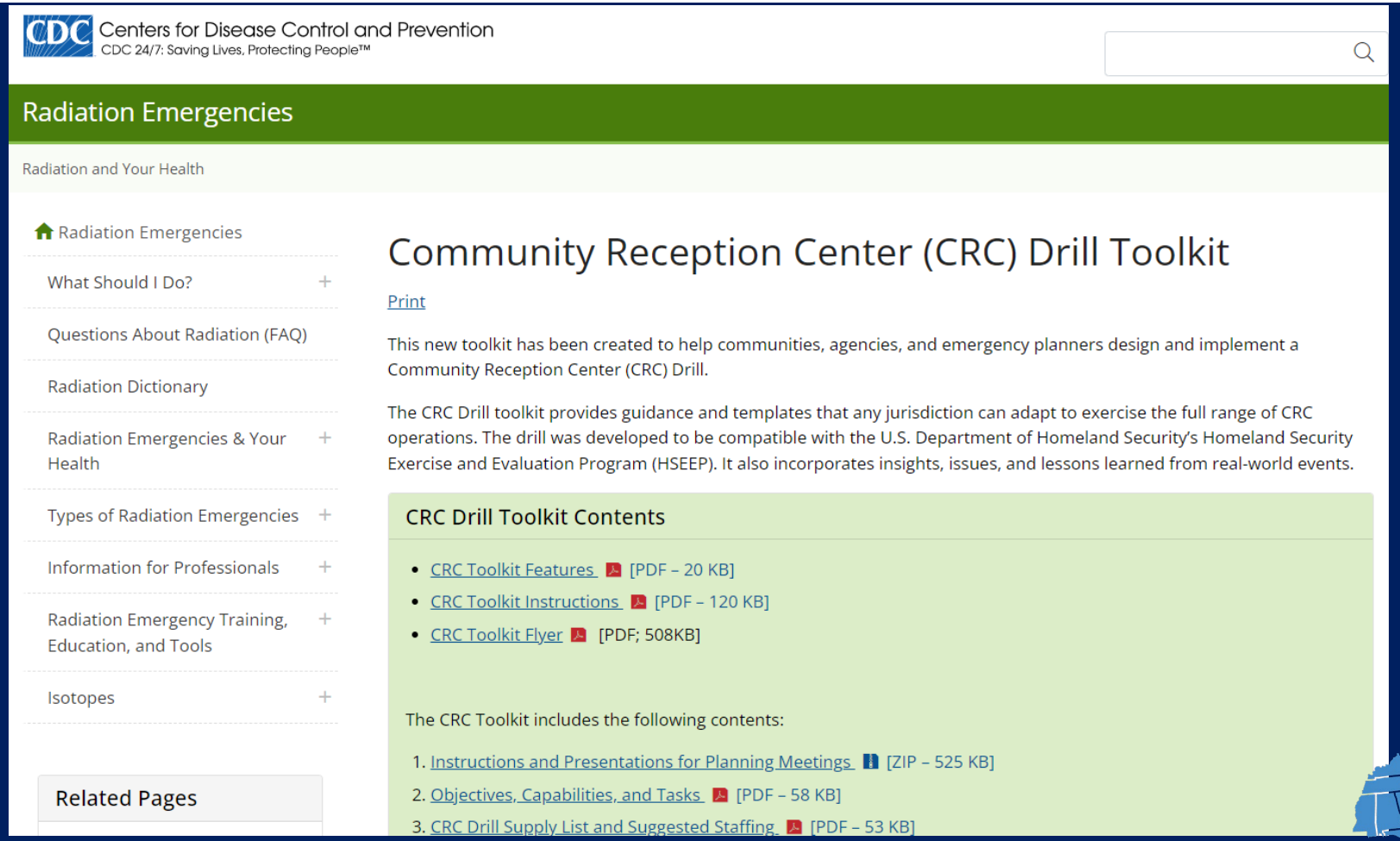
HHS Region 4

COMMUNITY RECEPTION CENTER (CRC) DRILL TOOLKIT



CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Radiation Emergencies

Radiation and Your Health

- Radiation Emergencies
- What Should I Do?
- Questions About Radiation (FAQ)
- Radiation Dictionary
- Radiation Emergencies & Your Health
- Types of Radiation Emergencies
- Information for Professionals
- Radiation Emergency Training, Education, and Tools
- Isotopes

Related Pages

Community Reception Center (CRC) Drill Toolkit

Print

This new toolkit has been created to help communities, agencies, and emergency planners design and implement a Community Reception Center (CRC) Drill.

The CRC Drill toolkit provides guidance and templates that any jurisdiction can adapt to exercise the full range of CRC operations. The drill was developed to be compatible with the U.S. Department of Homeland Security's Homeland Security Exercise and Evaluation Program (HSEEP). It also incorporates insights, issues, and lessons learned from real-world events.

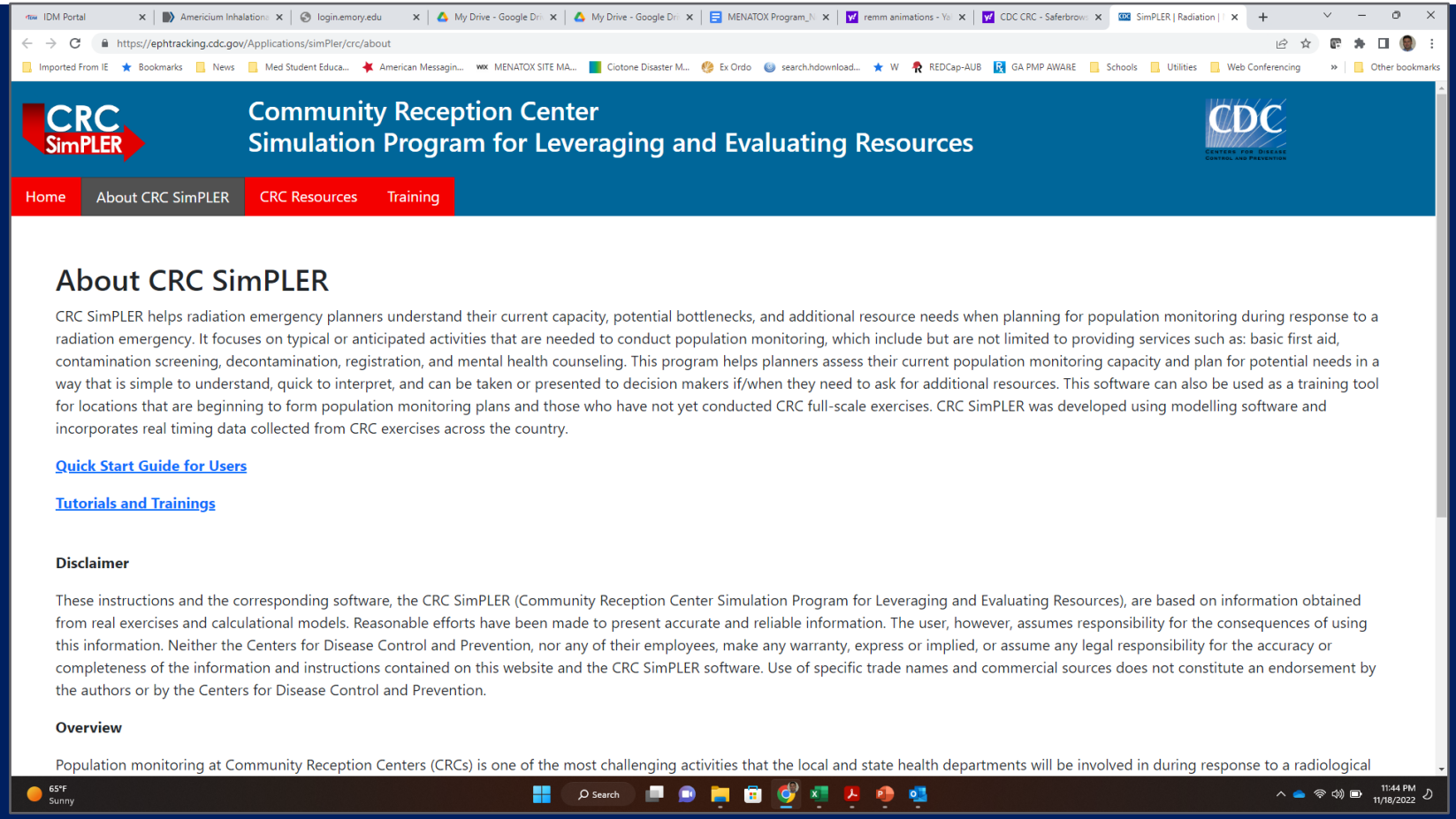
CRC Drill Toolkit Contents

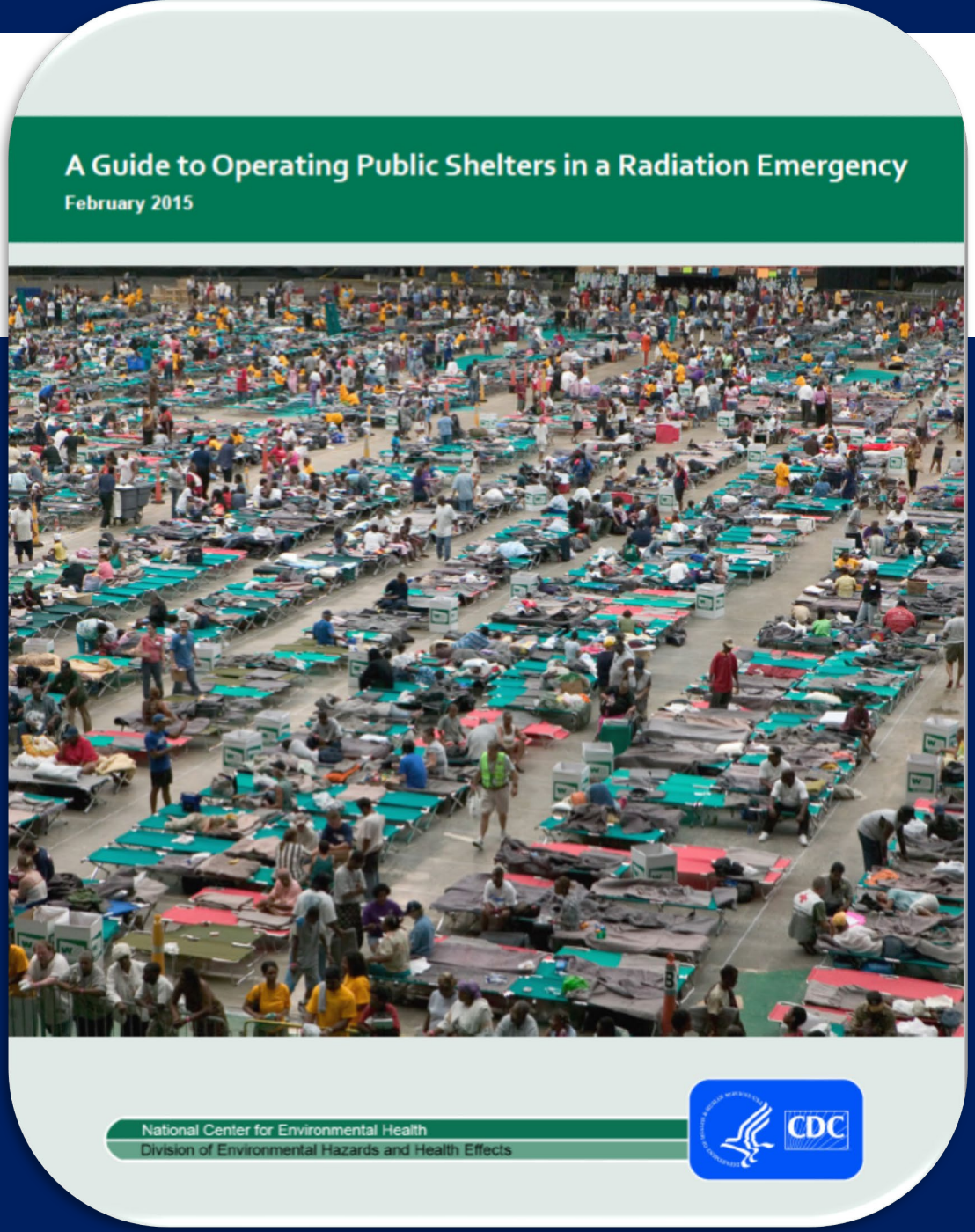
- CRC Toolkit Features [PDF – 20 KB]
- CRC Toolkit Instructions [PDF – 120 KB]
- CRC Toolkit Flyer [PDF; 508KB]

The CRC Toolkit includes the following contents:

1. Instructions and Presentations for Planning Meetings [ZIP – 525 KB]
2. Objectives, Capabilities, and Tasks [PDF – 58 KB]
3. CRC Drill Supply List and Suggested Staffing [PDF – 53 KB]

CRC SIMPLER


https://ephtracking.cdc.gov/Applications/simPler/crc/about
CRC SimPLER
Community Reception Center
Simulation Program for Leveraging and Evaluating Resources
CDC
Home
About CRC SimPLER
CRC Resources
Training
About CRC SimPLER
CRC SimPLER helps radiation emergency planners understand their current capacity, potential bottlenecks, and additional resource needs when planning for population monitoring during response to a radiation emergency. It focuses on typical or anticipated activities that are needed to conduct population monitoring, which include but are not limited to providing services such as: basic first aid, contamination screening, decontamination, registration, and mental health counseling. This program helps planners assess their current population monitoring capacity and plan for potential needs in a way that is simple to understand, quick to interpret, and can be taken or presented to decision makers if/when they need to ask for additional resources. This software can also be used as a training tool for locations that are beginning to form population monitoring plans and those who have not yet conducted CRC full-scale exercises. CRC SimPLER was developed using modelling software and incorporates real timing data collected from CRC exercises across the country.
Quick Start Guide for Users
Tutorials and Trainings
Disclaimer
These instructions and the corresponding software, the CRC SimPLER (Community Reception Center Simulation Program for Leveraging and Evaluating Resources), are based on information obtained from real exercises and calculational models. Reasonable efforts have been made to present accurate and reliable information. The user, however, assumes responsibility for the consequences of using this information. Neither the Centers for Disease Control and Prevention, nor any of their employees, make any warranty, express or implied, or assume any legal responsibility for the accuracy or completeness of the information and instructions contained on this website and the CRC SimPLER software. Use of specific trade names and commercial sources does not constitute an endorsement by the authors or by the Centers for Disease Control and Prevention.
Overview
Population monitoring at Community Reception Centers (CRCs) is one of the most challenging activities that the local and state health departments will be involved in during response to a radiological



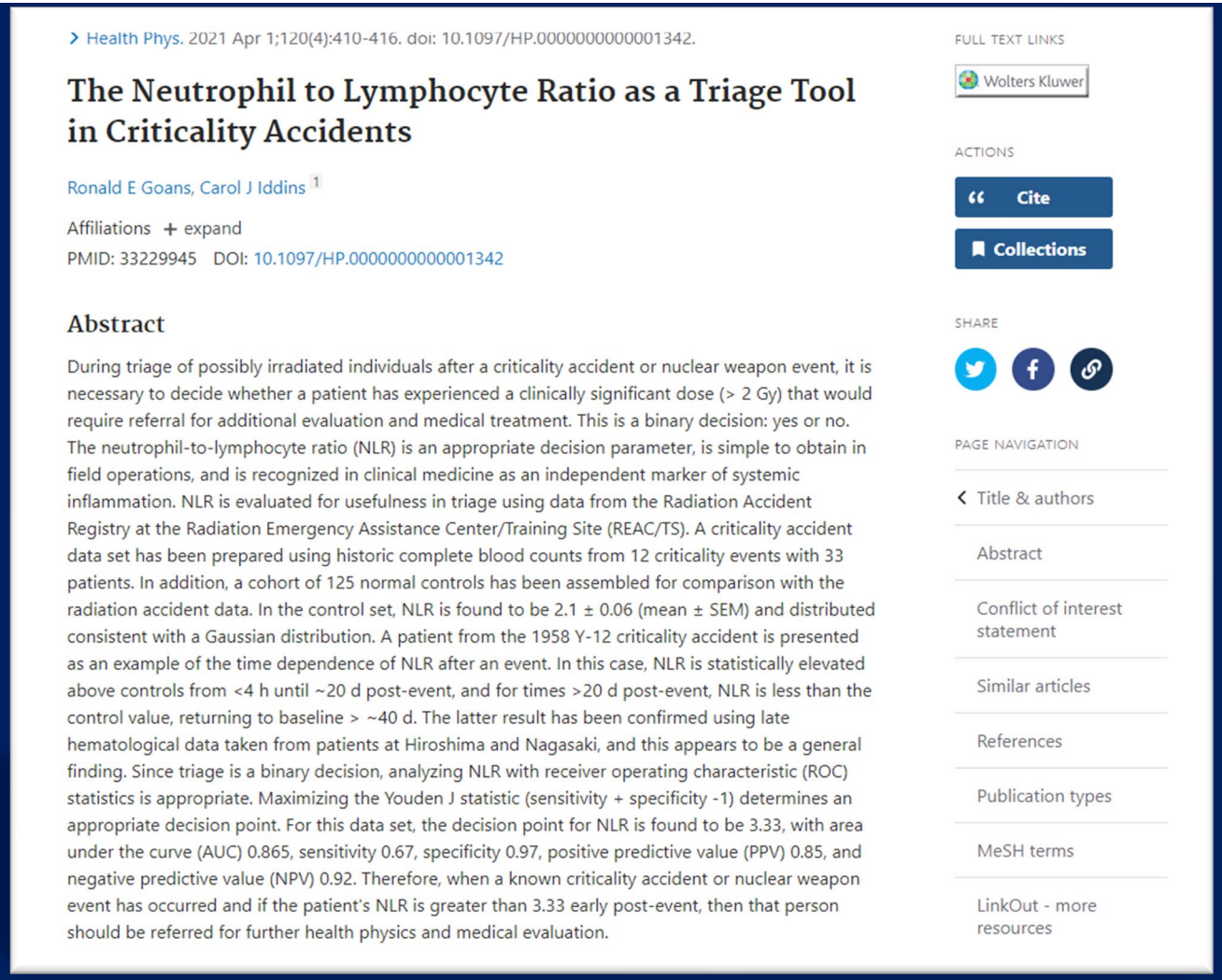
PUBLIC SHELTERS OPERATION

Southern Regional Disaster Response System
HHS Region 4

ON-SITE TRIAGE TOOLS AND CALCULATORS

HTTPS://REMM.HHS.GOV/ARS_WBD.HTM

- Geographic location
- Signs and Symptoms
  - Time to onset of vomiting
  - Diarrhea
  - Loss of consciousness
- Serial absolute lymphocyte counts
- EAST Tool
- N/L+E Formula



Health Phys. 2021 Apr 1;120(4):410-416. doi: 10.1097/HP.0000000000001342.

The Neutrophil to Lymphocyte Ratio as a Triage Tool in Criticality Accidents

Ronald E Goans, Carol J Iddins [1]

Affiliations + expand

PMID: 33229945 DOI: 10.1097/HP.0000000000001342

Abstract

During triage of possibly irradiated individuals after a criticality accident or nuclear weapon event, it is necessary to decide whether a patient has experienced a clinically significant dose (> 2 Gy) that would require referral for additional evaluation and medical treatment. This is a binary decision: yes or no. The neutrophil-to-lymphocyte ratio (NLR) is an appropriate decision parameter, is simple to obtain in field operations, and is recognized in clinical medicine as an independent marker of systemic inflammation. NLR is evaluated for usefulness in triage using data from the Radiation Accident Registry at the Radiation Emergency Assistance Center/Training Site (REAC/TS). A criticality accident data set has been prepared using historic complete blood counts from 12 criticality events with 33 patients. In addition, a cohort of 125 normal controls has been assembled for comparison with the radiation accident data. In the control set, NLR is found to be 2.1 ± 0.06 (mean ± SEM) and distributed consistent with a Gaussian distribution. A patient from the 1958 Y-12 criticality accident is presented as an example of the time dependence of NLR after an event. In this case, NLR is statistically elevated above controls from <4 h until ~20 d post-event, and for times >20 d post-event, NLR is less than the control value, returning to baseline > ~40 d. The latter result has been confirmed using late hematological data taken from patients at Hiroshima and Nagasaki, and this appears to be a general finding. Since triage is a binary decision, analyzing NLR with receiver operating characteristic (ROC) statistics is appropriate. Maximizing the Youden J statistic (sensitivity + specificity -1) determines an appropriate decision point. For this data set, the decision point for NLR is found to be 3.33, with area under the curve (AUC) 0.865, sensitivity 0.67, specificity 0.97, positive predictive value (PPV) 0.85, and negative predictive value (NPV) 0.92. Therefore, when a known criticality accident or nuclear weapon event has occurred and if the patient's NLR is greater than 3.33 early post-event, then that person should be referred for further health physics and medical evaluation.

INITIAL TRIAGE AFTER A NUCLEAR DETONATION - EAST TOOL

ARS Severity Prediction	Severe ARS Predicted (>6 Gy)	Moderate ARS Predicted	Mild ARS Predicted (<2 Gy)
ALC/lymphocyte single value estimate (x10^9) (3)	< 0.7 at 24h < 0.4 at 48h	0.7 – 1.1 at 24h 0.4 – 0.9 at 48h	> 1.1 at 24h > 0.9 at 48h
Vomiting onset (4)	Rapid (within 1h) after exposure	Intermediate (1-4h)	Delayed > 4h
Vomiting(per day) (5)	>6 or worsening with time	Moderate 3-6	1-2 or resolved
IMAAC /official 12-24h estimated dose map (6)	>6 Gy (modify to 2-6 Gy if good shelter for 24h)	2-6 Gy (modify to < 2 Gy if good shelter for 24h)	<2 Gy
Location in damage or fallout zone (non-IMAAC map) first 12-24h	In damage or fallout zone with minimal / no sheltering	In damage/fallout zone with good sheltering (e.g. concrete)	Not in damage/fallout zone according to map
Diarrhea (stools / day)	Severe (>6)	Mild / moderate (<6)	None
Headache (7)	Severe, interferes with activities	Mild/moderate	None/minimal
Fever (unexplained)	High/sustained	Low (< 101F) or resolved	None
Skin (beta) burns (8)	Burns / blisters > 3% BSA	Burns/blisters < 3% BSA	None
Match dominant signs/symptoms in column above to suggested triage category in same column below			
GCSF/myeloid cytokine **priority** (9)	**2** – Possible benefit	**1** – Most benefit	**3** – Unlikely benefit
Evacuation **group** (10)	**2** – Second evacuated	**1** – First evacuated	**3** - Third evacuated

Exposure and Symptom Triage (EAST) Tool to Assess Radiation Exposure after a Nuclear Detonation

Nuclear Detonation Survivor Prioritization for Evacuation / Bone Marrow Cytokines

Source: Hick JL, Bader JL, Coleman CN et al., Dis Med Public Health Prep, 2018;12:386-395.

Clothing/contamination control performed

Acute medical/trauma complaints? (1) — Yes → Refer to medical care area/facility

No

Were located in/transit through damage or fallout zone? — No → Send to support services

Yes

Assess symptoms/data – major predictors listed first (e.g. ALC is best predictor, skin changes unlikely) - base cytokine and evacuation priority on column with ***majority or strongest predictive variables*** (2)

ARS Severity Prediction	Severe ARS Predicted (>6 Gy)	Moderate ARS Predicted	Mild ARS Predicted (<2 Gy)
ALC/lymphocyte single value estimate (x10^9) (3)	< 0.7 at 24h < 0.4 at 48h	0.7 – 1.1 at 24h 0.4 – 0.9 at 48h	> 1.1 at 24h > 0.9 at 48h
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Evacuation **group** (10)	**2** – Second evacuated	**1** – First evacuated	**3** - Third evacuated

Complicating Medical Conditions / Vulnerability (see note 10)

Adjust evacuation priority to a *higher* color (e.g. yellow up to red) if patient has a condition for which local care is not available and that could deteriorate within 48h putting the patient at risk including but not limited to:

- Diabetes
- Dialysis / End Stage Renal Disease
- CHF (Congestive Heart Failure)
- Pregnancy
- Immunosuppression (e.g. AIDS, taking steroids/transplant meds, recent chemo)
- Severe Respiratory Disease (e.g. Asthma, COPD with disability, requiring oxygen, or daily symptoms)
- Vulnerable / at risk in current environment (e.g. pediatric, disability)

Myeloid cytokine (GCSF/other) administration (record dose/time) according to priority/availability (11)

Support – referral to resources for evacuation and basic needs coordination (12)

End notes – turn over

ARS Severity Prediction	Severe ARS Predicted (>6 Gy)	Moderate ARS Predicted	Mild ARS Predicted (<2 Gy)
ALC/lymphocyte single value estimate ($x10^9$) (3)	< 0.7 at 24h < 0.4 at 48h	0.7 – 1.1 at 24h 0.4 – 0.9 at 48h	> 1.1 at 24h > 0.9 at 48h
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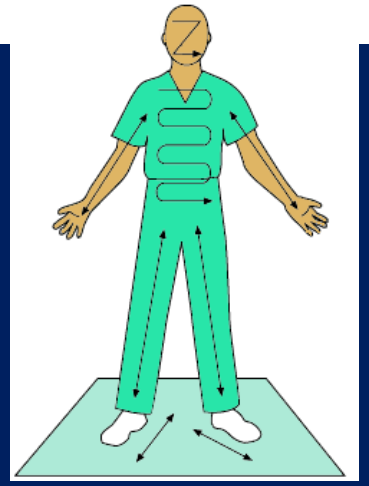
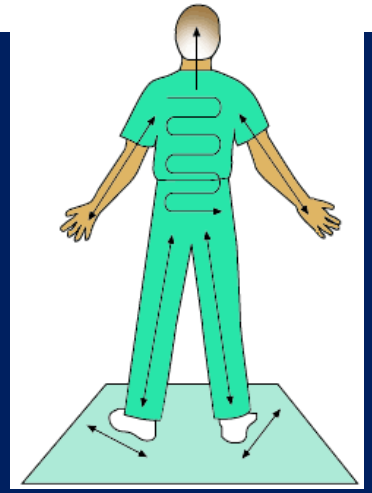
Evacuation **group** (10)	**2** – Second evacuated	**1** – First evacuated	**3** - Third evacuated

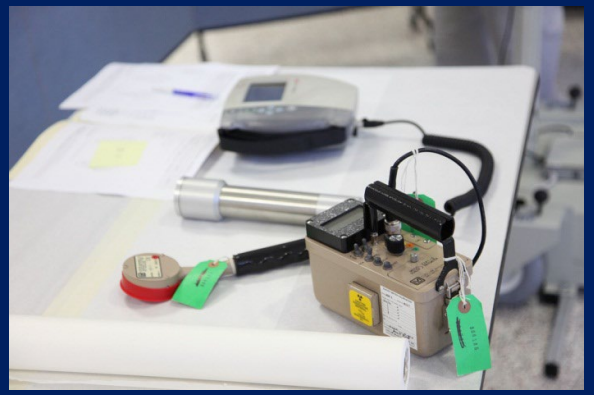
TREATMENT PROTOCOLS

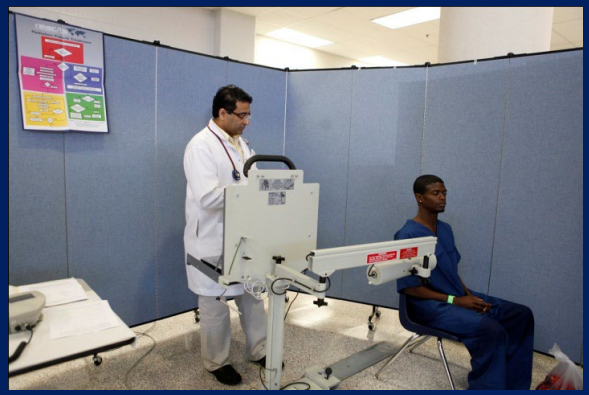
- Life-saving interventions and decontamination
- PPE at hospitals and prehospital
- Medical assessment materials and resources
- Medical management materials and resources

DIAGNOSIS OF INTERNAL CONTAMINATION - DIRECT









PITFALLS – ALPHA-EMITTERS LIKE POLONIUM-210

- Detection with a GM-Counter not possible
- Alpha particles easily shielded by water
- Will not be detected by direct assessment
- Zinc sulfide alpha detectors could potentially detect it in environmental samples
- Additional methods like alpha spectroscopy or liquid scintillation

DIAGNOSIS OF INTERNAL CONTAMINATION - INDIRECT

- Nasal swabs not recommended during a public health emergency

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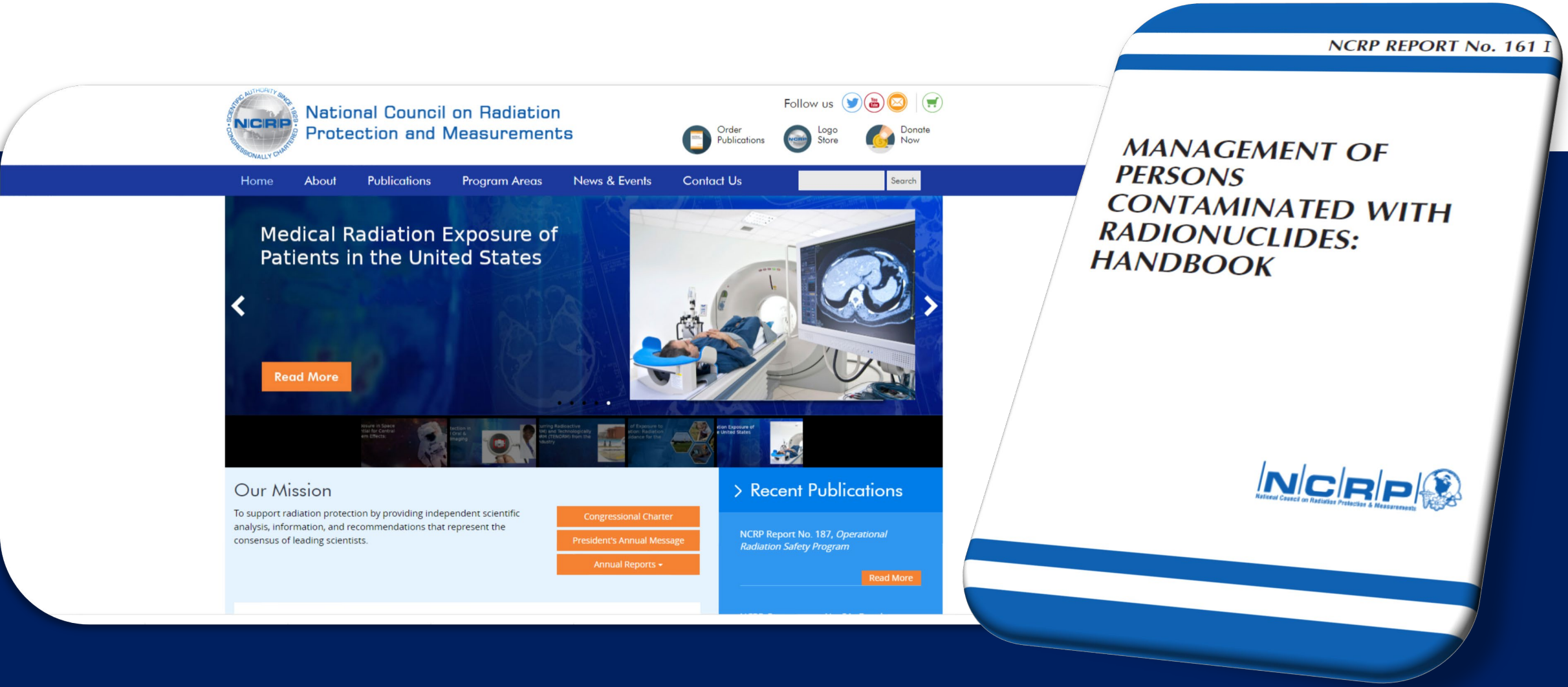
ACTIVITY ASSESSMENT FROM INTERNAL CONTAMINATION

- Clinical Decision Guides
  - NCRP Report 161
  - CDC Internal Contamination Clinical Reference App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MANAGEMENT OF PERSONS CONTAMINATED WITH RADIONUCLIDES: HANDBOOK
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Types of Radiation Emergencies
Information for Professionals
Radiation Emergency Training, Education, and Tools
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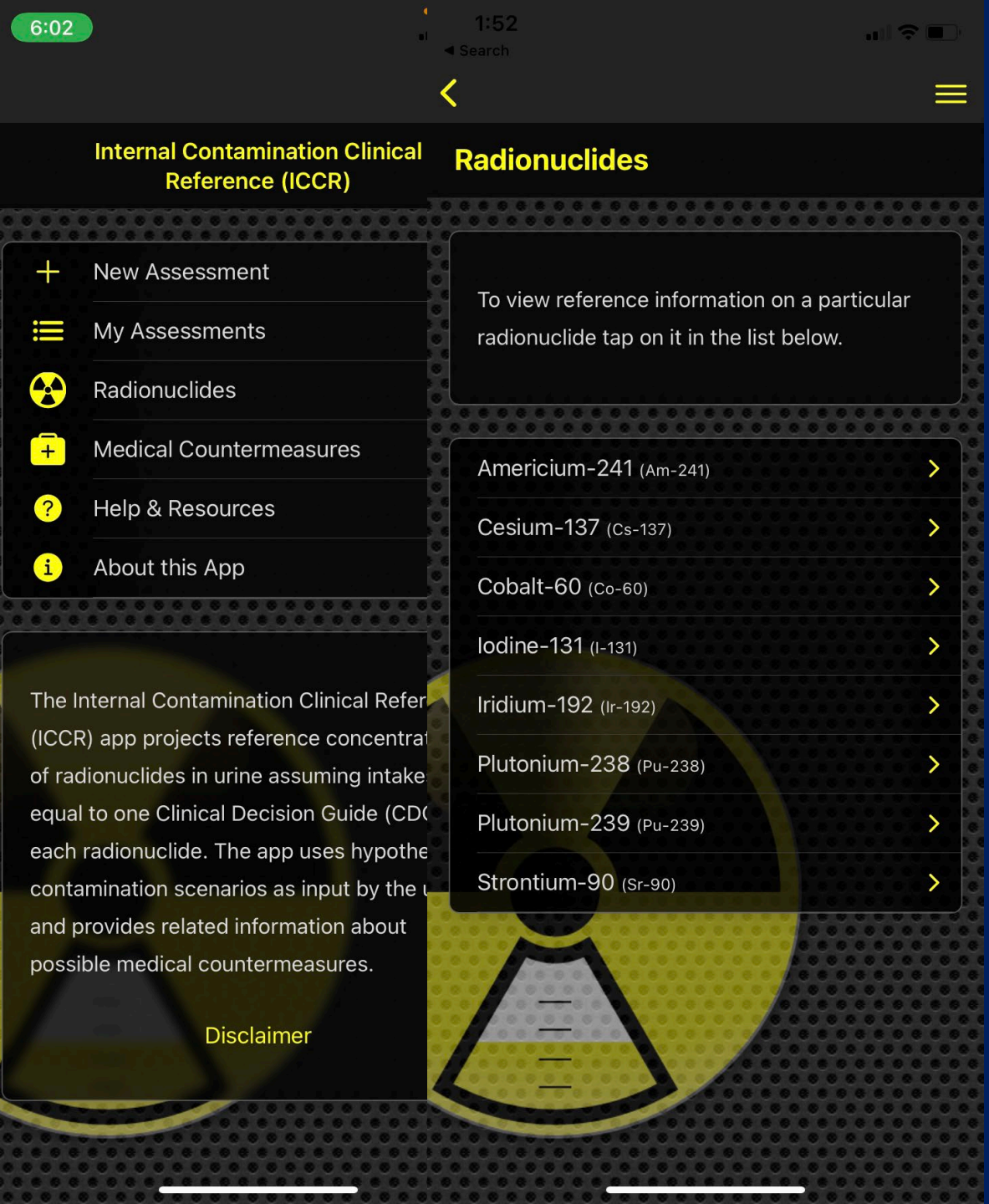
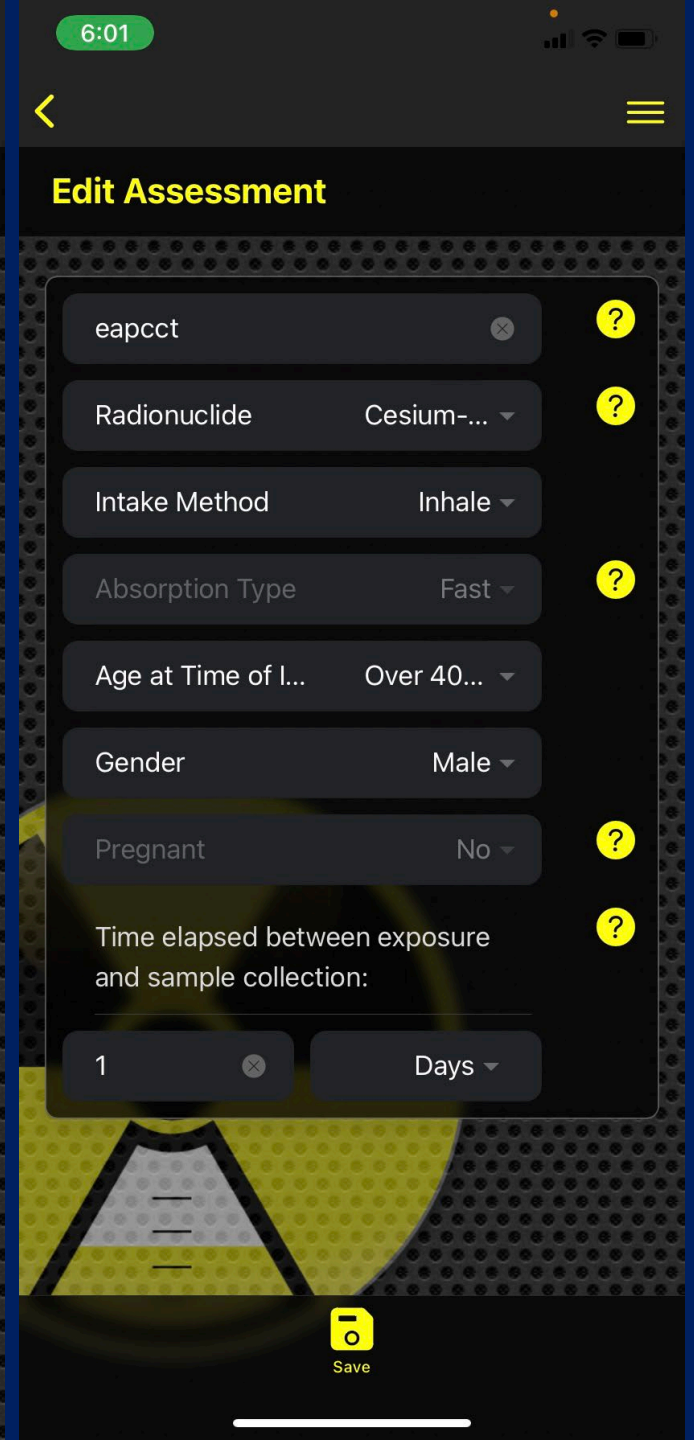
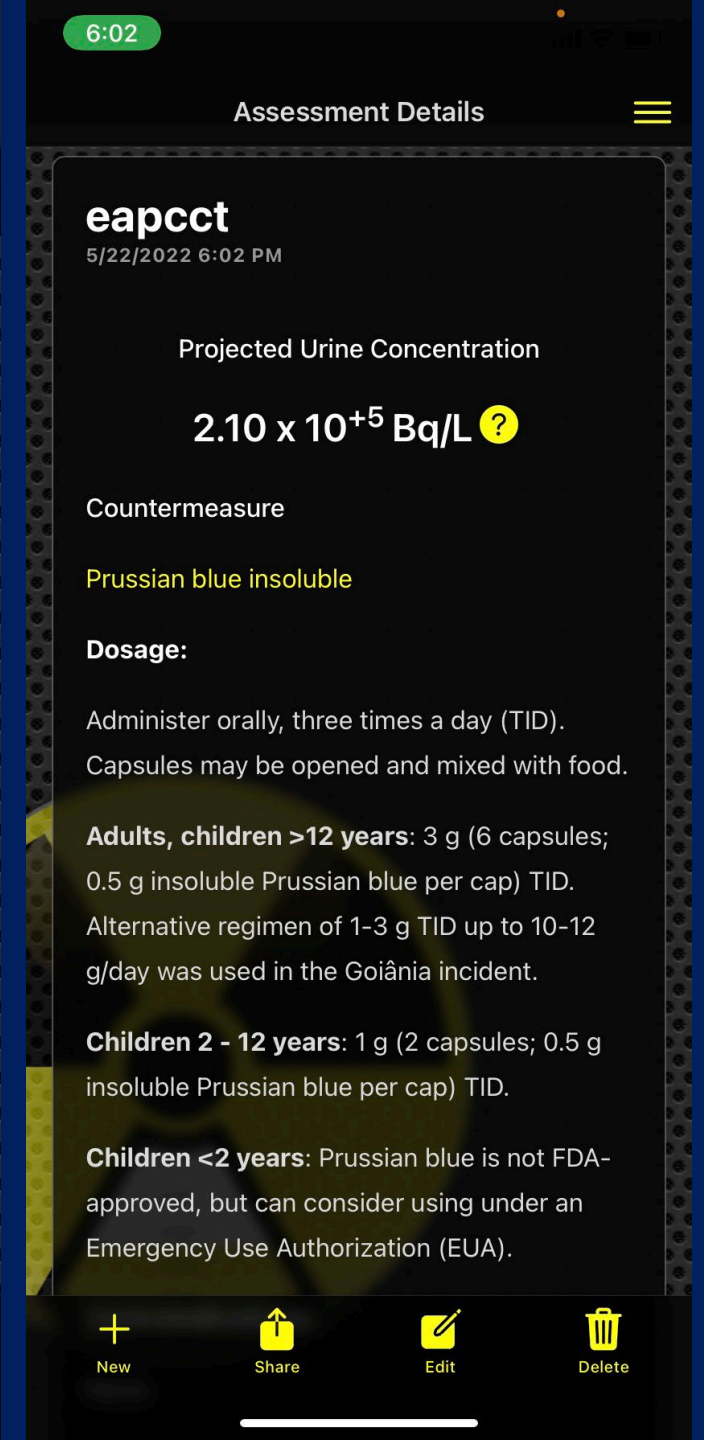
Related Pages
Internal Contamination Clinical Reference (ICCR) Application
Print
The Internal Contamination Clinical Reference is an application(for Android devices, iPads, and iPhones) estimating reference concentrations of radionuclides in urine assuming intakes equal to one Clinical Decision Guide (CDG) for each radionuclide.
The ICCR application (or app) is intended for clinicians, health professionals, radiation safety officers, medical and public health laboratory specialists, or any other professional interested in internal contamination with radioactive materials and their medical therapy.
Download the ICCR application for your Android or iOS device here
Download a walkthrough for the ICCR application here
If you have questions regarding the ICCR app, please email rsbinfo@cdc.gov
Page last reviewed: April 4, 2018
Content source: National Center for Environmental Health (NCEH), Emergency Management, Radiation, and Chemical Branch


6:02
Internal Contamination Clinical Reference (ICCR)
New Assessment
My Assessments
Radionuclides
Medical Countermeasures
Help & Resources
About this App
The Internal Contamination Clinical Refer
(ICCR) app projects reference concentrat
of radionuclides in urine assuming intake
equal to one Clinical Decision Guide (CD
each radionuclide. The app uses hypothe
contamination scenarios as input by the
and provides related information about
possible medical countermeasures.
Disclaimer

1:52
Search
Radionuclides
To view reference information on a particular radionuclide tap on it in the list below.
Americium-241 (Am-241)
Cesium-137 (Cs-137)
Cobalt-60 (Co-60)
Iodine-131 (I-131)
Iridium-192 (Ir-192)
Plutonium-238 (Pu-238)
Plutonium-239 (Pu-239)
Strontium-90 (Sr-90)


6:01
Edit Assessment
eapcct
Radionuclide
Cesium-...
Intake Method
Inhale
Absorption Type
Fast
Age at Time of I...
Over 40...
Gender
Male
Pregnant
No
Time elapsed between exposure and sample collection:
1
Days
Save


6:02
Assessment Details
eapcct
5/22/2022 6:02 PM
Projected Urine Concentration
2.10 x 10+5 Bq/L
Countermeasure
Prussian blue insoluble
Dosage:
Administer orally, three times a day (TID). Capsules may be opened and mixed with food.
Adults, children >12 years: 3 g (6 capsules; 0.5 g insoluble Prussian blue per cap) TID. Alternative regimen of 1-3 g TID up to 10-12 g/day was used in the Goiânia incident.
Children 2 - 12 years: 1 g (2 capsules; 0.5 g insoluble Prussian blue per cap) TID.
Children <2 years: Prussian blue is not FDA-approved, but can consider using under an Emergency Use Authorization (EUA).
New
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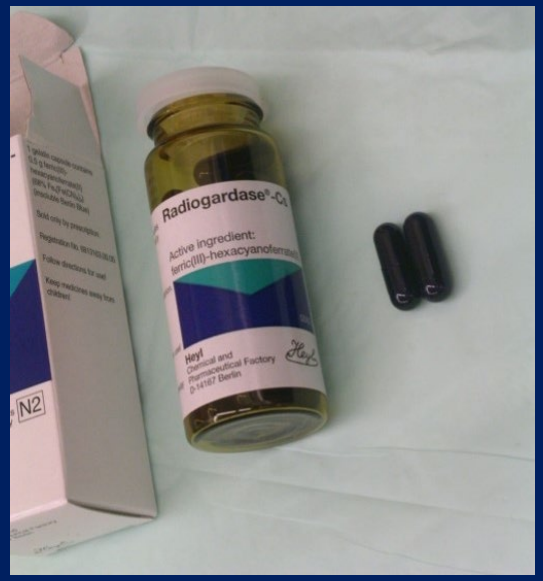
Delete

MEDICAL COUNTERMEASURES - ANTIDOTES

- Sodium bicarbonate to alkalinize the urine
- to prevent chemical renal toxicity of uranium overdose

Drug	Specific Radionuclide	Likely Scenario for Use
Prussian Blue	Cesium, Thallium, Rubidium	RDD
Calcium or Zinc DTPA	Plutonium, Americium or Curium	RDD, Industrial Accident
Potassium Iodide	Iodine	Nuclear Power Plant Emergency
Water	Tritium	Nuclear Power Plant

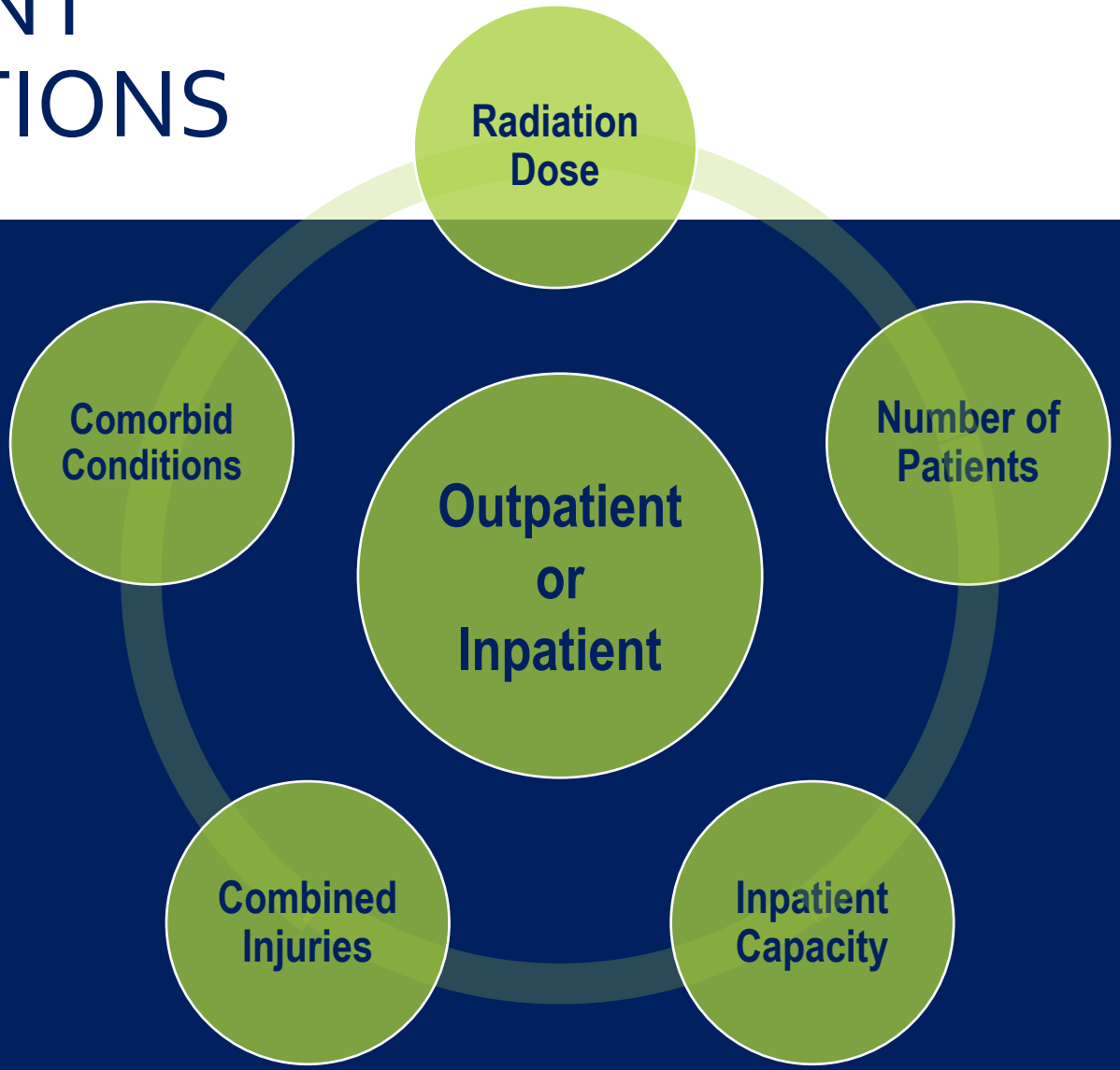


ACUTE RADIATION SYNDROME

- The Rule of 4s
  - 4 conditions
  - 4 stages

Southern Regional Disaster Response System
HHS Region 4

MANAGEMENT CONSIDERATIONS

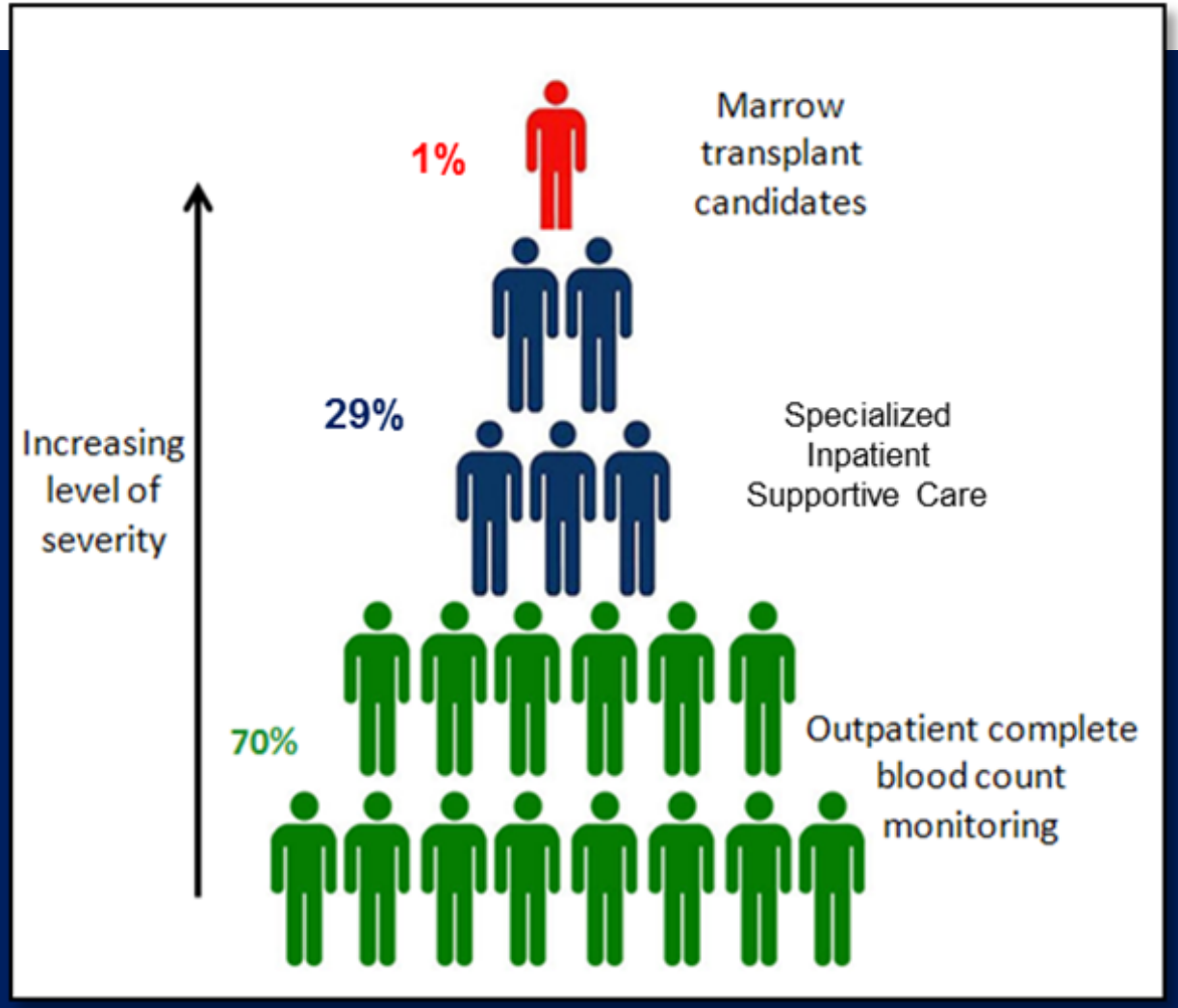


IVF	Neutropenic Precautions	Blood Products
Nutrition	Antiemetics	Antidiarrheals
Analgesics	Antibacterials	Antivirals Antifungals
Colony Stimulating Factors	Psychological Support	Stem Cell Transplant

MEDICAL COUNTERMEASURES - CYTOKINES

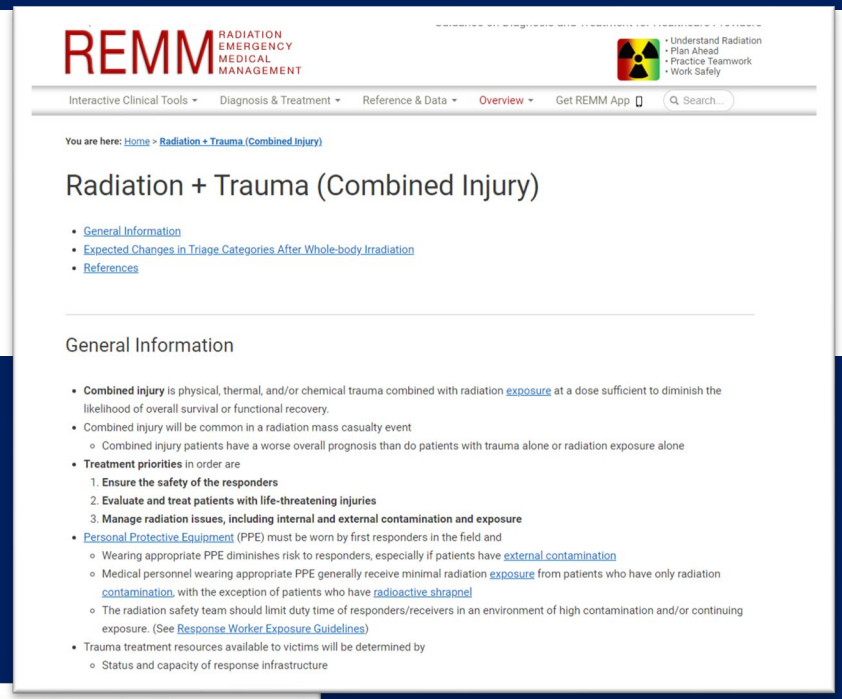
Generic	Brand Name	Administration	SNS	Hospitals
Filgrastim	Neupogen	Daily	Yes	Yes
Pegfilgrastim	Neulasta	Every 2 Weeks	Yes	Yes
Sargramostim	Leukine	Daily	Yes	Yes
Romiplostim	Nplate	Once	Yes	Yes

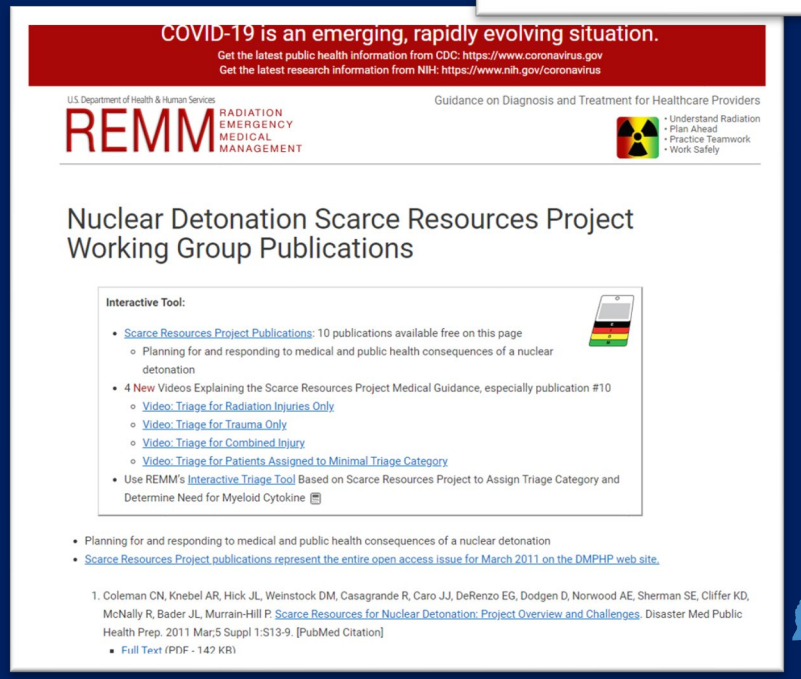
DIFFERENT CARE SETTINGS



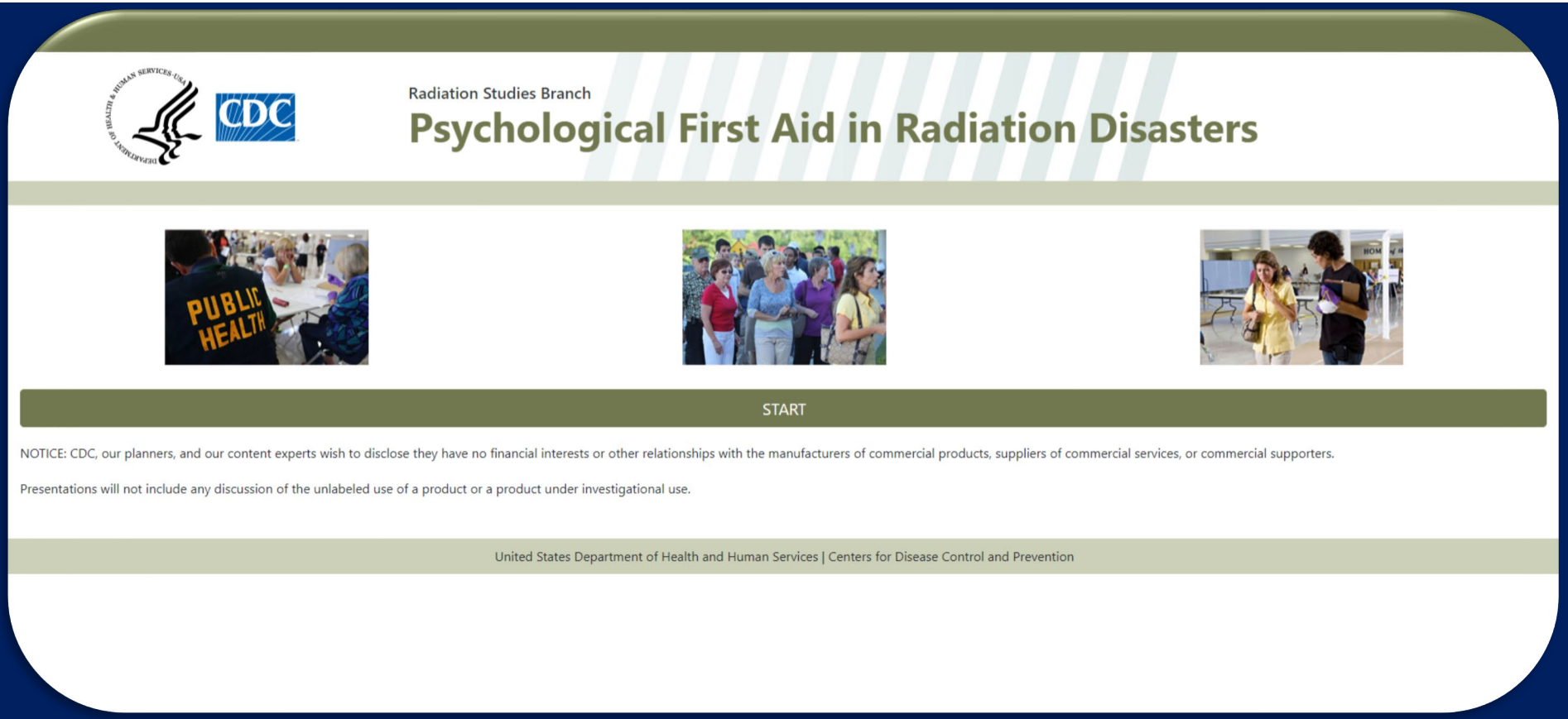
COMBINED INJURIES AND SCARCE RESOURCES MANAGEMENT

- Combined injuries will worsen prognosis and shift the lethal dose from radiation down to a lower dose
- When resources are scarce, management is adapted to direct resources to those with the greatest chance of survival



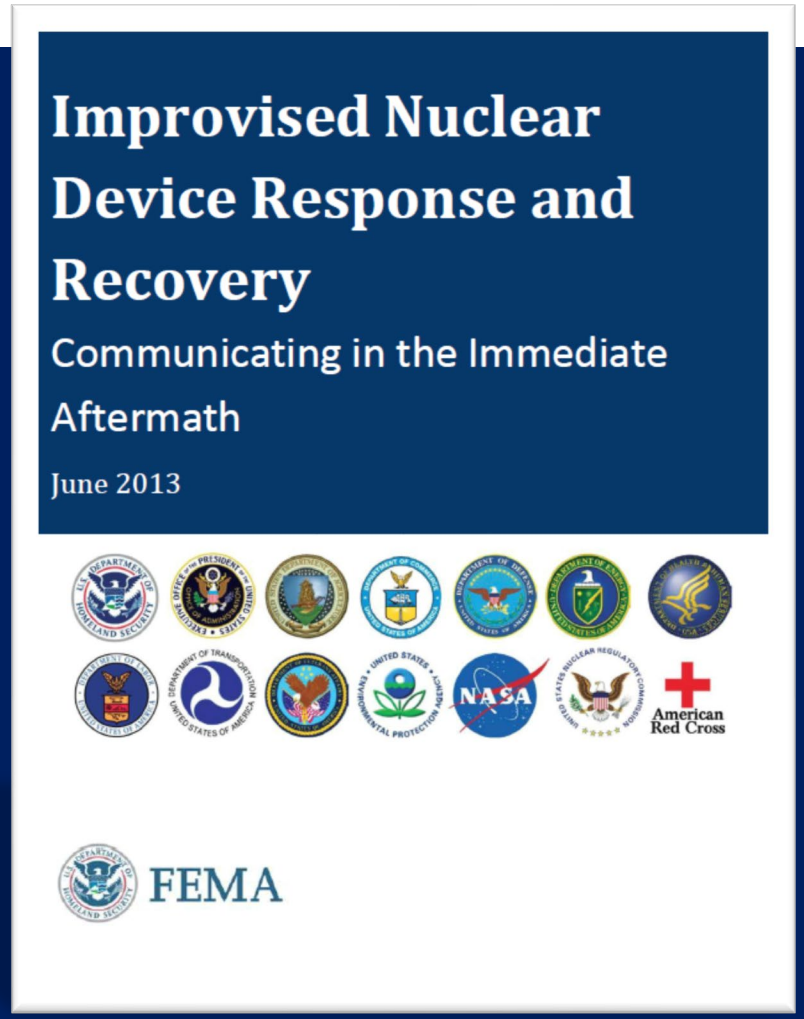


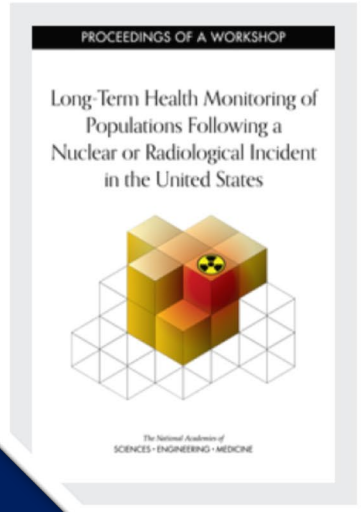
PSYCHOLOGICAL CONSEQUENCES AND ASPECTS OF RADIATION EMERGENCIES RESOURCES



https://www.orau.gov/rsb/pfaird/

SHORT AND LONG-TERM COMMUNICATION RESOURCES





Long-Term Health Monitoring of Populations Following a Nuclear or Radiological Incident in the United States: Proceedings of a Workshop (2019)

DETAILS

88 pages | 6 x 9 | PAPERBACK

ISBN 978-0-309-49263-8 | DOI 10.17226/25443

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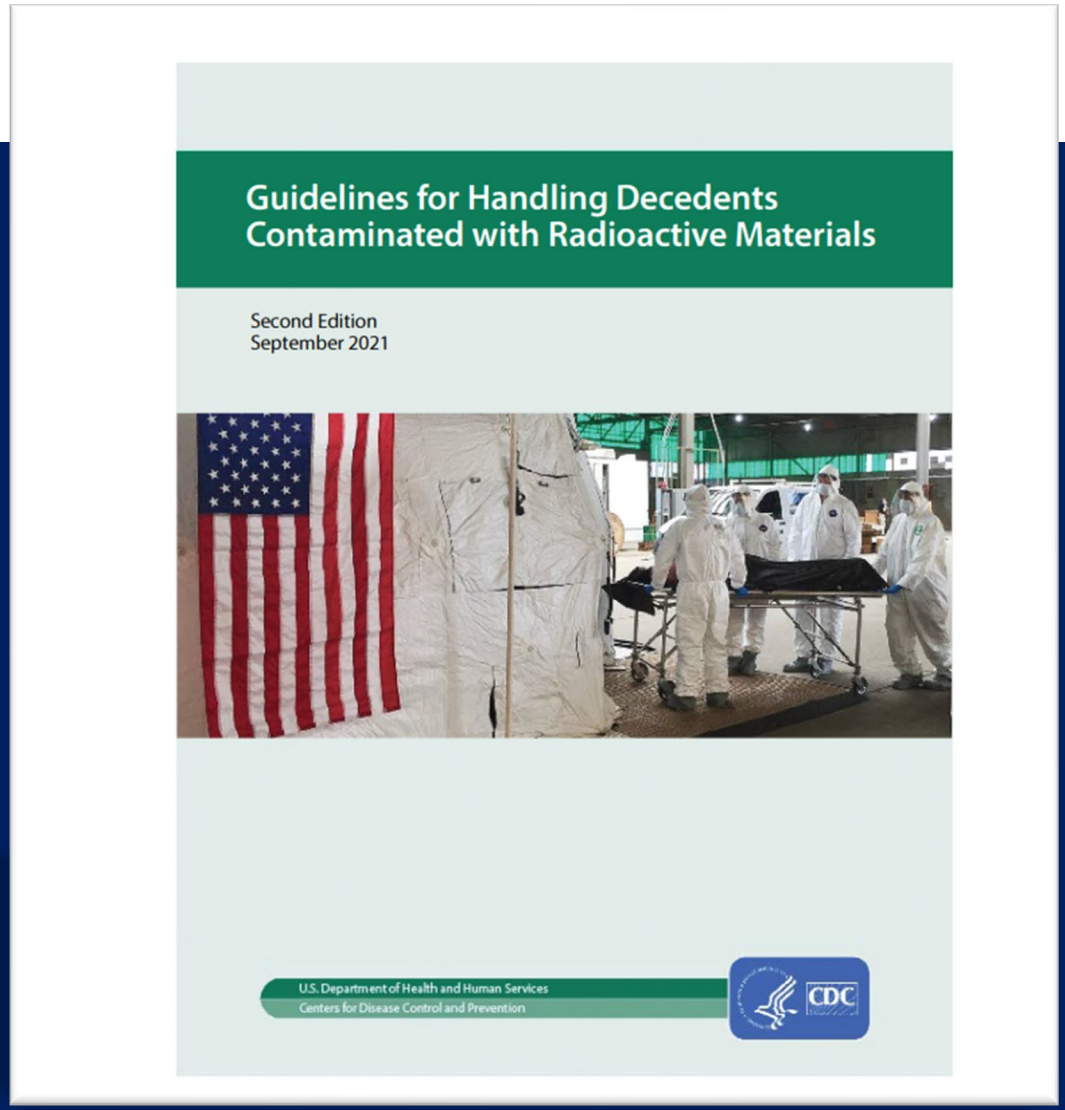
MANAGEMENT OF CONTAMINATED DECEDENTS RESOURCES



SURVEILLANCE AND LONG-TERM POPULATION MONITORING/CONSIDERATIONS

- Medical monitoring of those who exhibited clinical symptoms
- Public health monitoring of those affected
- Access to health care for those affected
- Research on radiation health effects
- Financial compensation for victims
- Social recognition of the tragedy
- Outreach to those affected such as updates on new scientific and medical developments or new programs or policies relevant to the incident

PEDIATRIC AND PREGNANT WOMEN CONSIDERATIONS

- Stochastic effects on the fetus:
  - All or none rule during first 2 weeks post-conception
  - Potential effects vary depending on stage of pregnancy
    - Intellectual disability
    - Growth restriction, congenital malformations
    - Miscarriage, neonatal death
  - Threshold 100 mSv

RADIATION AND PREGNANCY: A FACT SHEET FOR CLINICIANS

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Radiation Emergencies

Radiation and Your Health > Radiation Emergencies > Information for Professionals > Information for Clinicians

- Radiation Emergencies
- What Should I Do?
- Questions About Radiation (FAQ)
- Radiation Dictionary
- Radiation Emergencies & Your Health
- Types of Radiation Emergencies
- Information for Professionals
  - Radiation Thermometer
  - Information for Clinicians
    - Acute Radiation Syndrome: A Fact Sheet for Clinicians
    - Cutaneous Radiation Injury (CRI): A Fact Sheet for Clinicians
    - Radiation and Pregnancy: A Fact Sheet for Clinicians

Radiation and Pregnancy: A Fact Sheet for Clinicians

Print

This overview provides physicians with information about prenatal radiation exposure as an aid in counseling pregnant women.

How to use this document

This information is for clinicians. If you are a patient, we strongly advise that you consult with your physician to interpret the information provided, as it may not apply to you. Information on radiation exposure during pregnancy for members of the public can be found on the Health Information for Specific Groups webpage.

CDC recognizes that providing information and advice about radiation to expectant mothers falls into the broader context of preventive healthcare counseling during prenatal care. In this setting, the purpose of the communication is always to promote health and long-term quality of life for the mother and child.

This page is also available as a PDF [365 KB]

Radiation exposure to a fetus

Most of the ways a pregnant woman may be exposed to radiation, such as from a diagnostic medical exam or an occupational exposure within regulatory limits, are not likely to cause health effects for a fetus. However, accidental or intentional exposure above regulatory limits may be cause for concern.

Although radiation doses to a fetus tend to be lower than the dose to the mother, due to

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AMERICAN ACADEMY OF PEDIATRICS | JUNE 01 2003

Radiation Disasters and Children

Committee on Environmental Health

Pediatrics (2003) 111 (6): 1455–1466.
https://doi.org/10.1542/peds.111.6.1455

Connected Content

This article has been reaffirmed: AAP Publications Reaffirmed, January 2007

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The special medical needs of children make it essential that pediatricians be prepared for radiation disasters, including 1) the detonation of a nuclear weapon; 2) a nuclear power plant event that unleashes a radioactive cloud; and 3) the dispersal of radionuclides by conventional explosive or the crash of a transport vehicle. Any of these events could occur unintentionally or as an act of terrorism. Nuclear facilities (eg, power plants, fuel processing centers, and food irradiation facilities) are often located in highly populated areas, and as they age, the risk of mechanical failure increases. The short- and long-term consequences of a radiation disaster are significantly greater in children for

ADDITIONAL ITEMS NOT COVERED IN THIS PRESENTATION

- Nation Response Framework and available Federal/State/Interstate resources
- Waste Management and Transportation issues brief overview

THANK YOU FOR YOUR ATTENTION

- Happy to discuss any additional questions by email
- Follow me on Twitter @*ZiadKazzi*
- Check out our website and register to attend our upcoming webinar series starting with April 18, 2023 and then May 16, 2023
  - All webinars will be made available after May 16 for viewing. Stay tuned!

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THANK YOU

HOW CAN WE WORK TOGETHER TO STRENGTHEN REGION 4?

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HHS Region IV