



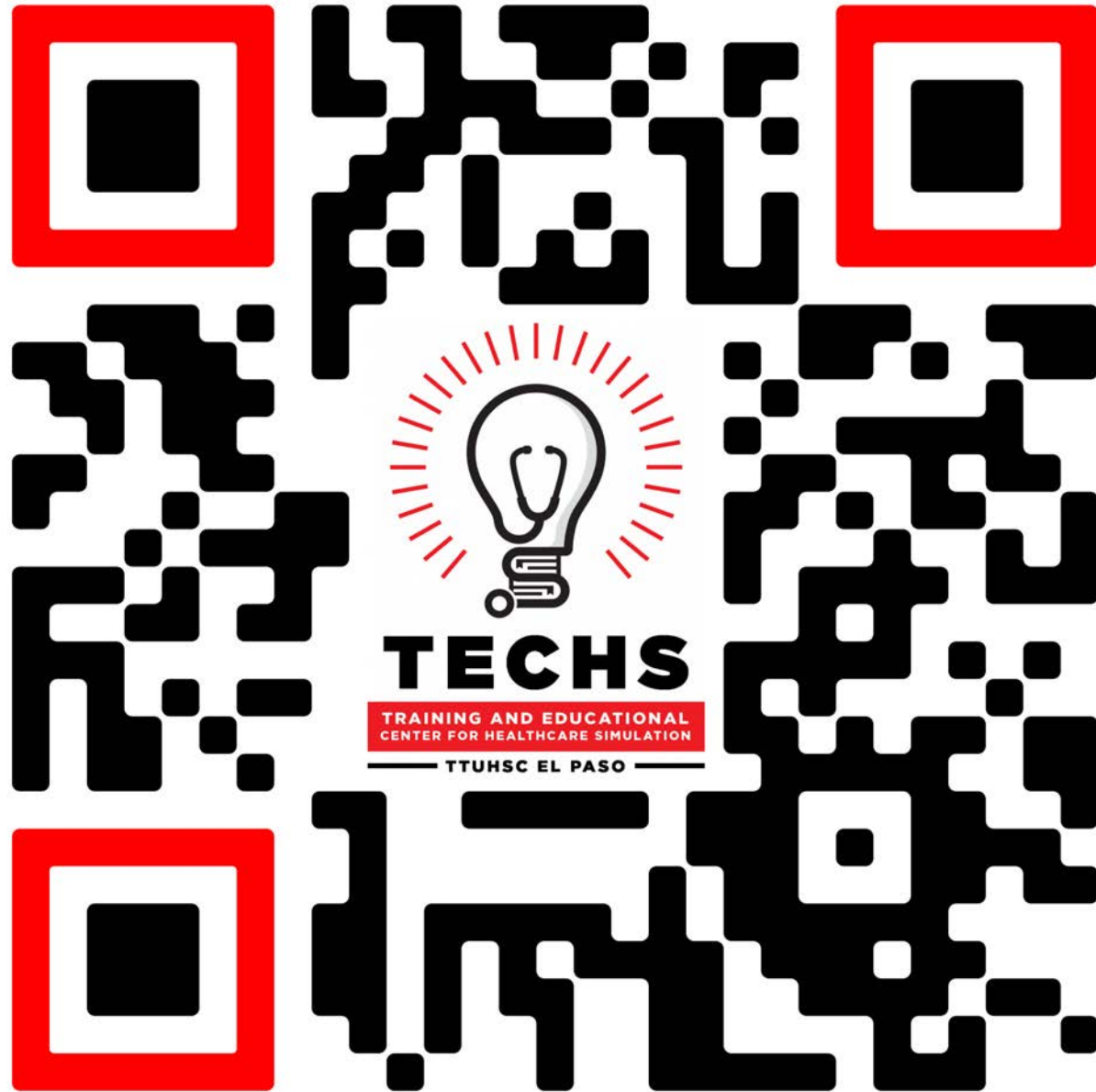
Radiation Disaster Treatment and Community Planning

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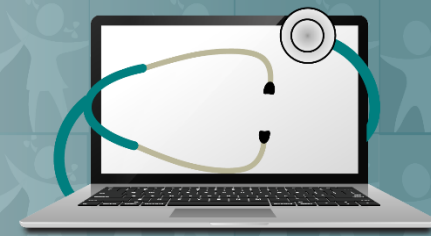


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PEHSU NATIONAL CLASSROOM

Pediatric Environmental Health Specialty Units



www.pehsu.net/nationalclassroom.html



Webinars

Series of scientific webinars that provide a forum for discourse on scientific issues.

Live and On-Demand

Case Conferences
Journal Clubs
Grand Rounds

CE Available



Online Courses

Evidence-based online courses on a variety of children's environmental health topics.

Interactive and Self-Paced

CE Available



Resource Catalog

Fact sheets, journal publications, reports, and other resources for parents, community members, patients and healthcare professionals

Topics included:
Air Quality, Pesticides, Natural Disasters, BPA, Mold, Lead, Mercury

The findings and conclusions in this presentation have not been formally disseminated by the Agency for Toxic Substances and Disease Registry and should not be construed to represent an agency determination or policy.

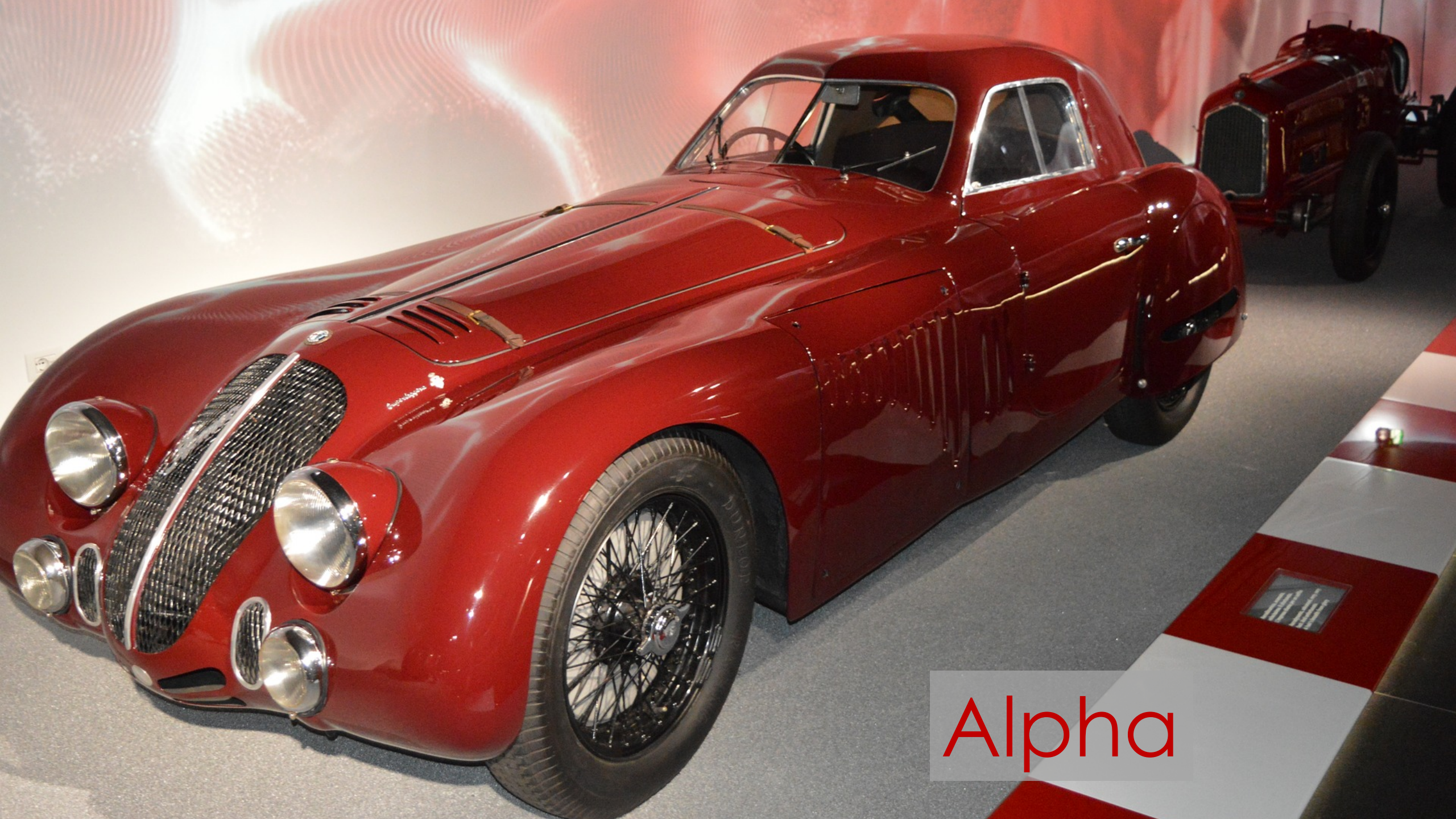
Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-95877701. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications.

Objectives

1. Describe the types of radiation and the important difference in treatment and care between exposure and contamination
2. Activate regional and national resources to assist in screening and provision of medical care to patients with radiation exposure
3. Identify patients at high risk of adverse events from radiation exposure.
4. Review disaster plan guidelines for UMC and the El Paso region related to the detection, notification, decontamination, and containment of radioactive materials or patient with radiation contamination.

Radiation types and shielding

- Alpha – large (2 protons and 2 neutrons)
 - Easily blocked by paper or layer of skin
- Beta – Electrons
 - Blocked by heavy clothing
- Gamma (x-rays) – electromagnetic energy
 - Blocked by thick or high density shielding
- Neutrons – Highly penetrating particles (from fission reactions)
 - Blocked by many feet of concrete or water



Alpha

Beta



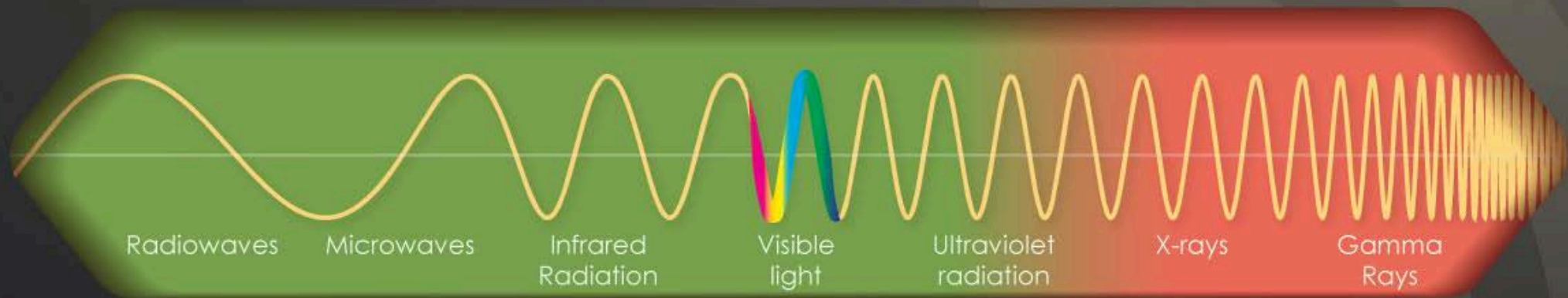


Gamma

ELECTROMAGNETIC SPECTRUM

LOWER ENERGY

HIGHER ENERGY



Radiowaves

Microwaves

Infrared
Radiation

Visible
light

Ultraviolet
radiation

X-rays

Gamma
Rays

Non-ionizing radiation

Ionizing radiation

Piece of Paper





Sheet of Plastic



Block of Concrete

A stack of several dark grey, rectangular lead bricks is shown. The bricks are stacked in a way that they form a protective barrier. A yellow warning label is affixed to the front of the stack. The label features a red radiation symbol (a trefoil) with the letters 'Cs' in the center. To the right of the symbol, the text reads 'CAUTION RADIOACTIVE MATERIAL' in black capital letters. The background shows a laboratory or industrial setting with various equipment, cables, and a metal structure.

**CAUTION
RADIOACTIVE
MATERIAL**

Lead shielding

Alpha Data. Economic Implications



Half-life

- Biologic half-life (elimination/excretion)
- Physical half-life (particle decay rate)
- Effective half life – predominated by faster of the above.
 - $1/\text{effective half-life} = 1/\text{physical half-life} + 1/\text{biological half-life}$

Radiation decay

Radionuclide Decay Data

Use this Web page to view the decay data (mode, emissions, energies, frequencies, etc.) for about 850 radionuclides of interest to internal and external dose assessment. Click on the element of interest to begin...

1 H																	2 He	
3 Li	4 Be										5 B	6 C	7 N	8 O	9 F	10 Ne		
11 Na	12 Mg										13 Al	14 Si	15 P	16 S	17 Cl	18 Ar		
19 K	20 Ca	21 Sc		22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y		40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	1	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	2	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt									

1	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
2	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Units

Unit	Absorbed	Biologic equivalent
1 J/kg	Gy (gray) or Rad	Sv (sievert) or Rem

1 Gy absorbed dose is threshold for Acute Radiation Syndrome (ARS)

$$\mathbf{Sv = Gy * Q * tissue\ factor}$$

Tissue Sensitivities

Organ or Tissue	Tissue Weighting Factor
Bone Marrow (red)	0.12
Colon	0.12
Lung	0.12
Breast	0.12
Gonads	0.08
Brain	0.01
Skin	0.01
Bone surface	0.01

Building Materials



Building Materials

A large group of people, mostly in swimwear, are gathered in a natural hot spring pool. The water is a dark, mineral-rich green. People are seen sitting on the rocky edges, standing in the shallow water, and swimming. The background is filled with lush green foliage and a concrete structure. The overall atmosphere is one of a busy, natural spa environment.

Radon



Exposure limits

- National Council on Radiation Protection and Measurements does not set a dose limit when performing life saving activities.
- When 0.5 Gy has been reached team leader may decide how to proceed

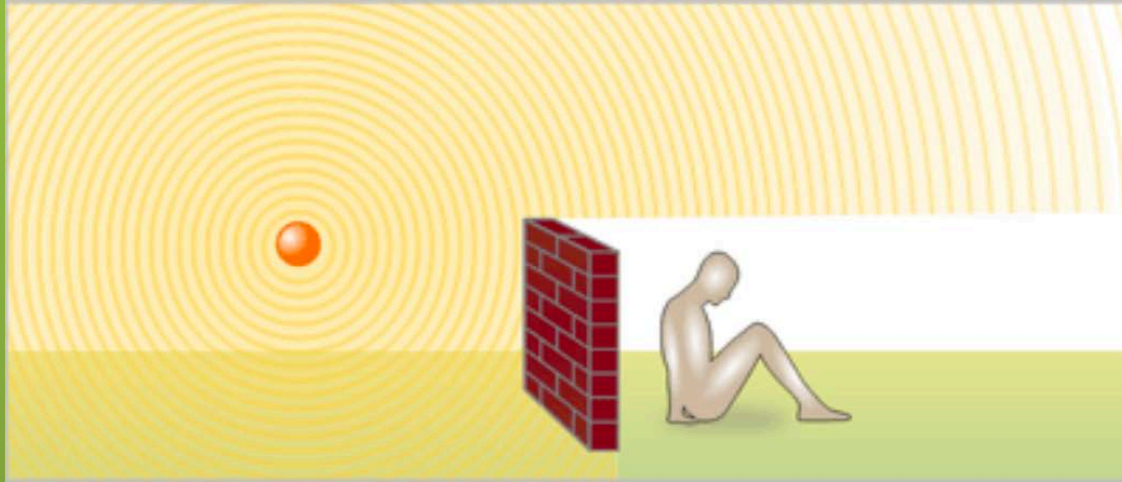
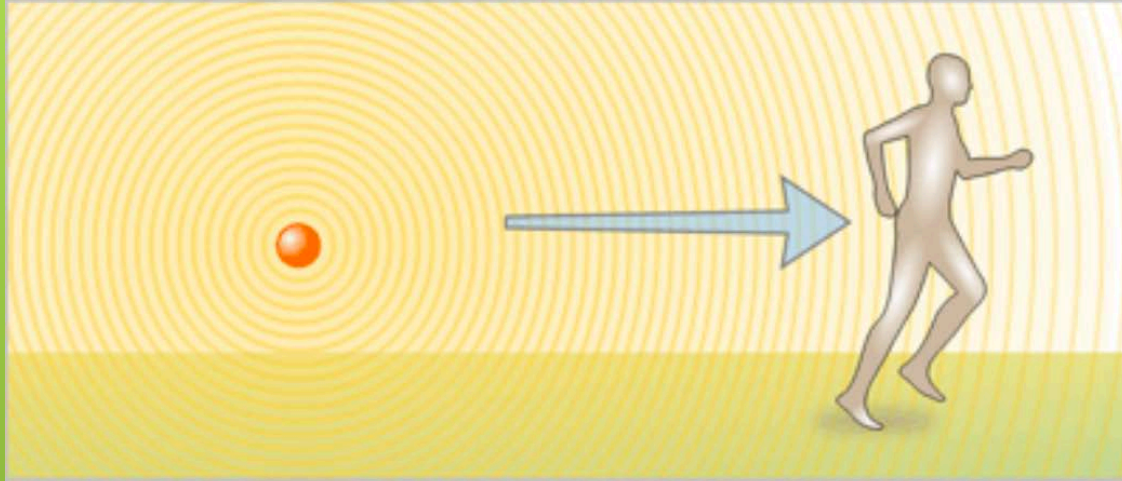
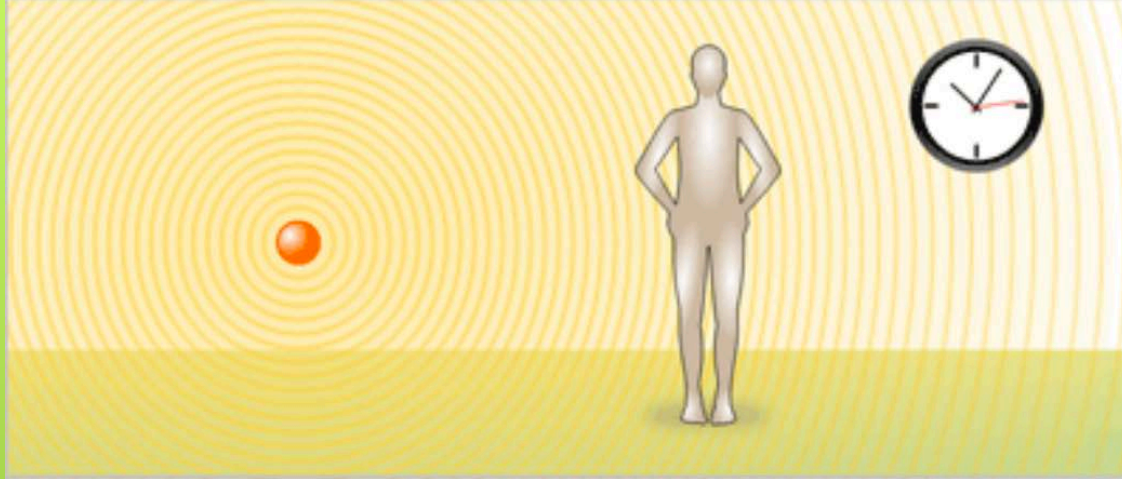
Kazzi, Z., Buzzell, J., Bertelli, L., & Christensen, D. (2015). Emergency Department Management of Patients Internally Contaminated with Radioactive Material. *Emergency medicine clinics of North America*, 33(1), 179-196.

ALARA



ALARA

- As Low As Reasonably Achievable
- Absolute zero radiation exposure is not feasible or possible, so as good as you can get...
 - Limit duration
 - Increase distance
 - Use shielding



Contamination vs Exposure

- Contamination - Threat goes with you
- Exposure – No subsequent risk to others

RADIATION EXPOSURE

Another word for radiation exposure is irradiation.

Radioactive materials give off a form of energy that travels in waves or particles.



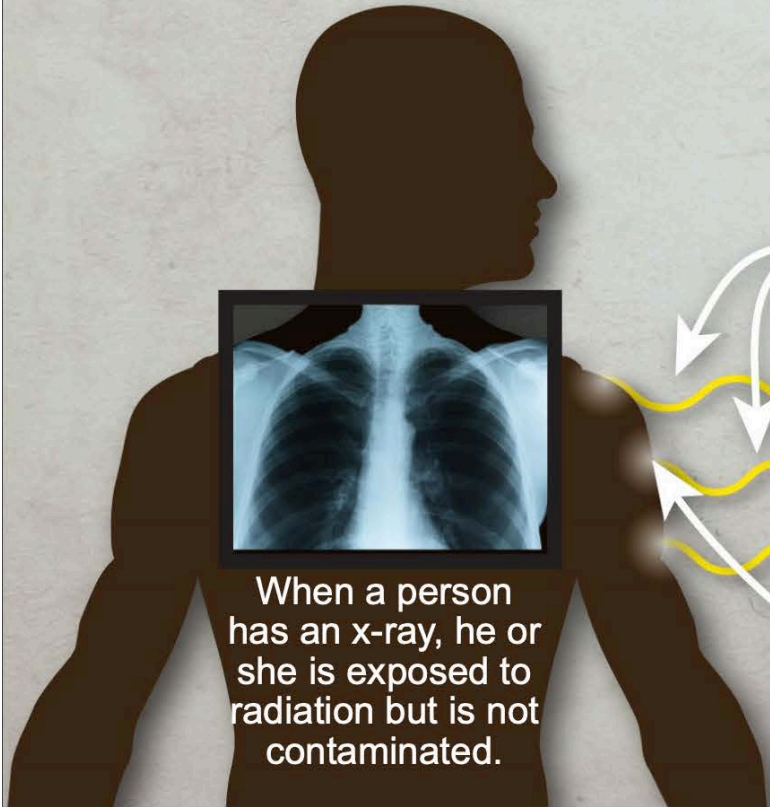
A person exposed to radiation is not necessarily contaminated with radioactive material.

For a person to be contaminated, radioactive material must be on or inside of his or her body.



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

<http://emergency.cdc.gov/radiation>



When a person has an x-ray, he or she is exposed to radiation but is not contaminated.

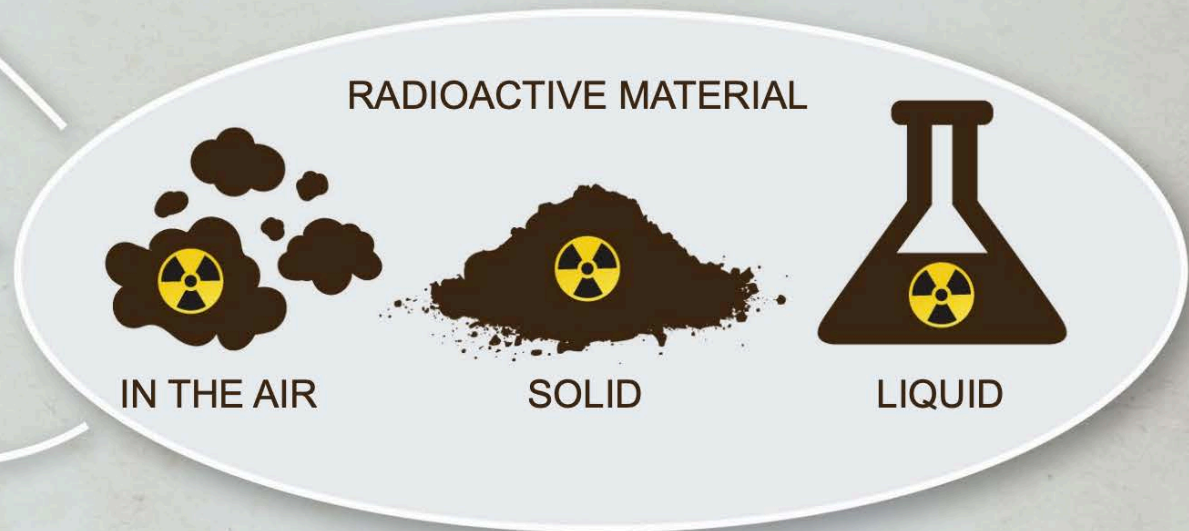
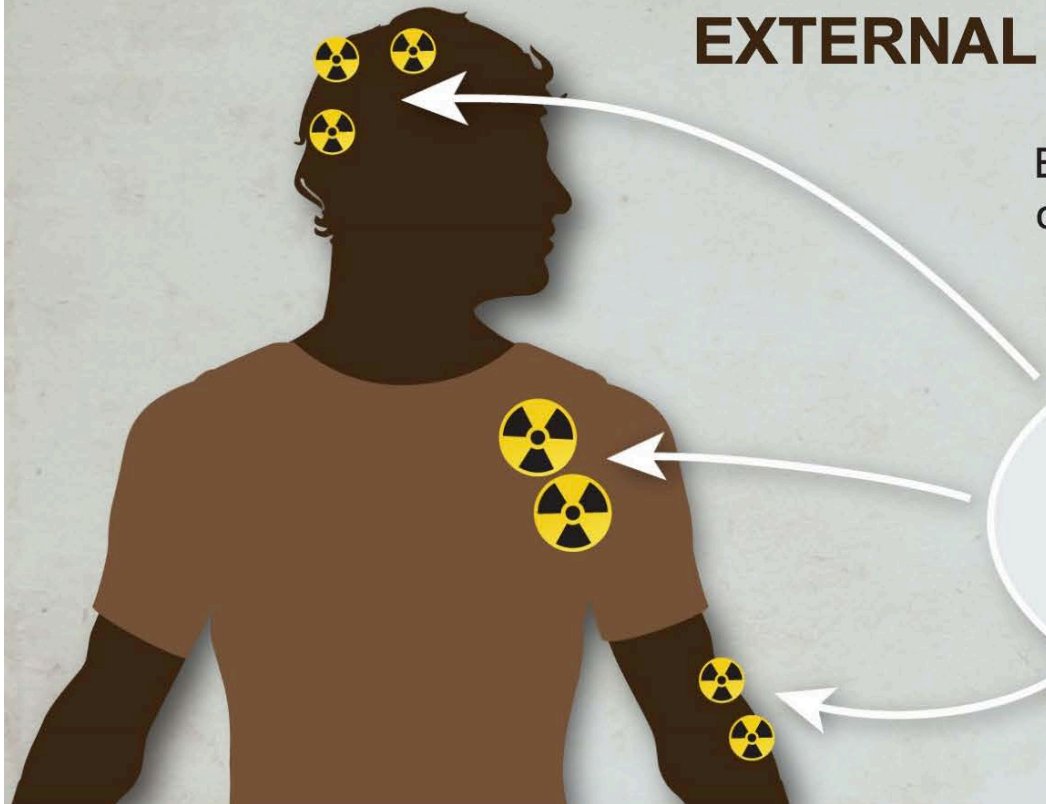
When a person is exposed to certain types of radiation, the energy may penetrate the body.

Radiation Safety Officer

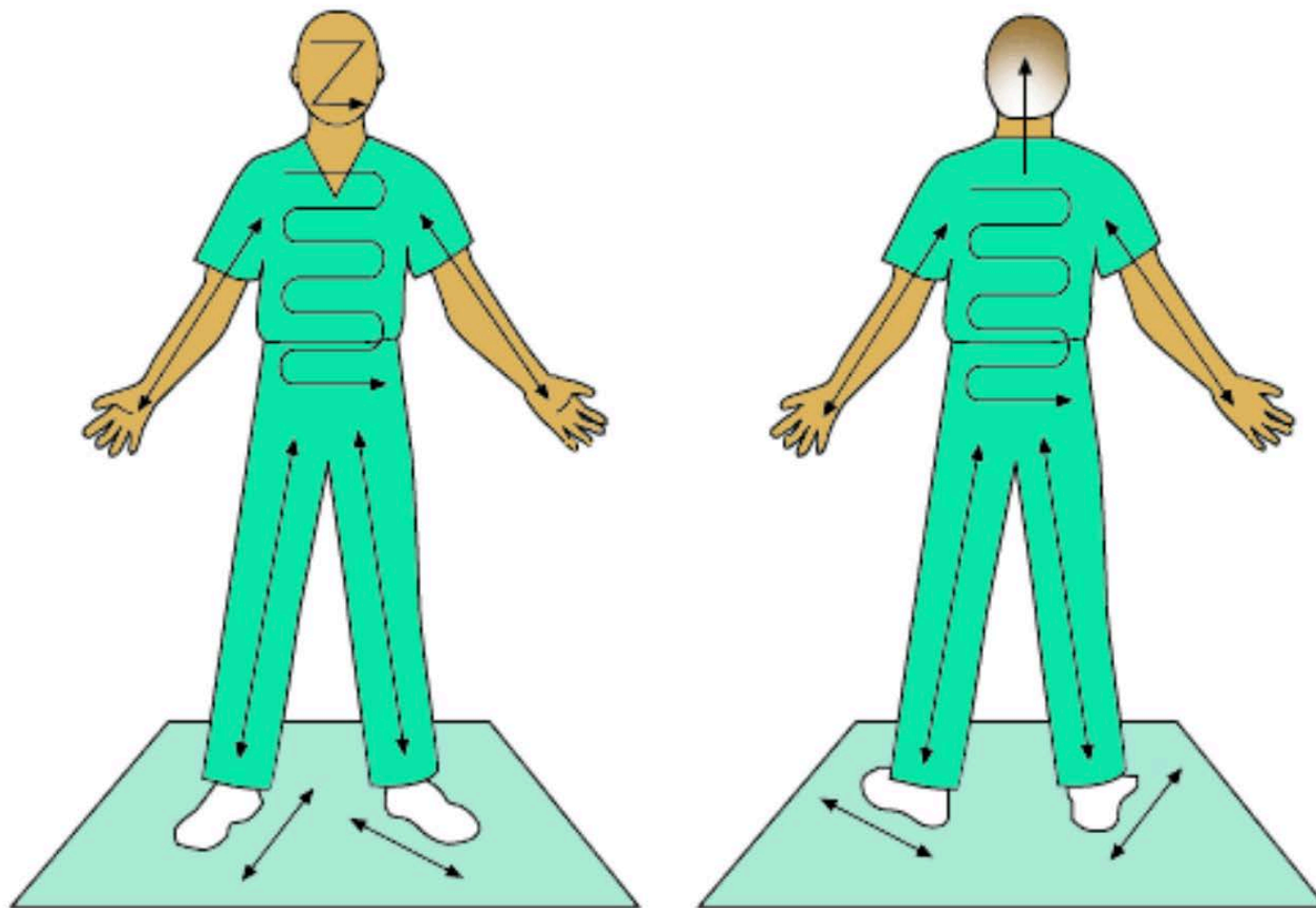
- Necessary level of PPE
 - Standard is protective except for Gamma
 - N-95 if recent dust/debris
- Personal dosimeter
- Contamination detected on patient
- Extent of decontamination procedure
- Shielding and storage of waste

EXTERNAL CONTAMINATION

External contamination occurs when radioactive material comes into contact with a person's skin, hair, or clothing.



Radiation Screening



Source of graphic: [Radiation Emergency Assistance Center/Training Site \(REAC/TS\)](#)

Decontamination

- Assess/treat life-threatening injuries
- Remove clothing and contaminated material
 - Store in double plastic bag
- Radiation survey
- Perform additional decontamination
 - Use soap and water
 - Use forceps for foreign bodies
- Repeat radiation survey

Decontamination

- Use multiple layers of sheets for removal
- Drain irrigation into a bag to remove contamination



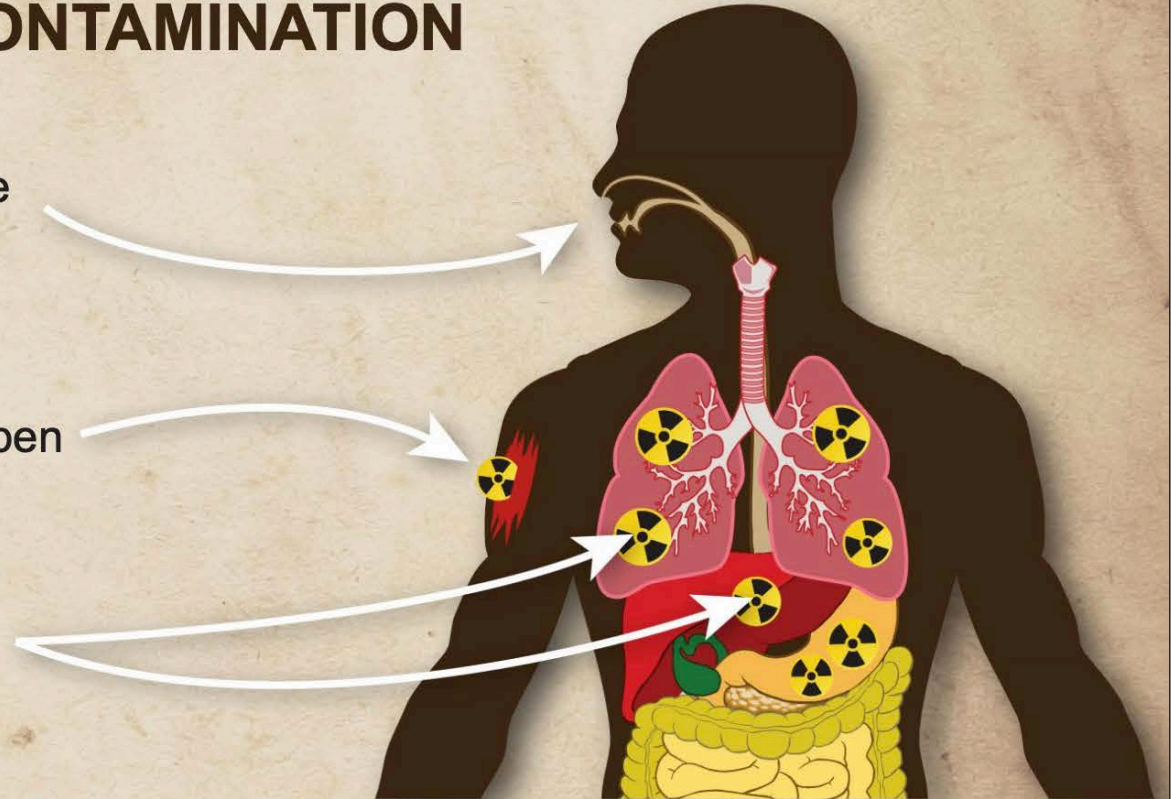
Aim for 2X Background

INTERNAL CONTAMINATION

Internal contamination can occur when radioactive material is swallowed or breathed in.

Internal contamination can also occur when radioactive material enters the body through an open wound.

Different radioactive materials can accumulate in different body organs.



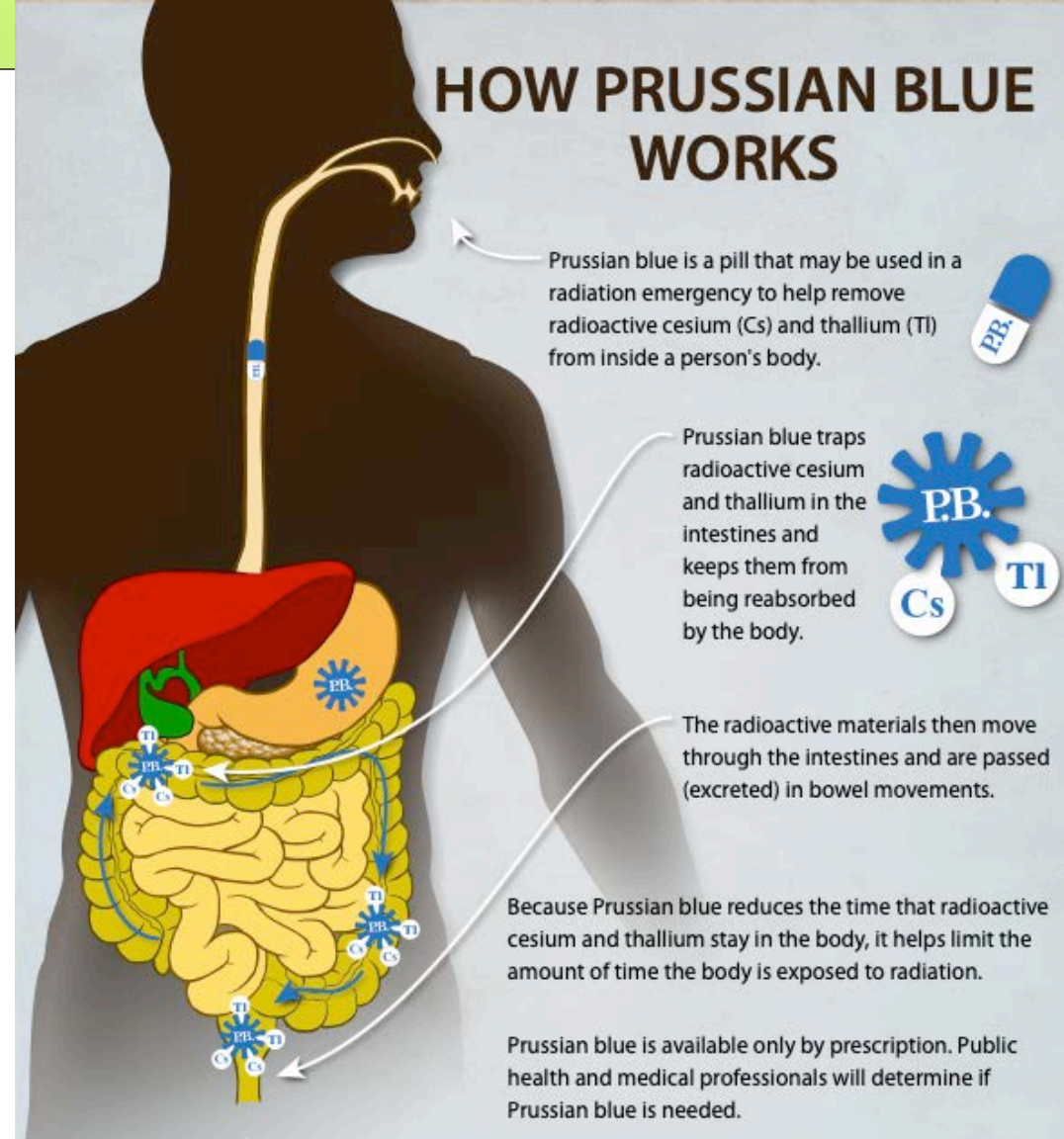
Managing internal contamination

- Supportive care
- Enhance excretion
 - Gastric lavage/charcoal (limited study)
 - Bronchoalveolar Lavage (rare)

Specific Therapies

- Prussian Blue – binds in intestinal tract
 - Used for Cesium and Thallium
 - 3g PO q 8 hours
- Calcium DTPA or Zinc DTPA
 - Used for Plutonium, Americium, Curium
 - 1g IV daily
- Potassium Iodide
 - Used for radioactive Iodine
 - Stop thyroid uptake
- Cytokines
 - Stimulate granulocytes to decrease infection risk

HOW PRUSSIAN BLUE WORKS



Prussian blue is a pill that may be used in a radiation emergency to help remove radioactive cesium (Cs) and thallium (Tl) from inside a person's body.



Prussian blue traps radioactive cesium and thallium in the intestines and keeps them from being reabsorbed by the body.



The radioactive materials then move through the intestines and are passed (excreted) in bowel movements.

Because Prussian blue reduces the time that radioactive cesium and thallium stay in the body, it helps limit the amount of time the body is exposed to radiation.

Prussian blue is available only by prescription. Public health and medical professionals will determine if Prussian blue is needed.

People **SHOULD NOT** take Prussian blue artist's dye in an attempt to treat themselves. This type of Prussian blue is not designed to treat radioactive contamination and can be harmful.



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

<http://emergency.cdc.gov/radiation>

Stochastic effects

- Random outcome effects for an for exposure, but risk increased with exposure
- Example – Cancer and birth defects

A close-up, top-down view of a dartboard. The board is circular with a silver metal rim and a dark green felt surface. The numbers 1 through 20 are arranged in a ring around the center, alternating between red and black segments. The numbers are white. The central bullseye is a small, circular metal disc. A white dart is visible in the 8 segment. The word "Stochastic" is overlaid in the center in a bold, red, sans-serif font.

Stochastic

Deterministic Effects

- Predetermined or destined response given a specific dose
- Example – Bone marrow failure and neutropenia



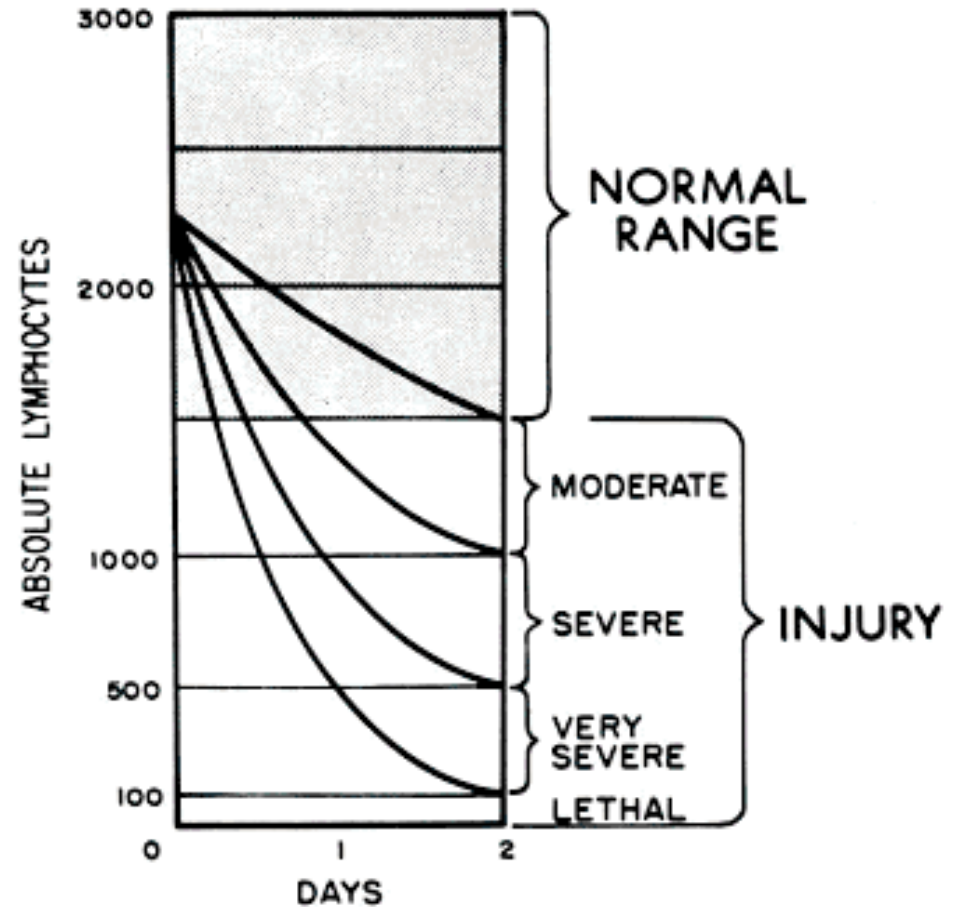
Acute Radiation Syndrome

- 1. Cerebro- or cardiovascular syndrome
 - >50 Gy dose
 - Confusion onset within minutes – lethal in days
- 2. Gastrointestinal syndrome
 - >10 Gy dose
 - GI sloughing and infection – lethal in weeks
- 3. Hematopoietic syndrome
 - >0.7 Gy dose
 - Prolonged course +/- recovery in weeks to months

Andrews Lymphocyte Nomogram

Q3 hours CBCs for lymphocyte count trending

Blood cell decline may last weeks



<https://www.cdc.gov/nceh/radiation/emergencies/pdf/arsphysicianfactsheet.pdf>

2. Lymphocyte Depletion Kinetics



Warning

[Background](#) | [Illustrations](#) | [References](#)

1. Date/time exposure began



(e.g., 01/22/2008, 14:25)



2. Date/time of one or more blood counts







(e.g., 01/22/2008, 23:00)

Lymphocyte count

(x 10⁹ cells/L) 

(e.g., 1.25)

3. Estimate dose from exposure

4. Dose estimate

Gy

[95% confidence limits](#)

Gy



- Understand Radiation
- Plan Ahead
- Practice Teamwork
- Work Safely

Interactive Clinical Tools ▾

Diagnosis & Treatment ▾

Reference & Data ▾

Overview ▾

Get REMM App

What Kind of Emergency?



- › Nuclear Detonation: Weapons, Improvised Nuclear Devices
- › Radiological Dispersal Devices, Dirty Bombs
- › Nuclear Power Plant/ Reactor Incidents
- › Radiological Exposure Devices
- › Transportation Incidents

Patient Management



- › Choose Appropriate Algorithm
- › Contamination
- › Exposure (Acute Radiation Syndrome)
- › Exposure + Contamination
- › Triage Guidelines
- › Hospital Orders Template

Initial Incident Activities



- › Discovering an Incident
- › Describing an Incident
- _____
- › On-site Activities
- › Triage Guidelines
- › Transport Victims
- › Hospital Activities

Management Modifiers



- › Radiation + Trauma
- › Burn Triage and Treatment
- › Mass Casualty
- › Psychological Issues
- › At-risk / Special Needs Populations

Practical Guidance



- › Use of Blood Products
- › Population Monitoring
- › Decontamination Procedures
- › Follow-up Instructions
- › Management of the Deceased
- › Develop a Response Plan

[More...](#)

Other Audiences



- › First Responders
- › Mental Health Professionals
- › Hospital Staff
- › Public Information Officers
- › Radiation Safety Officers
- › Planners
- › Trainers: Practices & Drills

[More...](#)

Radiological Dispersal Device (RDD) Response Guidance

Planning for the First 100 Minutes



Considerations

Tactic 6 – “Do Not Delay Lifesaving Rescue Efforts because of the presence of radiation” –

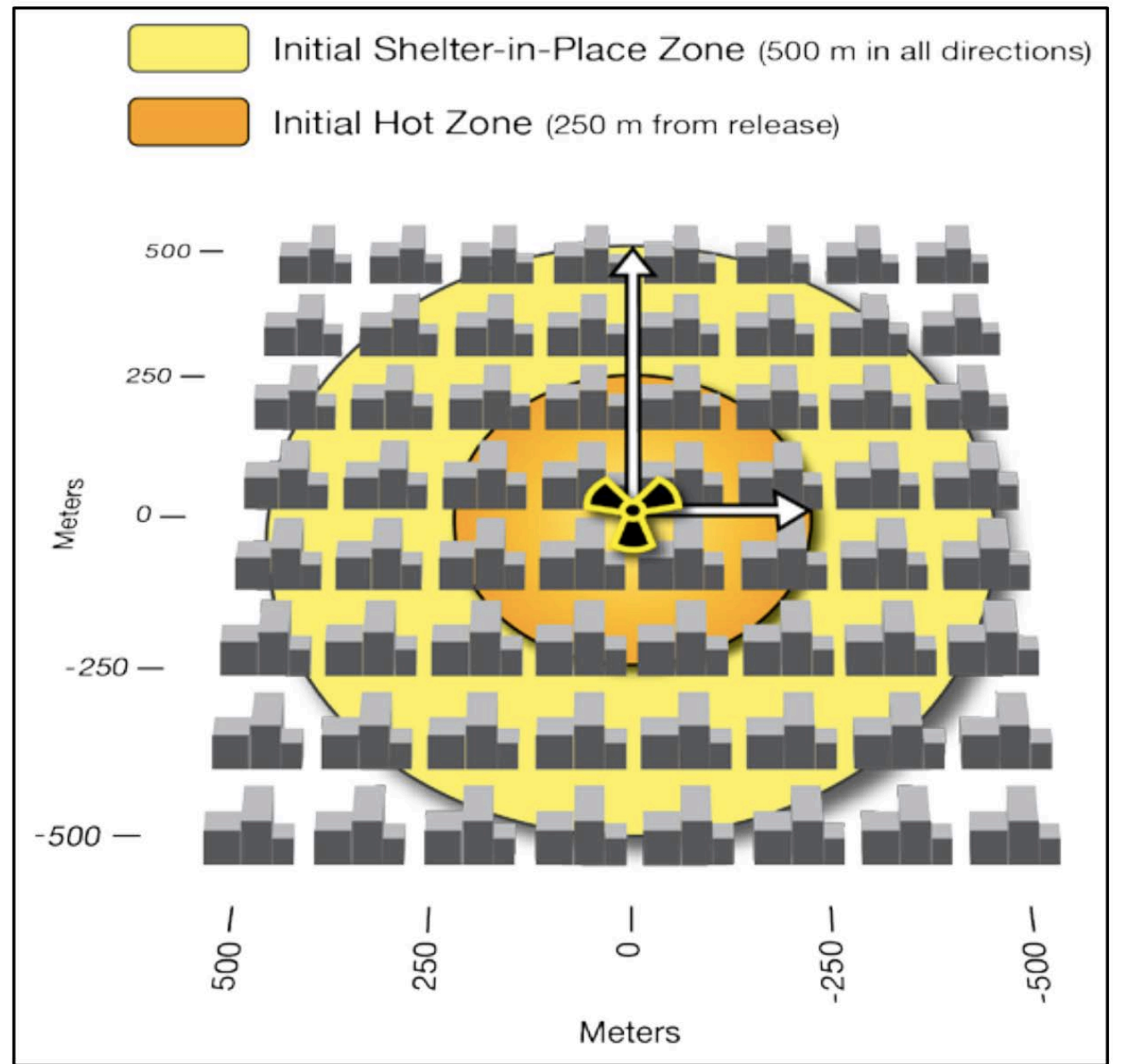
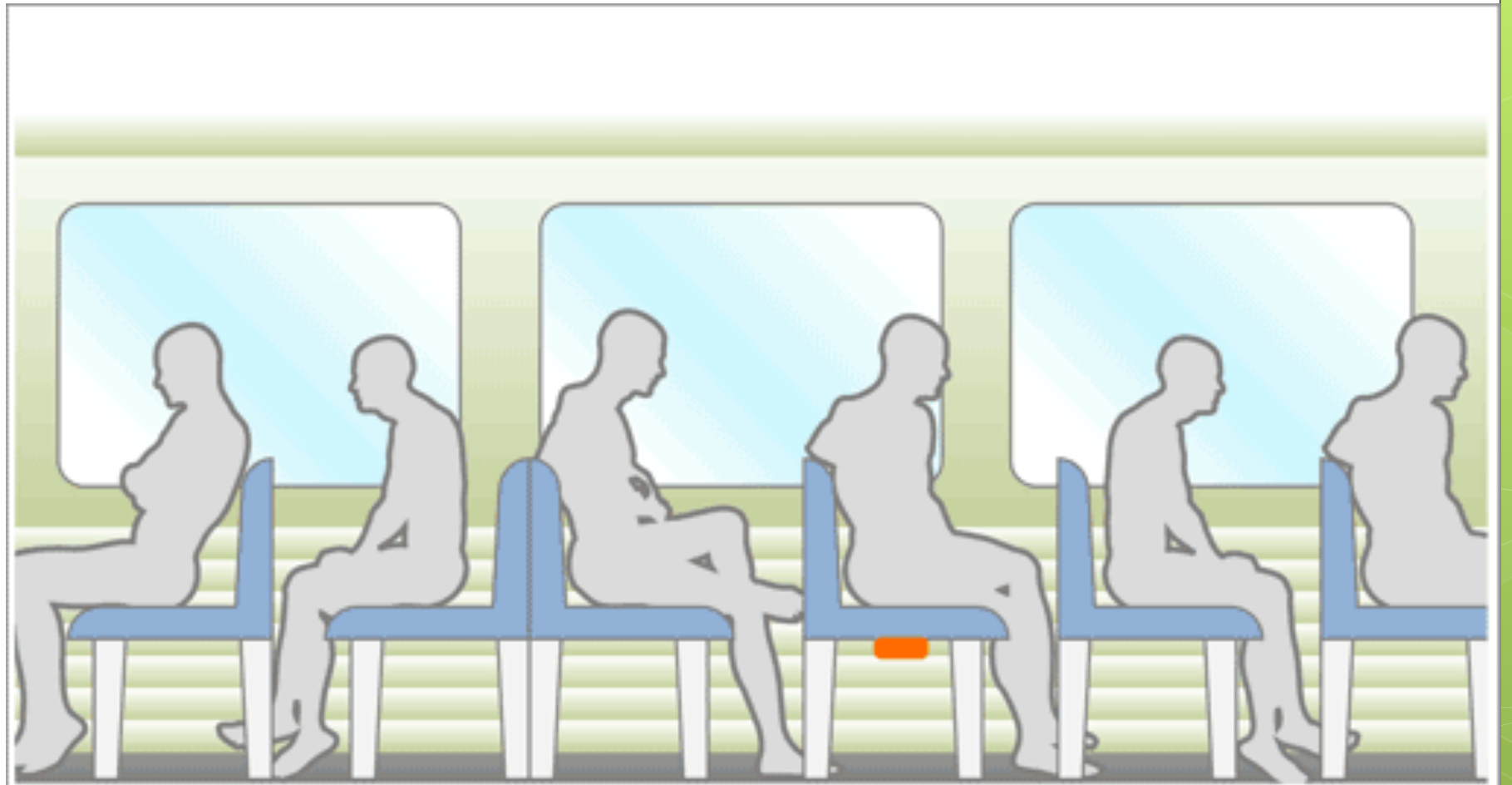


Figure 3: Initial Hot and Shelter-in-Place Zones, with Unknown Direction of Contamination

Radiological Exposure Device (RED)



Radiological Dispersal Device (RDD)



Emergency Management Annex D

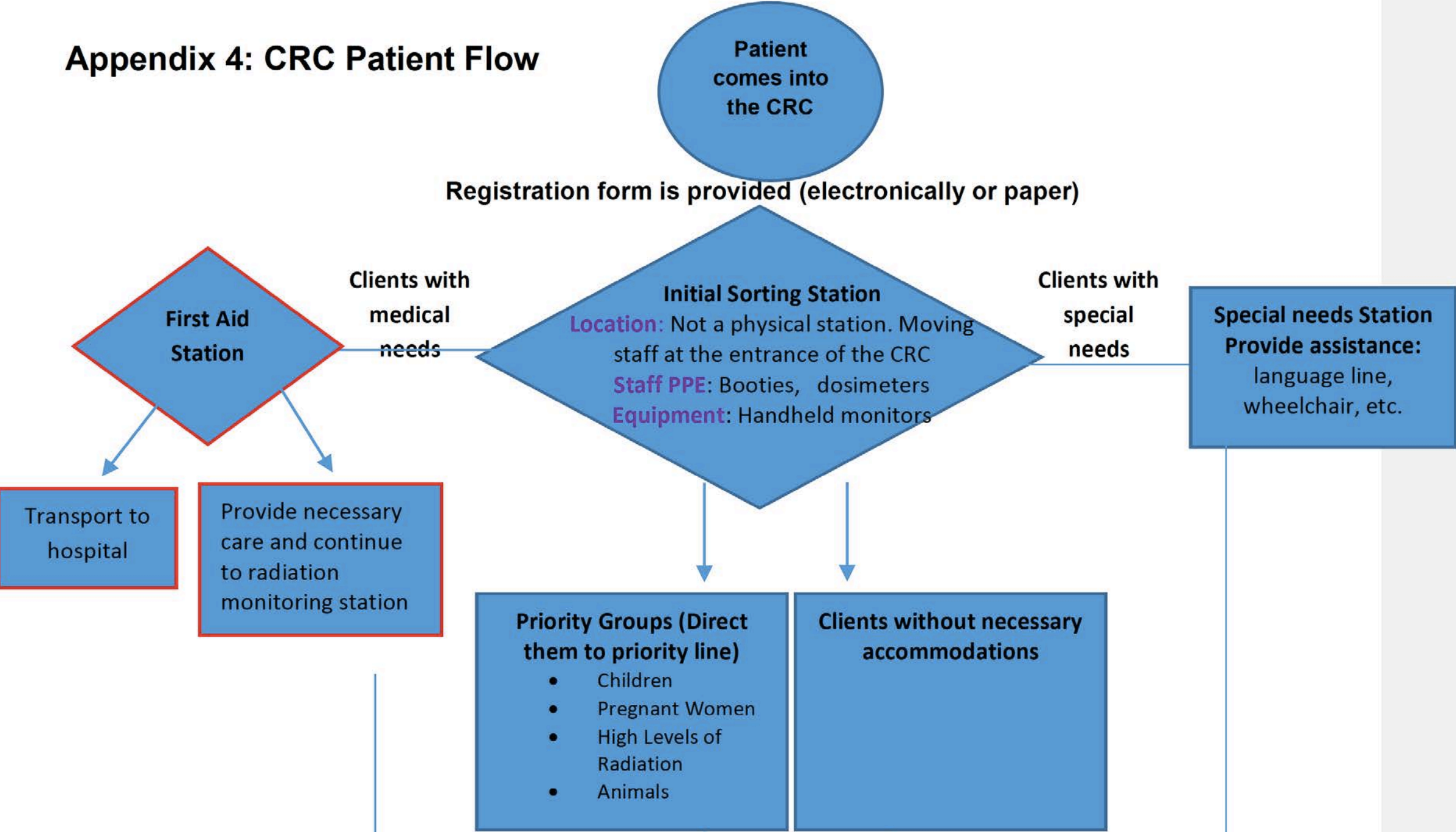
- Radiological

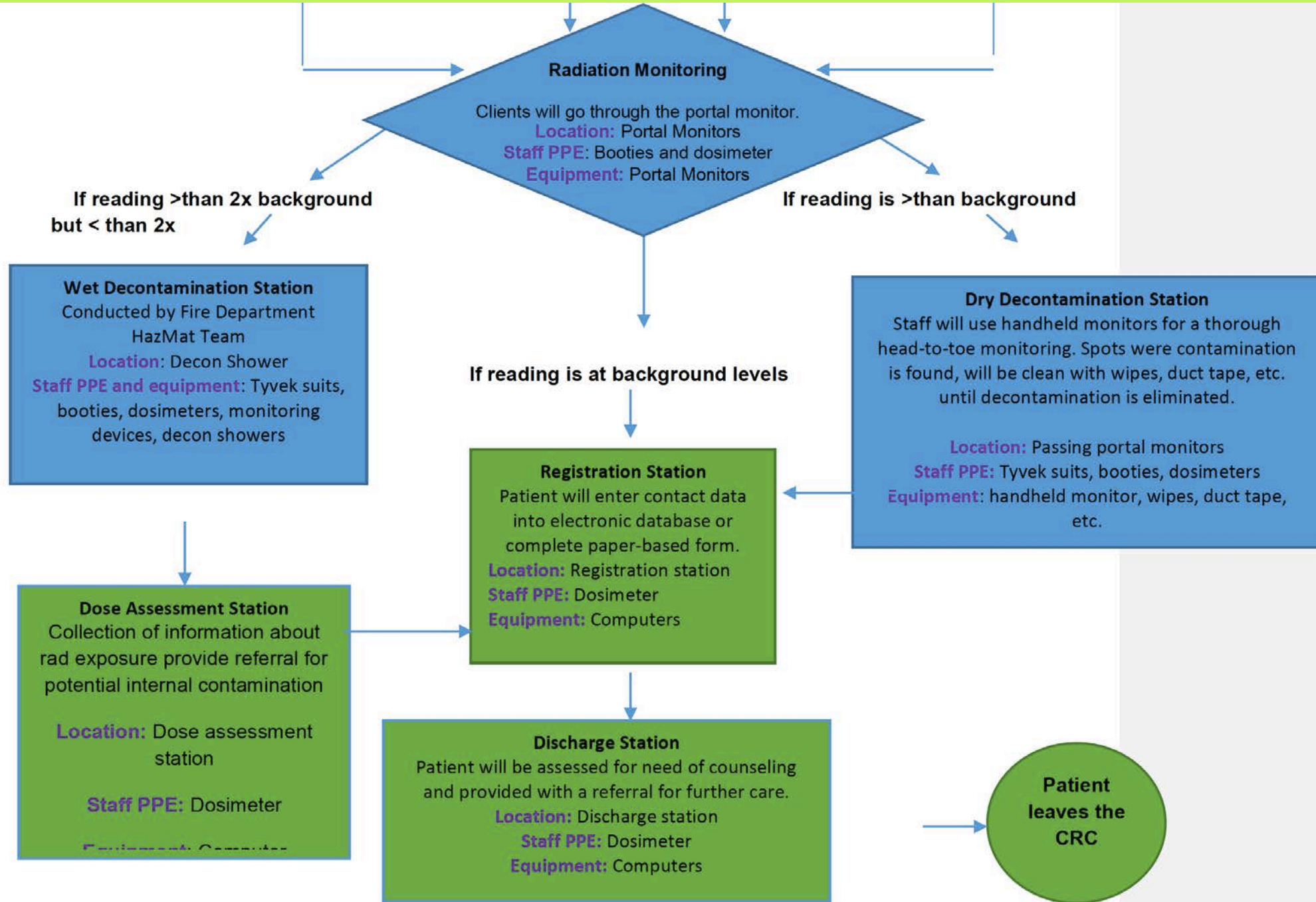
- El Paso Radiation Plan

Goal of Public Health in Radiation

- Establish and manage Community Reception Centers (CRC)
- Conduct population monitoring
- Dispense prophylactic medications

Appendix 4: CRC Patient Flow





Portal Monitoring



CDC does not recommend setting a predetermined, fixed screening criterion.

Who do you call?

- Radresponder.net
- [Texas – Trauma Regional Advisory Councils](#)
- Poison Control Center (1-800-222-1222)
- Health Department (Community Reception Centers)

Contact REAC/TS



General information

865-576-3131



General email

reacts@orau.org



Emergency number

865-576-1005 (Ask for REAC/TS)

EMS & Trauma Systems Home

Applications and Forms

Laws and Rules



Check EMS Certification/License Status

Designation



EMS Personnel



EMS Agencies (Providers)



EMS Education Programs

Complaints and Criminal History

Enforcement Actions

Funding Sources

Governor's EMS & Trauma Advisory Council

Line of Duty Deaths

Links

Home > EMS-Trauma Systems > Regional Advisory Councils

Regional Advisory Councils

 SIGN UP FOR EMAIL UPDATES

What is a RAC?

Regional Advisory Councils (RACs) are the administrative bodies responsible for trauma system oversight within the bounds of a given Trauma Service Area in Texas. Each of the 22 RACs is tasked with developing, implementing, and monitoring a regional emergency medical service trauma system plan. Generally, RAC stakeholders are comprised of healthcare entities and other concerned citizens with an interest in improving and organizing trauma care. As such, not every Regional Advisory Council is structured the same. However, each RAC has the same objectives – to reduce the incidence of trauma through education, data collection, data analysis and performance improvement. Typically, this is accomplished via the provision of educational programs and performance improvement efforts designed to offer every provider guidance and motive to reduce the incidence of trauma, as well as improve outcomes of trauma patients.

Texas DSHS

- Chris.Moore@dshs.texas.gov
 - W: 512-834-6678
 - C: 512-924-6460

Radiation Emergency Number: 512-458-7460



UNIVERSITY MEDICAL CENTER
OF EL PASO



Radiation Emergency Response Plan

March 2019

Detect – 2 Geiger-Mueller counters
3 Pocket Dosimeters

Notify – Dr. Diaz through Operator
(Will also get 2 Residents)

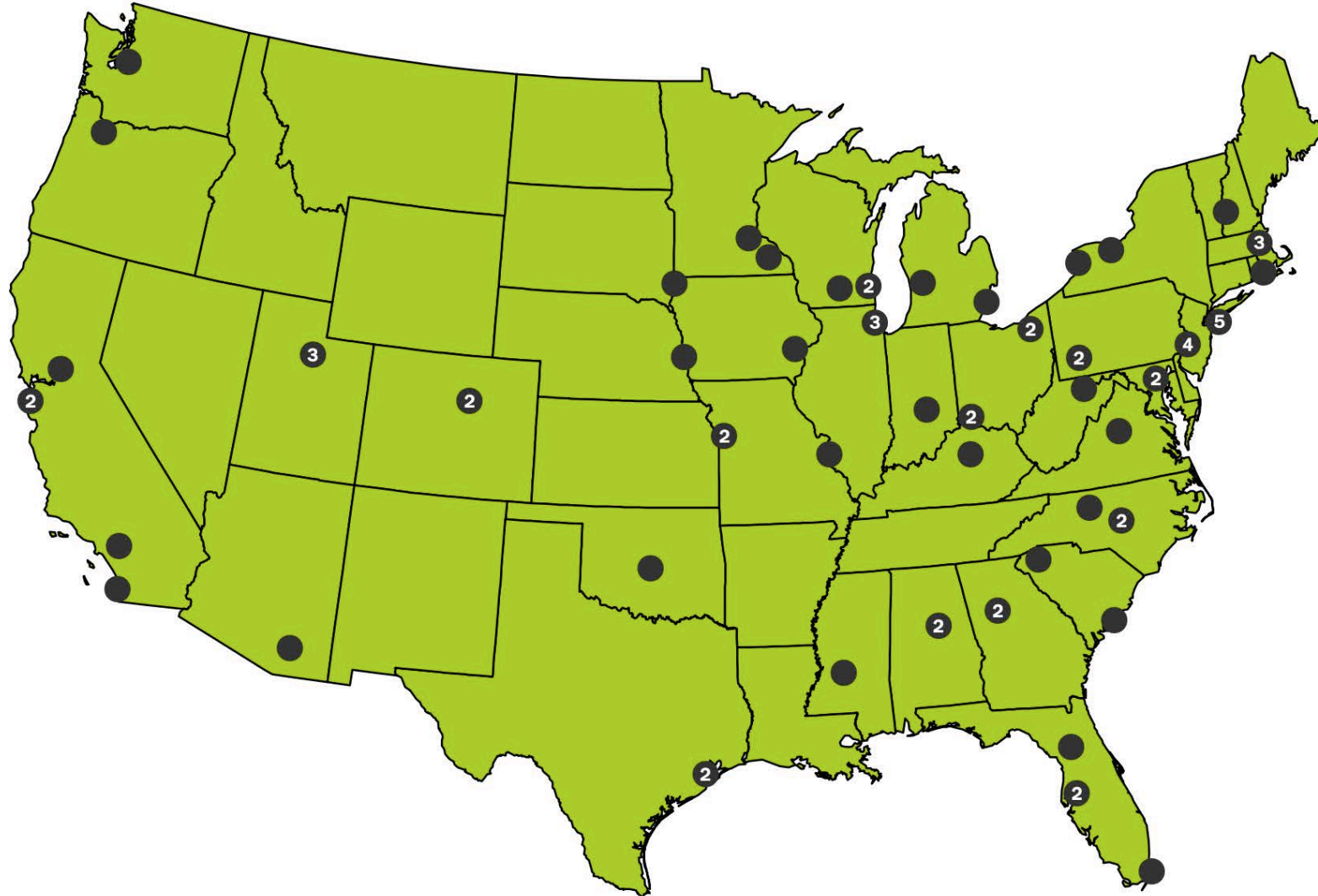
Contain – UMC Room 713 and 714 (Lead lined)
Waste storage employee garage

Emergency backup detection equipment available through the PEHSU

- UMC capabilities – National referral center
- RITN.net (Radiation Injury Treatment Network)
 - Houston – MD Anderson & Texas Children's
 - Phoenix – University of Arizona (Banner)
 - Denver – University of Colorado (Presbyterian)
 - Salt Lake City – University of Utah



Map of Participating Hospitals



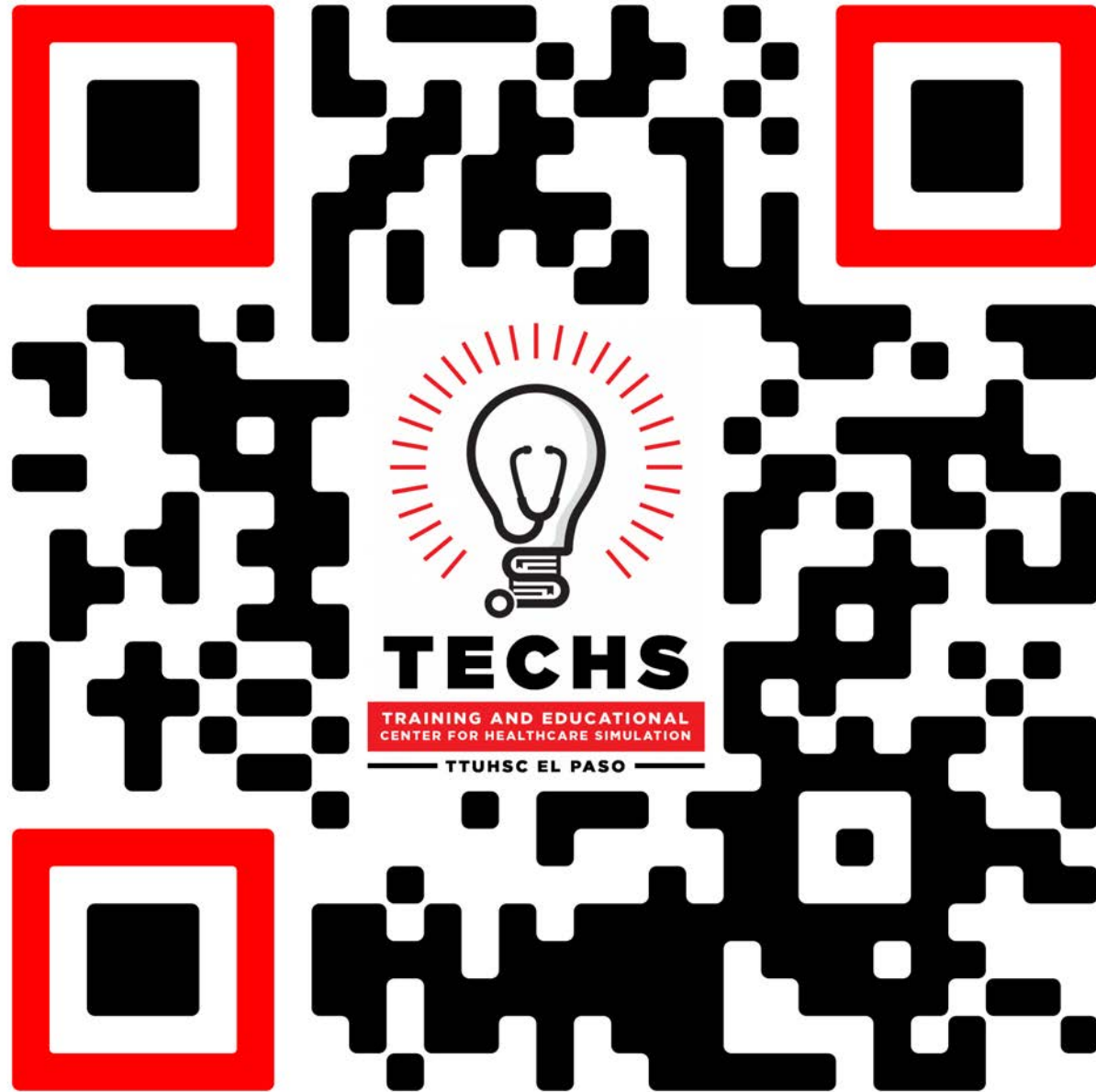
24-hour contacts

- REAC/TS
 - <https://orise.orau.gov/reacts/>
- Poison Control Center
 - 1-800-222-1222

Resources

- Radiological Dispersal Device (RDD) Response Guidance
 - https://www.dhs.gov/sites/default/files/publications/NUSTL_RDD-ResponsePlanningGuidance-Public_171215-508.pdf
- CDC Radiation
 - <https://www.cdc.gov/nceh/radiation/basics.html>
- Radiation Emergency Medical Management
 - https://www.remm.nlm.gov/ext_contamination.htm
- EMS Infectious Disease Playbook
 - <https://www.ems.gov/pdf/ASPR-EMS-Infectious-Disease-Playbook-June-2017.pdf>
- Health Physics Society
 - <https://hps.org/publicinformation/radardecaydata.cfm>
- Planning for the First 100 Minutes
 - https://www.dhs.gov/sites/default/files/publications/NUSTL_RDD-ResponsePlanningGuidance-Public_171215-508.pdf

Simulation

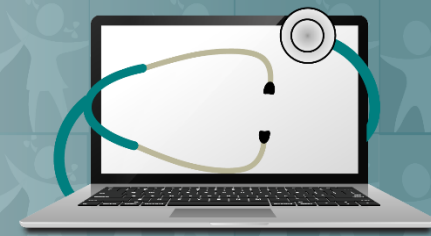


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