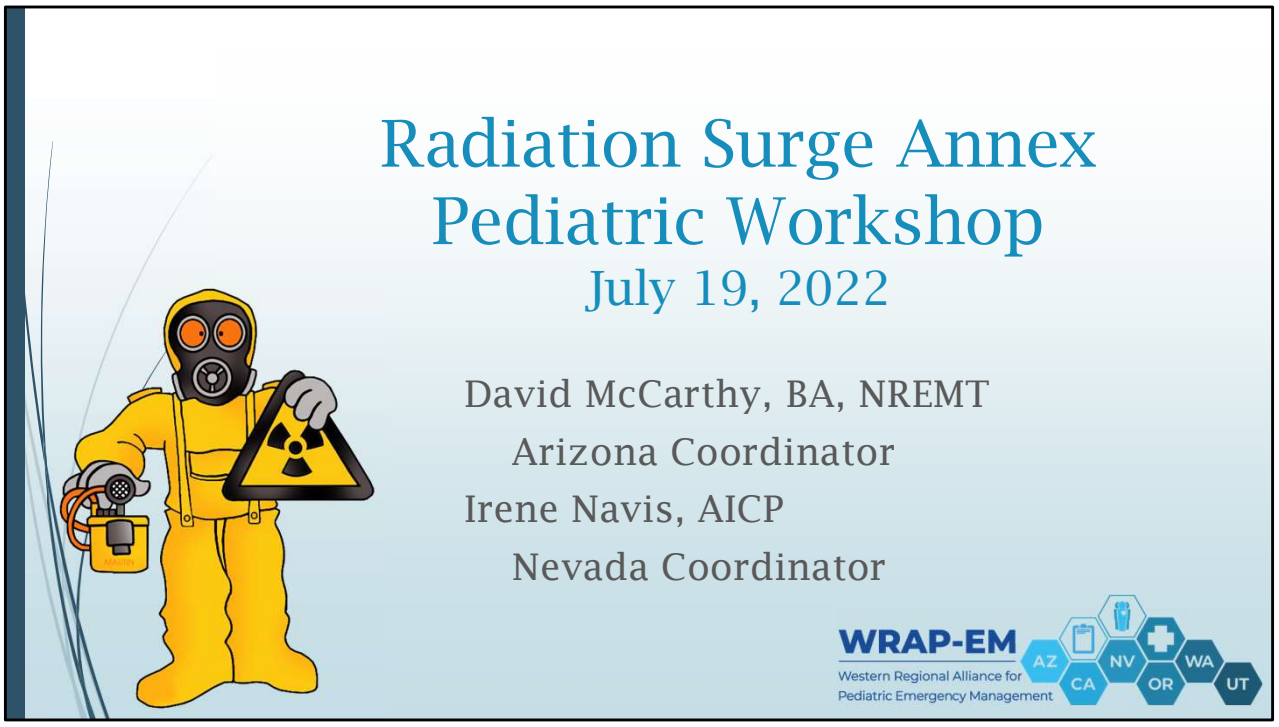

Please contact us if you have any questions or need assistance.

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What is WRAP-EM?

The Western Regional Alliance for Pediatric Emergency Management is an ASPR funded Center of Excellence that supports pediatric-focused initiatives to improve emergency pediatric disaster response capabilities. Initiatives are intended to produce helpful resources and guidance to address challenges that healthcare coalitions, facilities and their community partners may face in a crisis.

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Western Regional Alliance for Pediatric Emergency Management

AZ CA NV OR WA UT

Goal: To develop regional pediatric disaster planning and response capabilities – through collaboration between all levels of government and hospitals – that effectively match resources to needs for a catastrophic incident.

Funding & Disclaimer

- The Western Regional Alliance for Pediatric Emergency Management is supported by Award Number 6 U3REP190616-01-02 from the Office of the Assistant Secretary for Preparedness and Response (ASPR).

- The content presented here and throughout the presentation is that of the authors and does not necessarily represent the official views of, nor an endorsement by ASPR, HRSA, HHS, or the U.S. Government.

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Purpose of Workshop

- Provide pediatric focused content for HCCs to include in Radiation Response Annex
- Provide Pediatric focused resources and templates for inclusion in a Radiation Response Annex
- The workshop is being record and will be made available
- The PowerPoint and other materials will be made available

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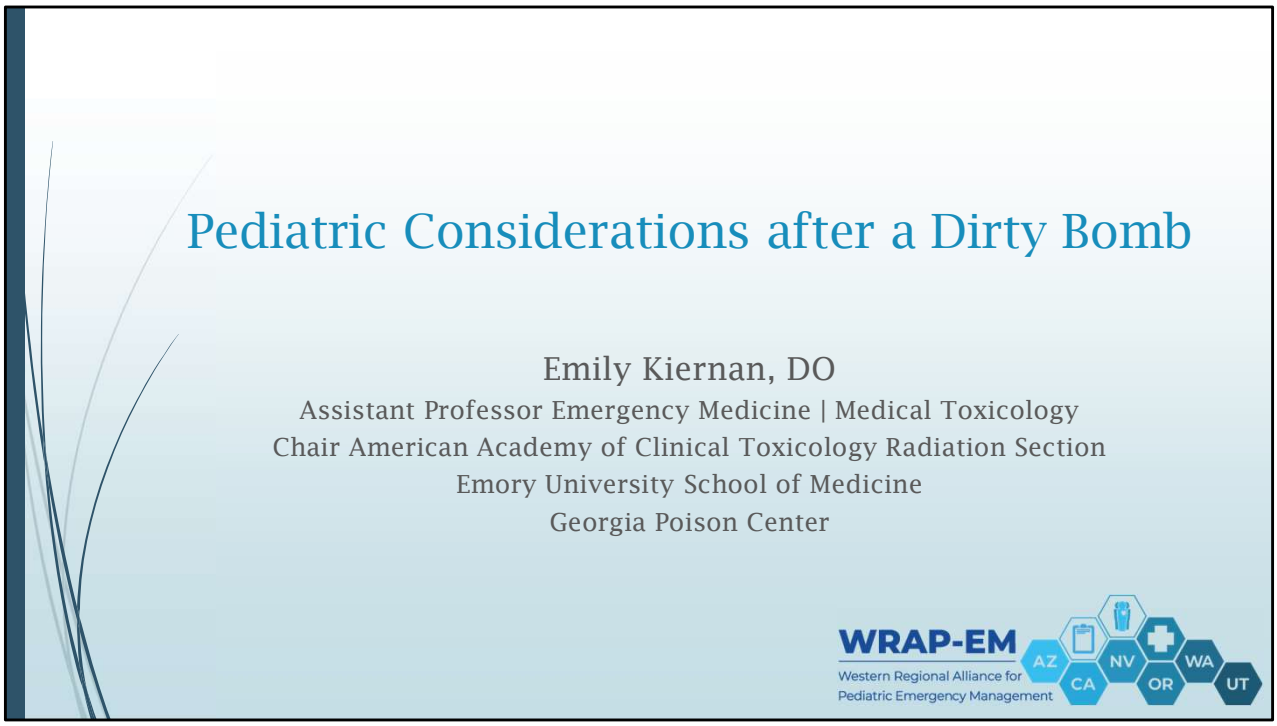

Emily Kiernan is an Emergency Medicine physician and Assistant Professor of Emergency Medicine and Medical Toxicology at Emory University School of Medicine and the Georgia Poison Center. She is the current Chair of the American Academy of Clinical Toxicology Radiation section and had a strong interest in chemical, biological, radiological, and nuclear emergency management and disaster preparedness.

Pediatric Care - Emily Kiernan, DO

- Treat life threats before decontamination
- Triage
- Cocooning for transport
- Decontamination

Google: WRAPEM

Disclosures

- I have no disclosures.

After this presentation, the learner will be able to:

- Discuss significant factors distinguishing radiation emergencies in children regarding
  - Triage
  - Cocoon for transport
  - Decontamination (decon)

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Treat life threats before decontamination
Triage
Cocooning for transport
Decontamination

Bottom Line Up Front

- Key #1: Address life threats before decon
- Key #2: Triage is crucial
- Key #3: Cocoon for transport
- Key #4: Decon is crucial

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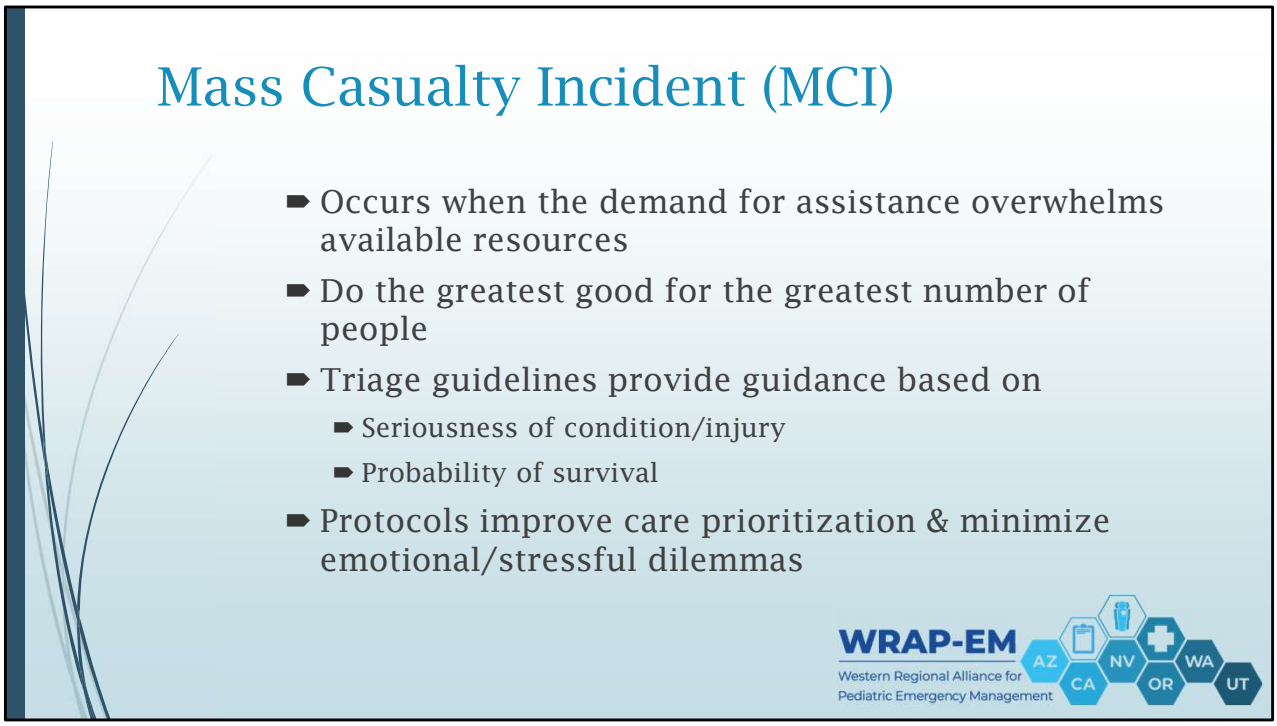


Occurs when the demand for assistance overwhelms available resources.

Goal is to do the greatest good for the greatest number of people.

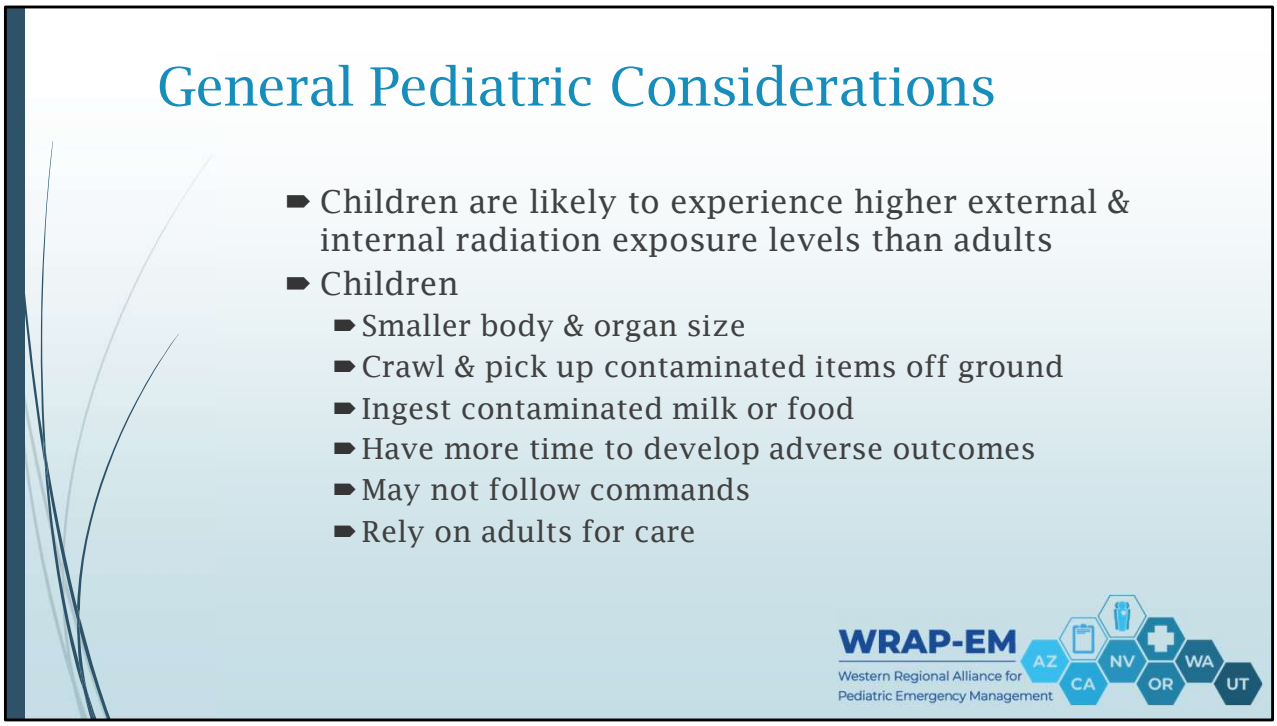
Triage protocols provide guidance based on:

Seriousness of condition/injury

- Probability of survival

Protocols improve priority of care and minimize emotional/stressful dilemmas.

- Extremely important in incidents involving the pediatric population
- Desire to classify children with higher priority than appropriate.



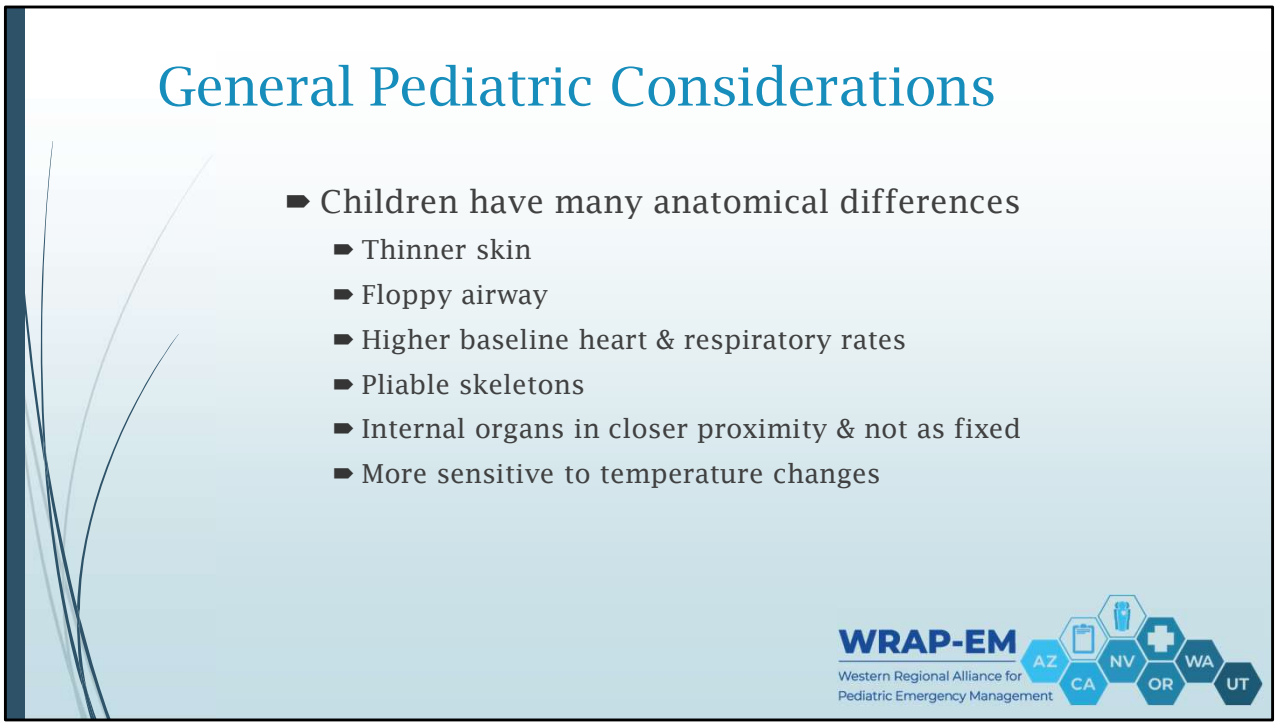
Children are likely to experience higher external and internal radiation exposure levels than adults because of their smaller body and organ size and other physiologic characteristics.

Children:

Smaller body and organ size

Have tendency to pick up contaminated items, crawl on ground

May ingest radioactive material from picking up contaminated items and putting hands in their mouths when crawling, ingesting soil, or consuming milk from cows feeding Children have a longer time to live and, thus, more time in which to develop adverse outcomes



Children have many anatomical differences:

Thinner skin

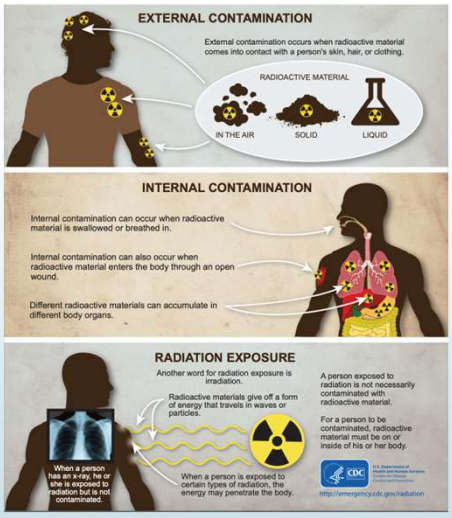
Floppy airway

Higher baseline heart and respiratory rates

Pliable skeletons

Internal organs in closer proximity and not as fixed

Radiation Contamination vs. Exposure



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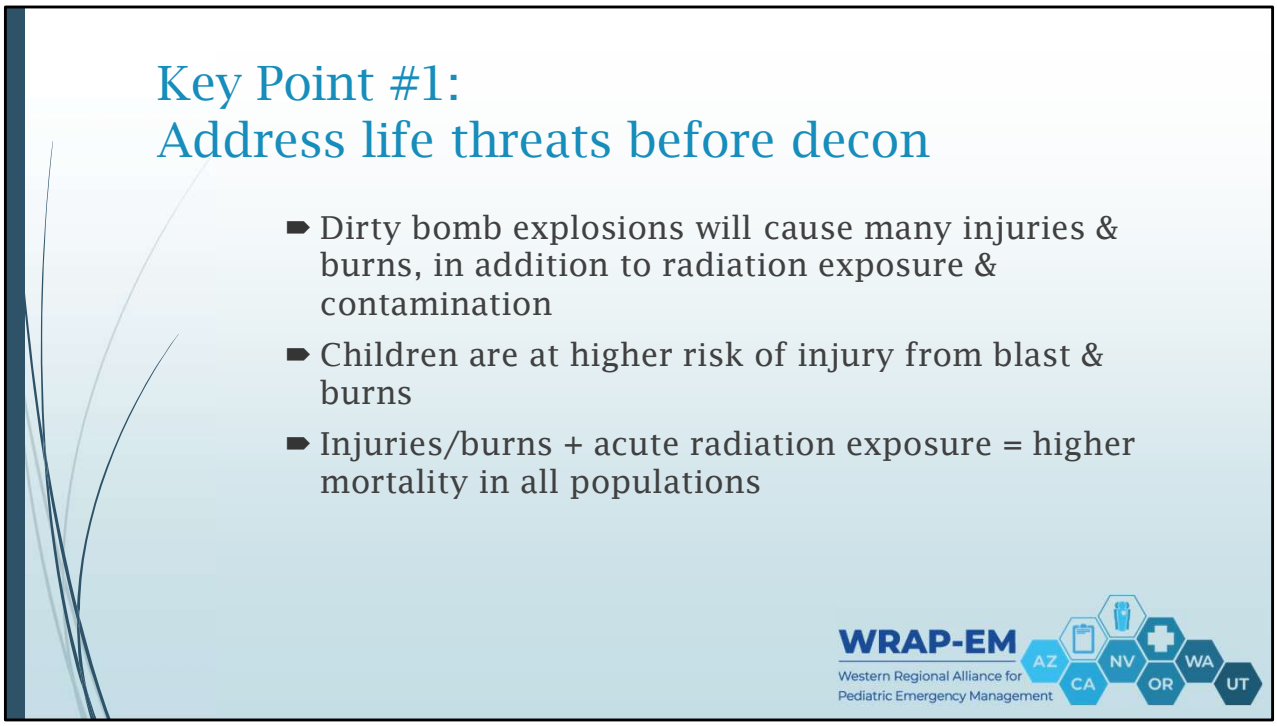
Today we will be focusing on external contamination
My colleague will be discussing MCM in another lectures. These are used for internal contamination
Radiation exposure does not pose a threat to anyone but the exposed patient.
Imagine this like when you get an XR – you are not radioactive

Picture:
https://www.cdc.gov/nceh/radiation/emergencies/pdf/infographic_contamination_versus_exposure.pdf



The danger to children from blast injuries—primary injuries from over- pressurization force (blast wave) that have an impact on the body surface; secondary injuries from projectiles; tertiary injuries from being thrown into other objects; quaternary injuries like crush injuries, burns, and toxic exposure—is a consequence of several physiological factors.

Thinner skin and a high body-surface-area-to-mass ratio make children particularly susceptible to the effects of blast and burn injuries.

Open wounds from projectiles and burns coupled with acute radiation exposure lead to higher mortality in all populations from bone marrow stem cell damage, slow wound healing, and an ensuing high risk of secondary infection.

Combined injury with radiation exposure is a concern given children's risk of injury from blast and burn

#1: Address life threats before decon

- Perform life-saving interventions before decon
- Wear appropriate PPE
- Attempt to decrease spread of contamination
- No significant exposure risk to healthcare workers during life-saving interventions

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Picture:
https://commons.wikimedia.org/wiki/File:ZZS_MSK,_záchranáři,_kardiopulmonáln%C3%AD_resuscitace_a_endotracheáln%C3%AD_intubace_(13).jpg

Life threatening injuries must be addressed before decontamination.
First responders or hospital staff should wear appropriate PPE during the procedure.
Make efforts not to spread contamination or make external contamination become internal contamination.
No significant exposure risk to healthcare workers when treating life threatening injuries on a contaminated patient.

Analysis of past emergencies showed that severe deterministic health effects have resulted from holding or carrying (e.g. in a pocket) a dangerous source for just a few minutes. Therefore efforts must be taken to prevent handling of possibly radioactive material (e.g. fragments from an explosion). However, limited stays (of a few minutes) near a very dangerous source6, for example for life saving purposes, should not result in severe deterministic health effects (https://www-pub.iaea.org/MTCD/Publications/PDF/EPR_FirstResponder_web.pdf).

#1: Address life threats before decon

- Advanced Life Support (ALS), Advanced Cardiac Life Support (ACLS)
- Spinal motion restriction
- Oxygen
- Advanced airway maneuvers
- Chest tube, finger thoracostomy
- Tourniquet – STOP THE BLEED
- IV access for fluid/blood

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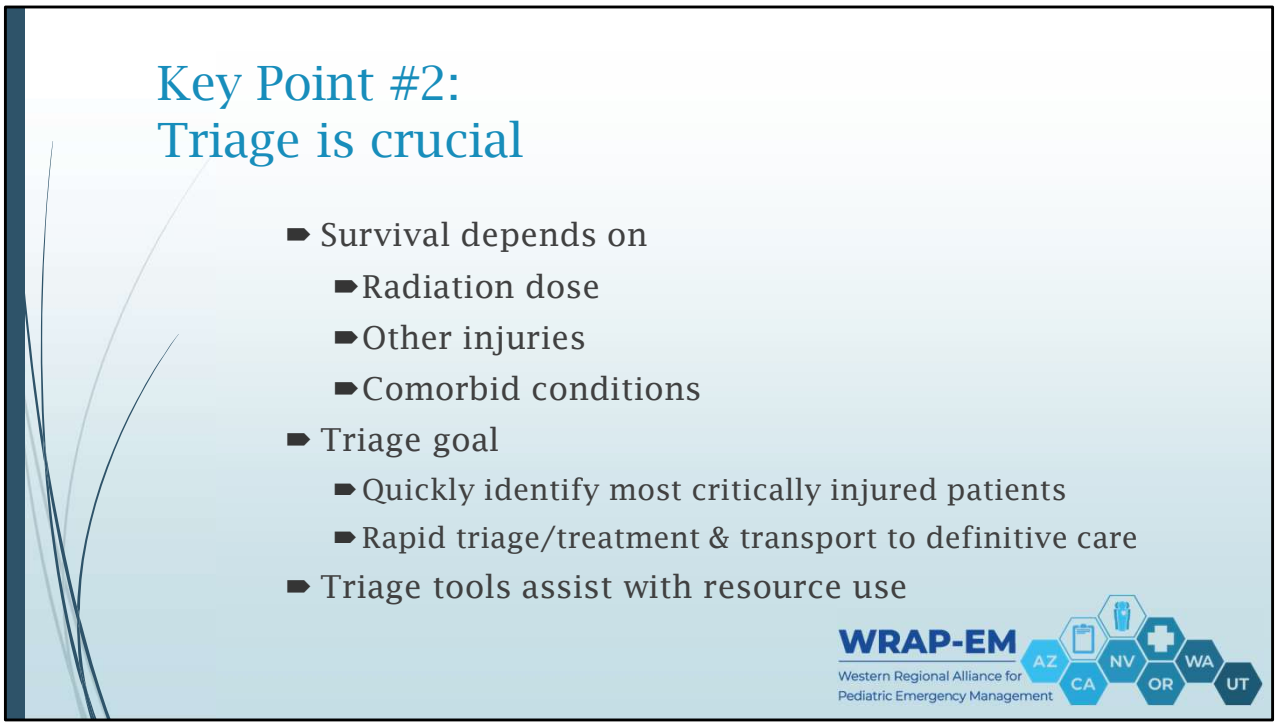
Picture: https://commons.wikimedia.org/wiki/File:Blast_injury-lower_extremities.PNG

What are we talking about with life threatening injuries?
Most radiological exposures, except in extremely high doses, are not going to cause immediate life-threatening situation.

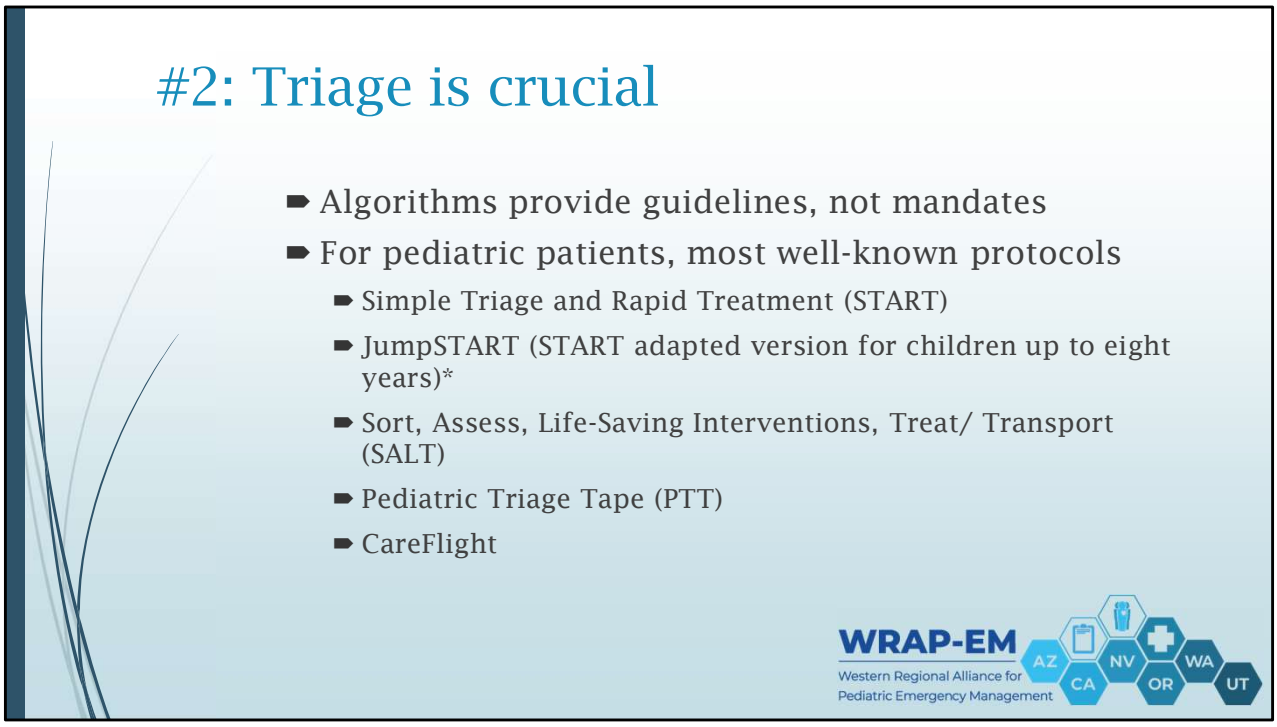
Advanced Life Support (ALS), Advanced Cardiac Life Support (ACLS)
Spinal immobilization
Oxygen therapy
Advanced airway maneuvers – intubation, LMA, surgical airway
Chest tube, finger thoracostomy
Tourniquet – STOP the bleeding
IV access for fluid or blood
Expose those areas needed for treatment as necessary



A patient's survival will depend on the dose of radiation received, the presence of other injuries (eg, trauma and burns), and comorbid medical conditions.

During a mass-casualty incident, limited treatment resources will be allocated to patients who have survivable injuries, whereas others will be triaged for palliative care, highlighting the importance the importance of determining the radiation dose received by the patient (dose ~ time to emesis and abs lymphocyte counts based on data in adults) →see REMM website for tools to estimate rad dose

In a mass-casualty incident (MCI) involving children, there is a need to apply accurate triage tools in order to help those who require important care, and at the same time, to avoid unnecessary use of resources.

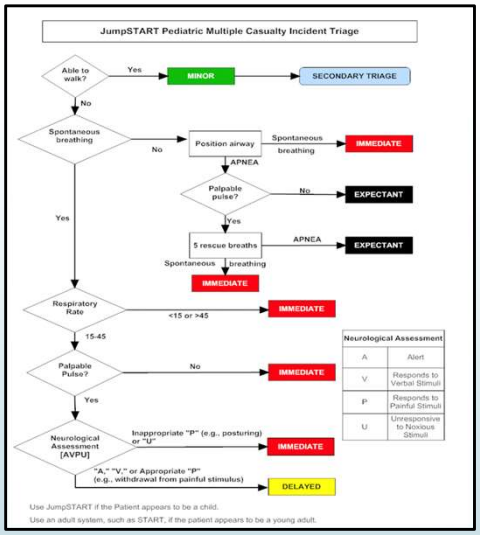


The goal of triage is to quickly identify the most critically injured patients at the scene and to provide rapid treatment and transfer to definitive care, as needed.

Some of the most known protocols are Simple Triage and Rapid Treatment (START); JumpSTART (a START adapted version for children up to eight years old); Sort, Assess, Life-Saving Interventions, Treat/ Transport (SALT); Pediatric Triage Tape (PTT); and CareFlight.3 Among them, one of the most popular is JumpSTART, the pediatric version of START, which was developed in 1995 and modified in 2001.8

With both chemical and radiological emergencies, first responders at the initial stage of response are the same (local officials and emergency services personnel typically carry it out). Furthermore, the basic actions of first responders to radiological emergencies should not differ, in general, from those taken in response to emergencies involving other hazardous materials.

#2: JumpSTART for MCI



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References:

1. https://remm.hhs.gov/startpediatric.htm
2. https://chemm.hhs.gov/StartPediatricTriageAlgorithm.pdf

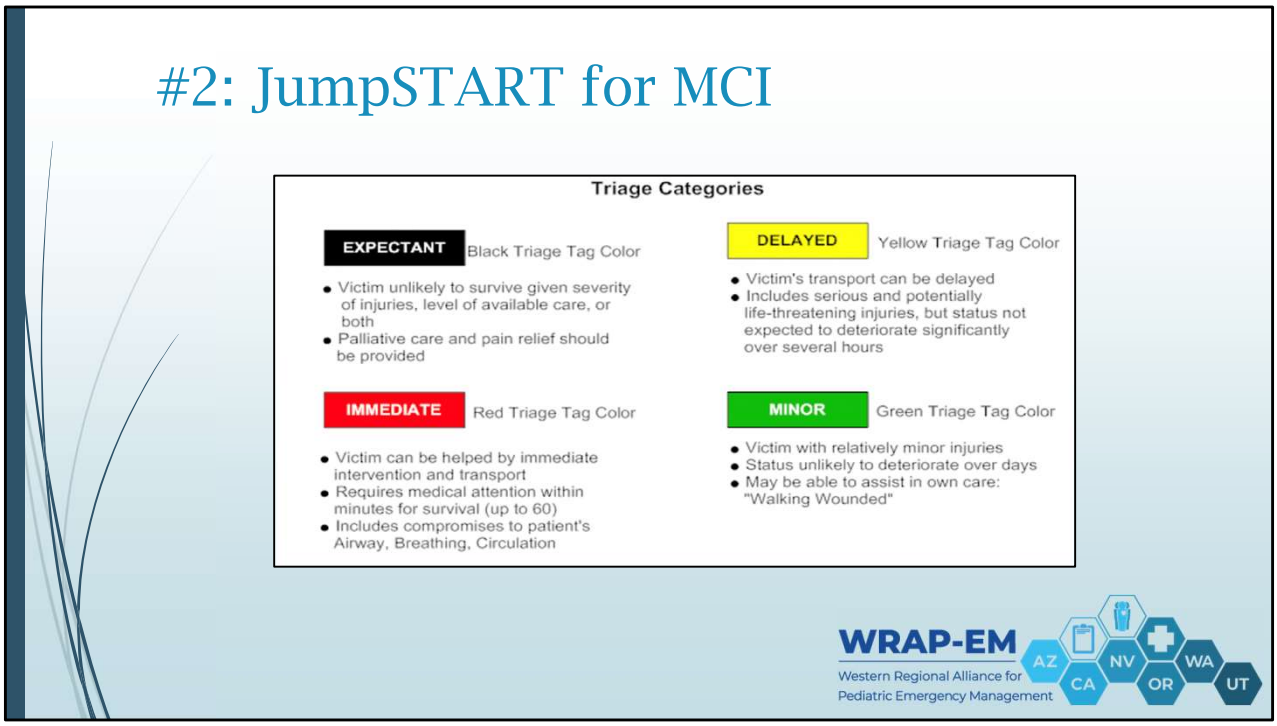
JumpSTART takes into account the unique aspects of pediatric physiology that theoretically should result in more accurate triage assignments in children.

Go through algorithm.

However, recent systemic review of the literature states “There is insufficient evidence to validate JumpSTART as a universal triage tool, given the disparities in the results obtained from the comparisons. No tool performed satisfactorily well, therefore there is an urgent need to create a reliable algorithm.” (Stéfani GM, de Melo ME, Zardeto HN, Costa VSLP, Lima FS, Cola M. JumpSTART Triage Protocol in Disaster Pediatric Patients: A Systematic Literature Review. Prehosp Disaster Med. 2022 Feb 3:1-7. doi: 10.1017/S1049023X22000127. Epub ahead of print. PMID: 35109962.)

Systems should use their protocol for MCI and be sure that it is adapted to the

pediatric population.

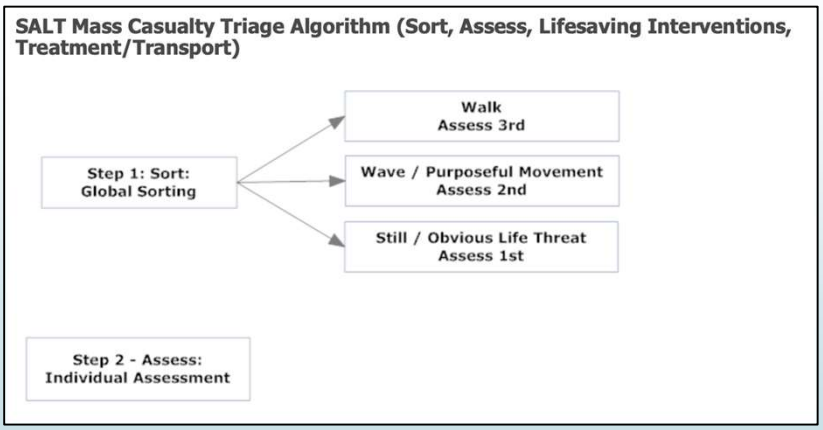


References:

1. https://remm.hhs.gov/startpediatric.htm
2. https://chemm.hhs.gov/StartPediatricTriageAlgorithm.pdf

Based on a color-coded triage like START, the algorithm uses clinical aspects (ambulatory status, airway, breathing, circulation, and neurologic status) to categorize the victims as “Minor,” “Expectant,” “Immediate,” and “Delayed.”

#2: SALT for MCI



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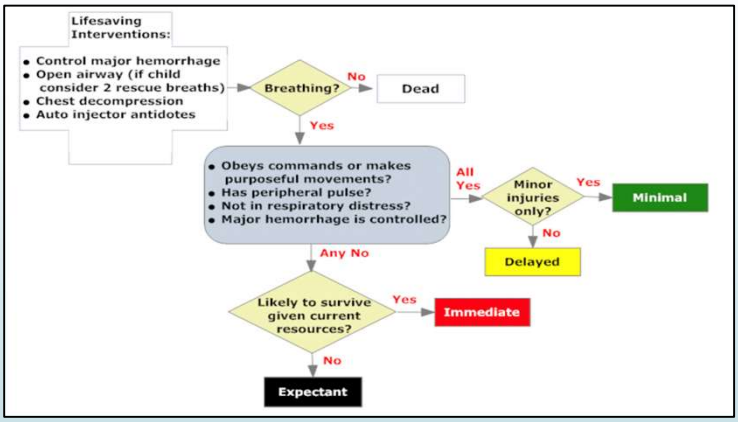
https://chemm.hhs.gov/salttriage.htm

SALT stands for "Sort - Assess - Life Saving Interventions - Treatment and/or Transport"
It was developed as a national all-hazards mass casualty initial triage standard for all patients.
Agencies can easily incorporate SALT into their current Mass Casualty Incident (MCI) triage protocol through simple modification.

SALT mass casualty triage: concept endorsed by the American College of Emergency Physicians, American College of Surgeons Committee on Trauma, American Trauma Society, National Association of EMS Physicians, National Disaster Life Support Education Consortium, and State and Territorial Injury Prevention Directors Association. Disaster Med Public Health Prep. 2008 Dec;2(4):245-6. [PubMed Citation]

#2: SALT for MCI



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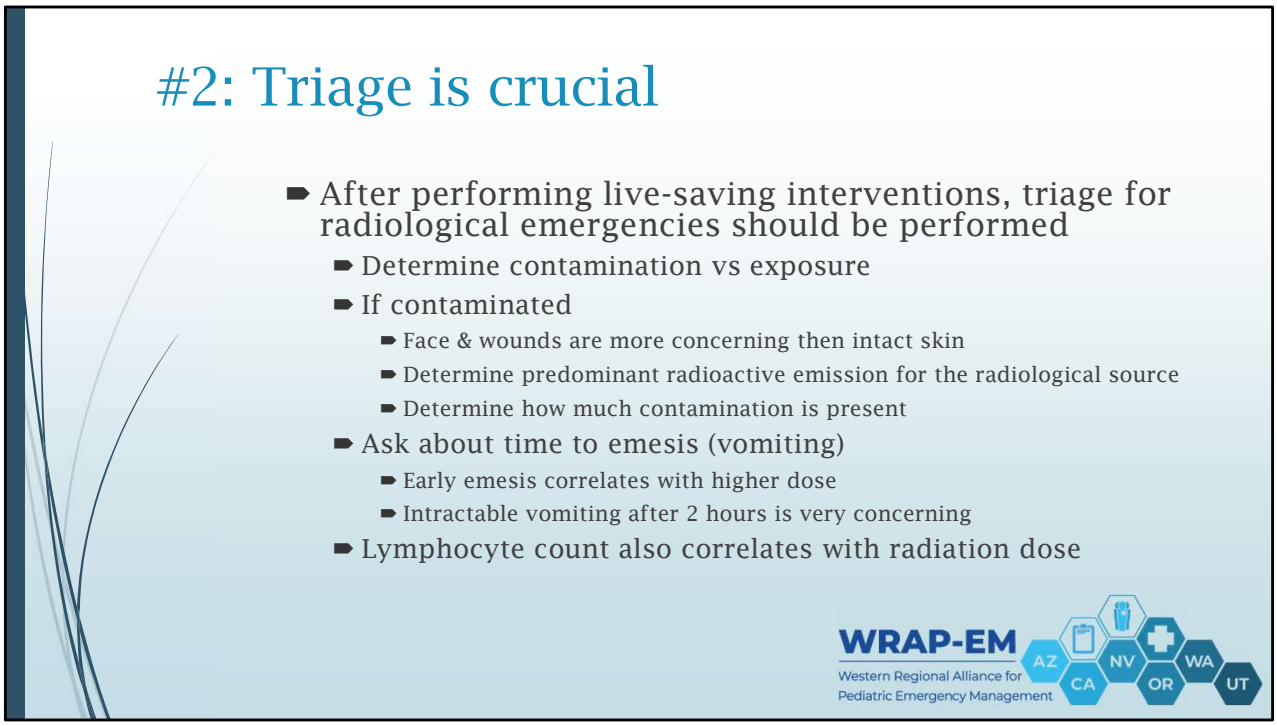


After performing live-saving interventions, triage for radiological emergencies should be performed

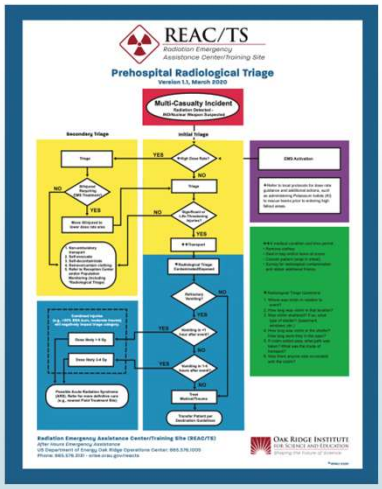
- Determine contamination vs exposure
- If contaminated
  - Face & wounds are more concerning then intact skin
  - Helpful to know the predominate emission of the radiation source– alpha, beta, gamma
  - Determine predominant radioactive emission for the radiological source
  - How much contamination is present
- Ask about time to emesis (vomiting)
  - Early emesis correlates with higher dose
  - Intractable vomiting after 2 hours is very concerning
- Lymphocyte count also correlates with radiation dose

ymphocytes are more radiosensitve cell in body
As soon as possible after triage, obtain a CBC with differential to determine

lymphocyte count
Calculator is available to determine estimated dose with these 2 pieces of information

As with med and trauma triage, triage tools are fluid
Trauma will impact triage in rad emergency

#2: Triage is crucial



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https://vimeo.com/672776055?embedded=true&source=video_title&owner=96128995

Key #3:
Cocoon for transport

- If decon not possible before before transport, ensure transport personnel wear proper PPE & personal dosimeters
- Cover open wounds
- Cocoon patient for transport
  - Wrap contaminated areas or whole patient in two layers of full-body sheets to contain contamination
- Preserve ability to observe and monitor patient fully during transport

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If unable to decontaminate patient before transport, ensure that transport personnel wear proper PPE, including personal dosimeters.
Cocoon the patient for transport

Wrap contaminated areas or whole patient in two layers of full-body breathable sheets to contain contamination

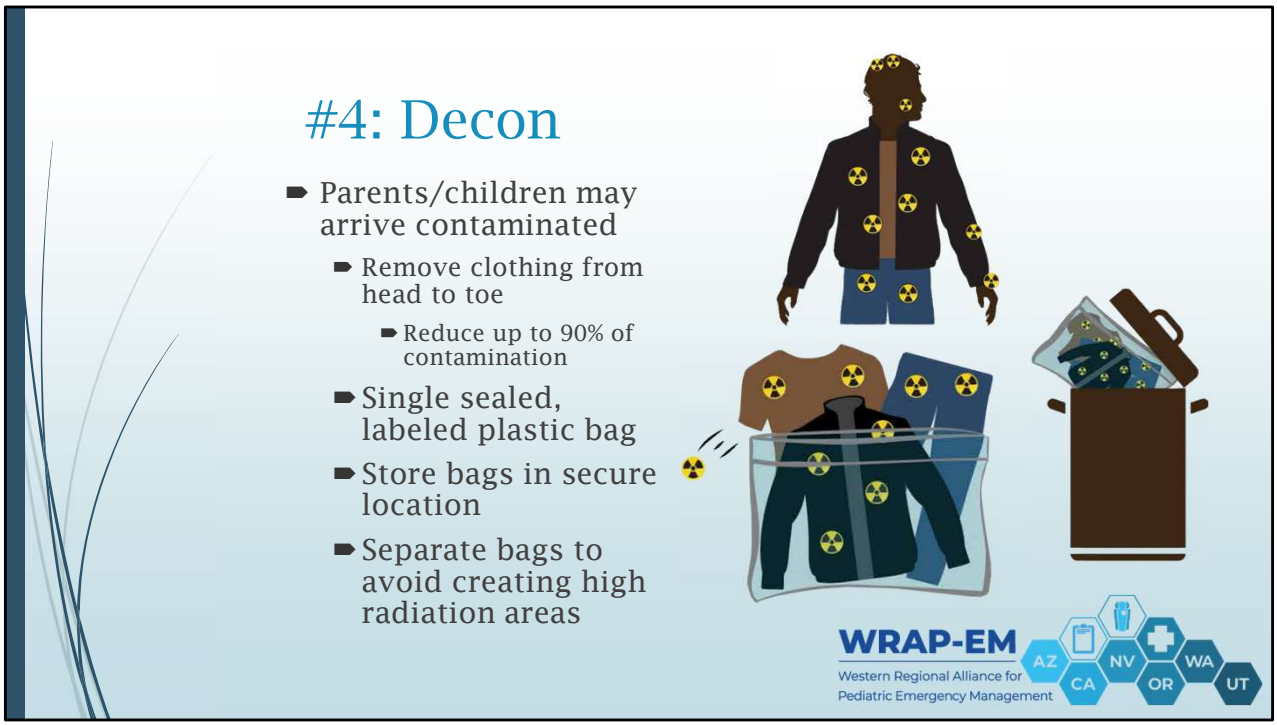
Cover open wounds with gauze

Preserve ability to observe and monitor patient fully during transport even though patient is wrapped.

Pictures: https://orise.orau.gov/resources/reacts/guide/prehospital-medical-management.html

Radiation levels above background indicate the presence of contamination. Remove the contaminated accident victims' clothing in a controlled manner, provided removal can be accomplished without causing further injury or delaying care.
Move stretcher, with a clean sheet or blanket on it, to the control line. Place the patient on the covered stretcher and prepare the patient for transport by folding the stretcher sheet or blanket over them and securing them in the appropriate manner. Do not remove the patient from the spineboard if one was used for medical purposes.

Irradiated patients are not a threat to others and do not require decontamination.
External contamination occurs when clothing, hair, or skin becomes contaminated with radioactive material.
External contamination of the skin can lead to ingestion or inhalation of the radioactive substance leading to internal contamination.
Children are at high risk for contamination with radioactive material.



Parents and children may or may not have been decontaminated before arriving at a central location or medical facility.

Remove clothing from head to toe

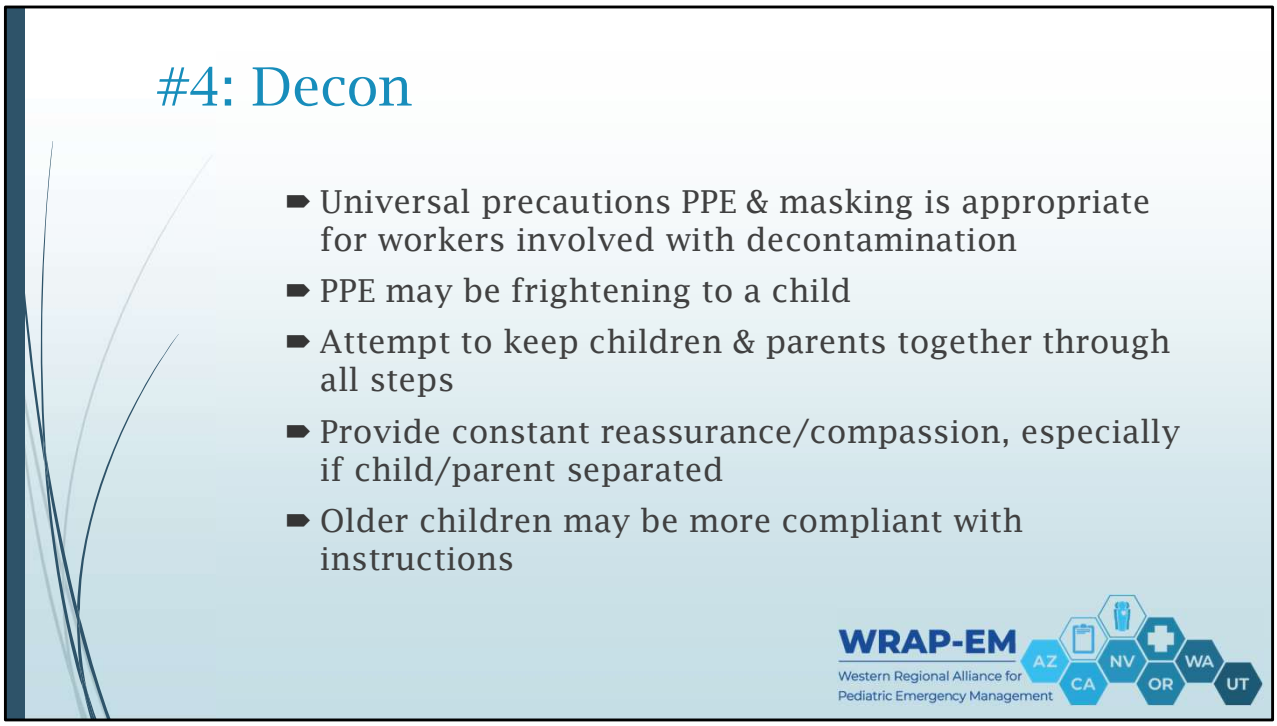
Removal of clothing can reduce up to 90% of contamination.

Place all property in a single sealed, labeled plastic bag.

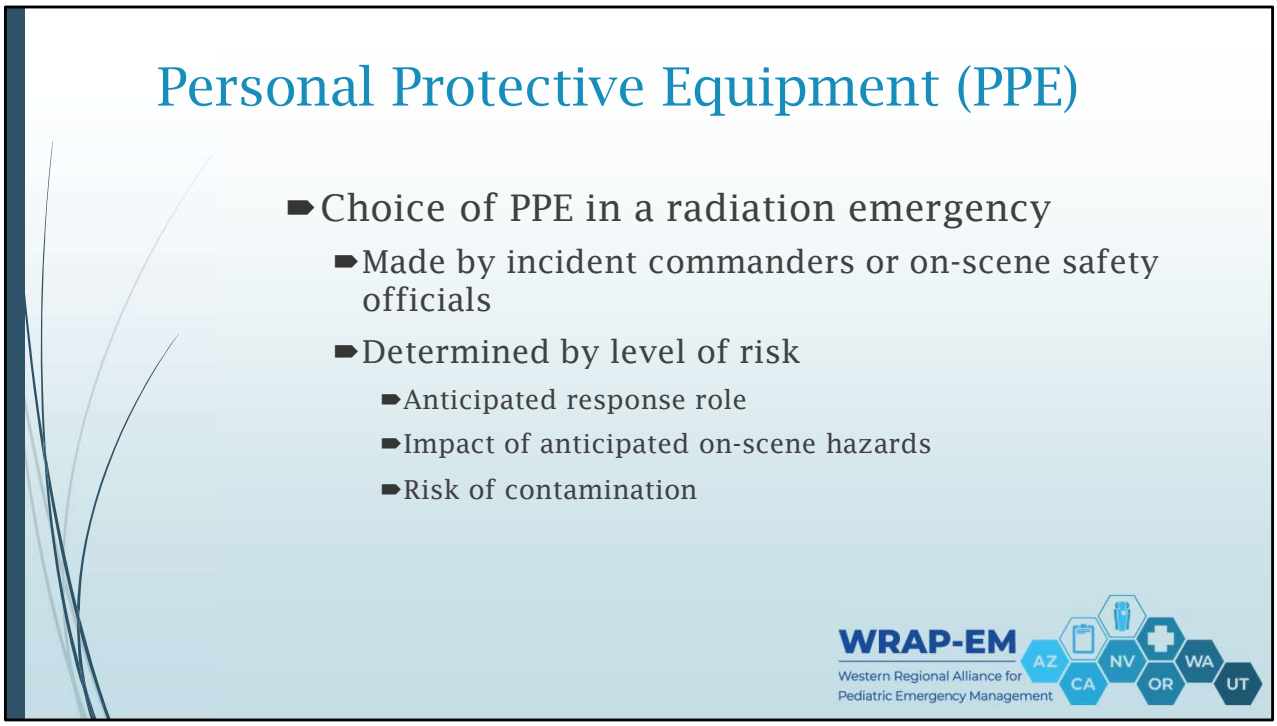
Store property bags in secure location.

Separate property bags from one another to avoid creating high radiation areas within

contamination zone.



] Proper PPE is important for workers involved with decontamination.
PPE may be frightening to a child, resulting in less cooperation and greater psychological trauma.
Attempt to keep children and parents together during decontamination, medical treatment, and transport.
Constant reassurance and compassion will be especially important if a child and parent are separated.
Older children may be more compliant with instructions but are still susceptible to mass hysteria if not properly informed and reassured.



Protection provided by ensembles should be proportional to the anticipated level of risk.

First responders expected to enter environments immediately dangerous to life and health must have access to PPE that provides the highest levels of skin and respiratory protection

Choice of PPE in a radiation emergency

- Is made by incident commanders or other on-scene safety officials
- Is determined by level of risk which is based on
  - Anticipated response role
  - Impact of anticipated on-scene hazards (radioactive and environmental) on response role[9, 14]
  - Risk of contamination (internal, external) with radioactive material

In a radiation emergency, the choice of appropriate personal protective equipment (PPE) depends on

- Response role and specific tasks

Risk of contamination

PPE can protect against[1]

External contamination

Internal contamination via inhalation, ingestion, absorption through open wounds

Other physical hazards (e.g., debris, fire/heat, or chemicals)

PPE **cannot** protect against exposure from high energy, highly **penetrating** forms of ionizing radiation[2] associated with most radiation emergencies.

Lead aprons worn in diagnostic radiology do not provide sufficient shielding against these kinds of radiation.

See Types of Ionizing Radiation and Shielding Required

PPE should include a personal radiation dosimeter whenever there is concern about exposure to penetrating ionizing radiation.

Direct-reading personal radiation dosimeters may be used to monitor radiation dose and can help workers stay within recommended Dose Limits for Emergency Workers.

Direct-reading dosimeters should be worn so that a worker can easily see the read-out and/or hear warning alarms.

Recommended respiratory PPE includes a full-face piece air purifying respirator with a P-100 or High Efficiency Particulate Air (HEPA) filter[3].

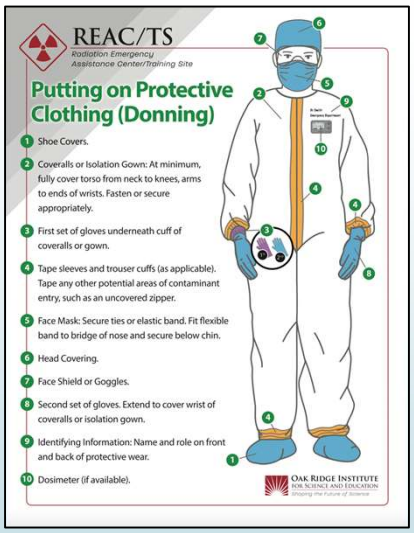
Other respiratory protective equipment (e.g., a simple surgical facemask, N-95 respirators), non-fit tested respirators, or ad hoc respiratory protection do not deliver appropriate or sufficient respiratory protection.

Environmental testing and hazard assessment by a safety professional can help identify hazards and risk levels and direct choices of permissible PPE.

PPE

Radiation only event with high contamination risk	Level of PPE
First responders	-Level C PPE respiratory & dermal protection
Healthcare providers working in **pre-decon (triage) & decontamination areas**	-Level C PPE respiratory & skin protection -Can move to Level D PPE when advised to be safe
Healthcare providers working in **post-decon areas of the hospital**	Level D PPE provides sufficient respiratory & skin protection -Delivering care to persons who may not yet be decontaminated

https://remm.hhs.gov/radiation_ppe.htm



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https://orise.orau.gov/resources/reacts/documents/reacts-poster-donning.pdf
https://remm.hhs.gov/radiation_ppe.htm

Other references for PPE in first responders:
https://www.osha.gov/sites/default/files/publications/OSHA3370-protecting-EMS-respondersSM.pdf

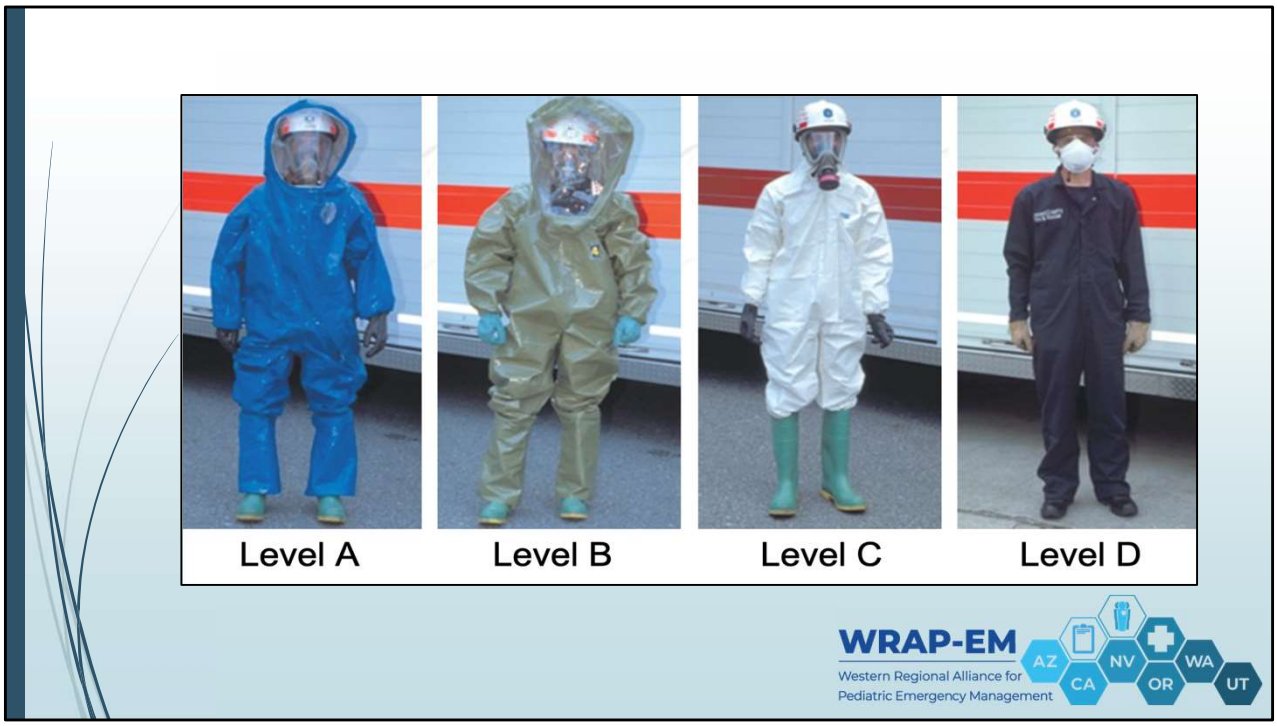
The focus is not on PPE today, but know that there are many great resources available.
Since victims may arrive for treatment contaminated with hazardous materials, first receivers need to protect themselves against secondary contamination by putting on appropriate PPE before delivering medical care
Once a combined hazard has been confirmed to not be present, radiation only, level C PPE provides sufficient respiratory and dermal protection

PPE confers no protection against high energy, highly penetrating ionzing radiation.
Factors that decrease radiation dose from exposure include: time, distance, and shielding.

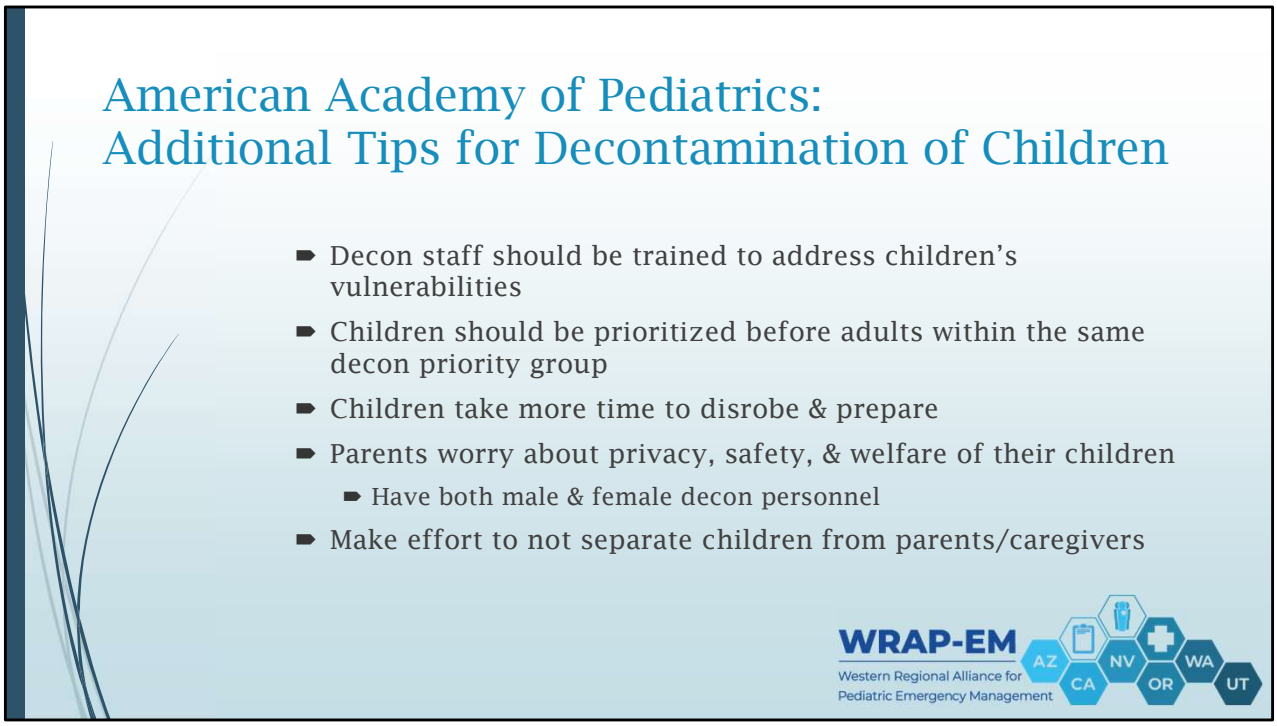
Healthcare providers working in **pre-decontamination (triage) and decontamination areas**
Level C PPE usually provides sufficient level of respiratory and skin protection
Level C PPE should be worn until risk characterization determines that Level D PPE provides sufficient protection

Healthcare providers working in **post-decontamination areas of the hospital**
Level D PPE provides sufficient respiratory and skin protection for first receivers working in post-decontamination areas of the hospital; this includes those delivering care to persons who may not yet be decontaminated (e.g., patients who self-refer or who arrive by transport with life- and limb-threatening injuries)
Level D PPE also protects skin and personal clothing against possible splashes of contaminated blood and body fluids (urine, feces, wound drainage, etc.)
Level D PPE is equivalent to Standard Precautions PPE worn in medical facilities as protection against transmission of biohazards from patients to providers

REAC/TS describes donning PPE for HCW – notice the appropriate level C/D PPE.



Picture:
https://hazwoper-osha.com/blog-post/hazmat-suits-levels-of-protection/



https://www.aap.org/en/patient-care/disasters-and-children/disaster-management-resources-by-topic/decontamination/

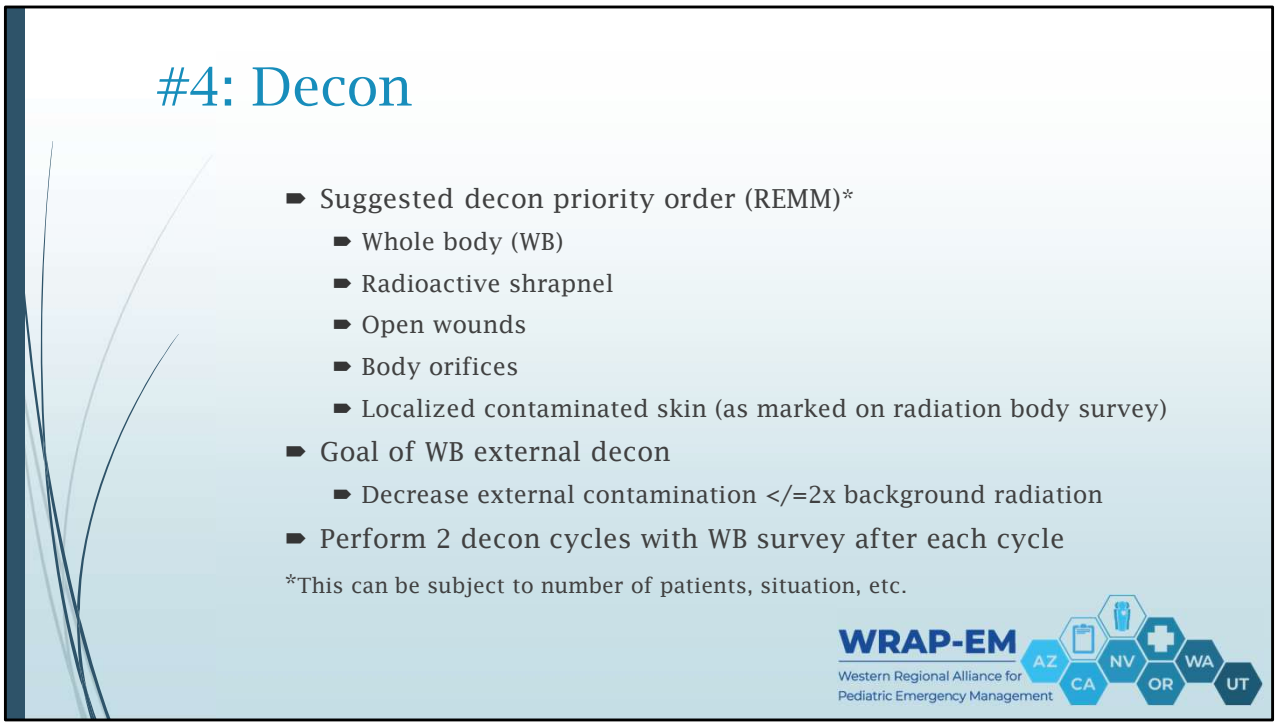
The following are tips and suggestions for decontaminating children:

Staff helping with decontamination should receive training on the vulnerabilities of children and how to address these.
Children should be prioritized before adults within the same decontamination priority

group.
Children take more time to disrobe and prepare.
Parents may worry about privacy, safety, and welfare of their children if they are cared for by opposite-gender responders.

Recommended to have both male and female personnel.

Staff helping with decontamination should receive training on the vulnerabilities of children and how to address these.
Children should be prioritized before adults within the same decontamination priority group.
Unless strictly contraindicated due to medical needs, families should undergo decontamination together. Children and parents may become upset if separated from family members during decontamination. Keeping children with their parents or caregivers may reduce psychological stress for all family members and decrease the need for additional assistance from responders or health care personnel.
Children will take more time to disrobe and prepare (emotionally) for the decontamination. Parents may fear that the privacy, safety, and welfare of their children are not protected if they are cared for by responders of the opposite gender.
Children of certain ages may become more anxious when asked to disrobe, and it is recommended to have both male and female personnel to assist children. A **study sponsored by the HHS** revealed that 99% of chemical contamination can be eliminated by carefully removing clothes and wiping skin with a paper towel or dry wipe.
The risk of adverse consequences of water-based decontamination may be greater in children; warming measures will be necessary. The water temperature should be 98◦ to 110◦ F out of tap, and foil/metallic blankets should be used post decontamination for ease of use and disposal.
Hospital personnel should take care to ensure each child's airway remains open and protected during decontamination.
Low pressure shower systems should be used to decontaminate children.
Infants and young children can be slippery when wet and will require a system to ensure their safety (eg, hand spraying while on a stretcher, in a bassinet, or laundry basket with holes).



https://vimeo.com/667289110?embedded=true&source=video_title&owner=96128995

REAC/TS suggests addressing RS first as this is most concerning to the patient and health care worker safety.
Based on the scenario, patients may be sent home to self-decon before presenting to the hospital.
MCI may not allow time for individual, detailed WB screenings.

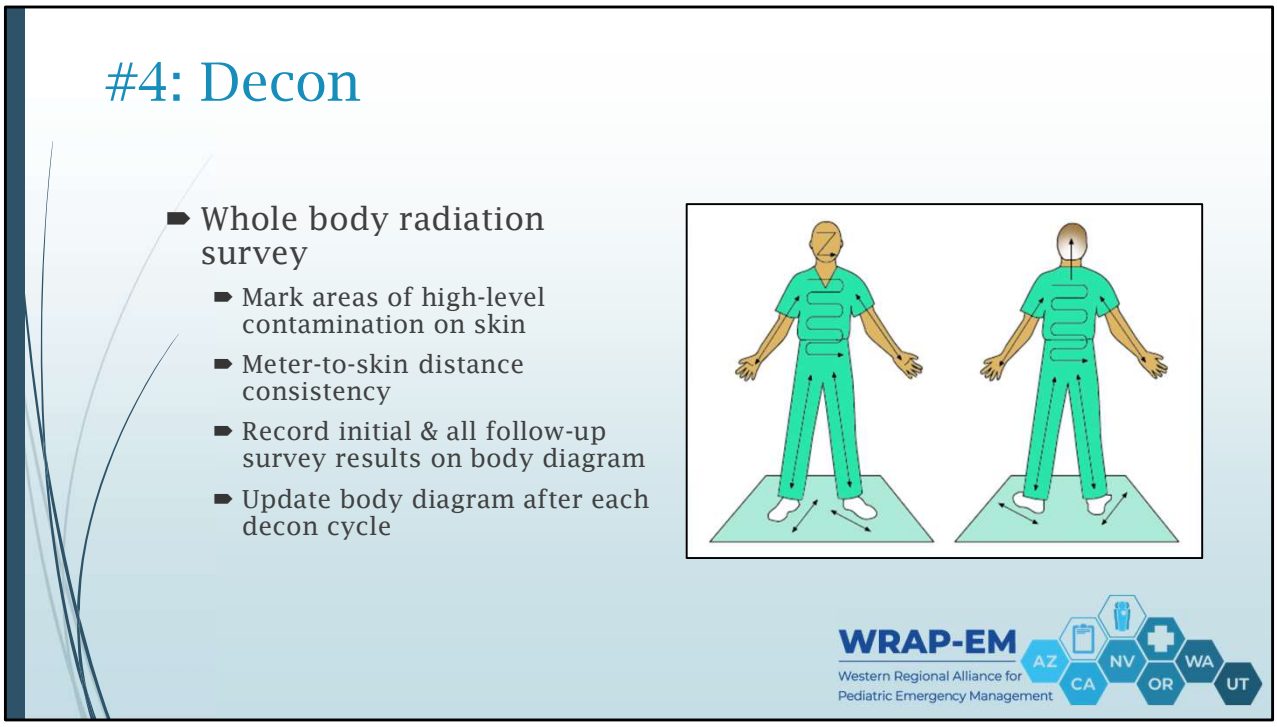
If possible in the scenario, REMM suggests the following order:
Conduct decontamination in the following order

Whole body
Radioactive shrapnel
Open wounds
Body entrance cavities: nose, mouth, ears
Localized contaminated skin starting with area of highest contamination noted on radiation body survey

Consider general guidance

Goal of whole body external decontamination is to decrease external

contamination to a level of no more than 2 times background radiation level. Perform **two decontamination cycles** if feasible, with a whole body radiation survey after each cycle.



Gross Whole-Body Contamination

Perform whole body radiation survey.

Mark on patient's/victim's skin, using waterproof felt tip marker, any areas of high level contamination found by radiation survey.

Ensure that meter-to-skin distance is consistent in all surveys to minimize inter-survey errors.

Record initial and all follow-up survey results for an individual patient/victim on a body diagram (PDF - 49 KB); include name, and time and date of initial and all follow-up radiation surveys.

Update body diagram after each decontamination cycle or use new body diagram for each cycle.

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#4: Decon

- Ensure child's airway remains open/protected
- Infants/young children are slippery when wet
- Use low pressure showers
- Hypothermia risk is greater in children; warming measures will be necessary
  - Keep water temperature 98-110◦F
  - Thoroughly dry patient
  - Wrap in foil/metallic blankets

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Picture: https://www.cdc.gov/nceh/multimedia/infographics/decontamination.html

Picture:https://www.pinterest.com/pin/182536591119247428/

https://www.aap.org/en/patient-care/disasters-and-

children/disaster-management-resources-by-topic/decontamination/

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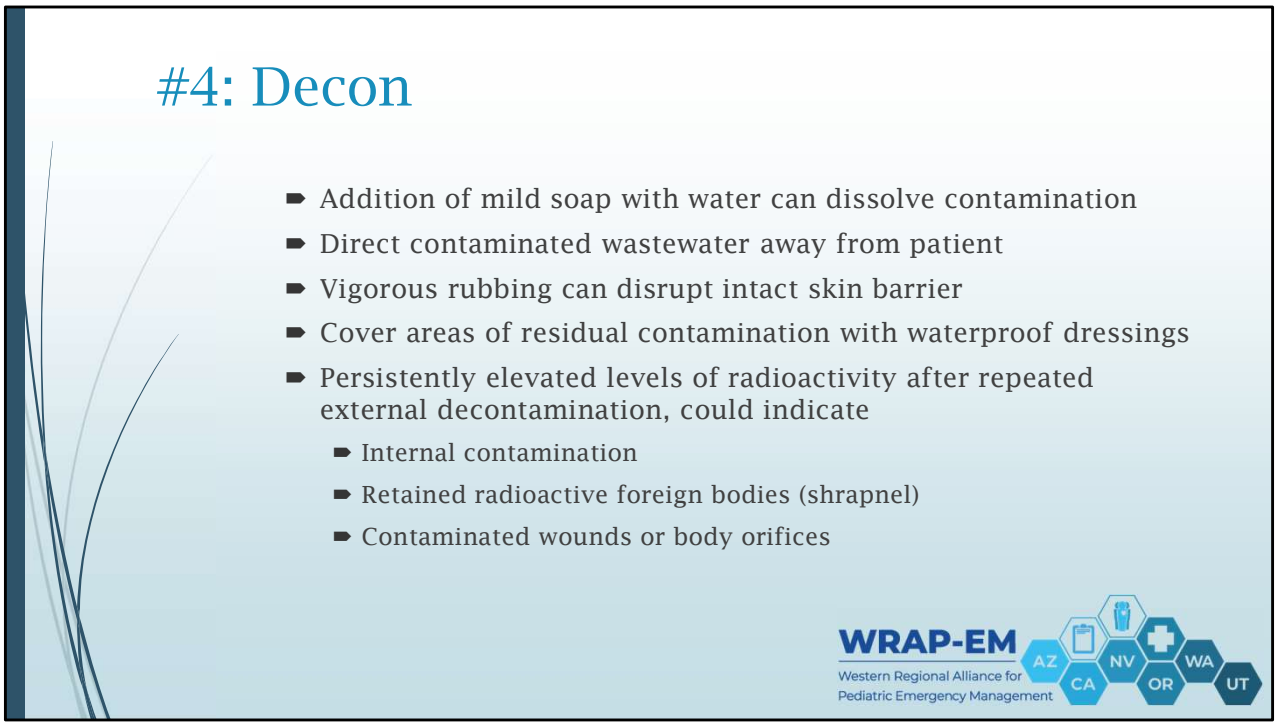

https://www.aap.org/en/patient-care/disasters-and-children/disaster-management-resources-by-topic/decontamination/

Add mild soap to water to dissolve contamination
Direct contaminated wastewater away from patient

Vigorous rubbing can disrupt intact skin barrier
Cover areas of residual contamination with waterproof dressings
Persistently elevated levels of external contamination after adequate decontamination efforts, consider:

- Internal contamination
- Retained radioactive foreign bodies (shrapnel)
- Contaminated wounds or body orifices

Add all video references here

https://remm.hhs.gov/deconvideo.htm
https://remm.hhs.gov/ext_contamination.htm

References

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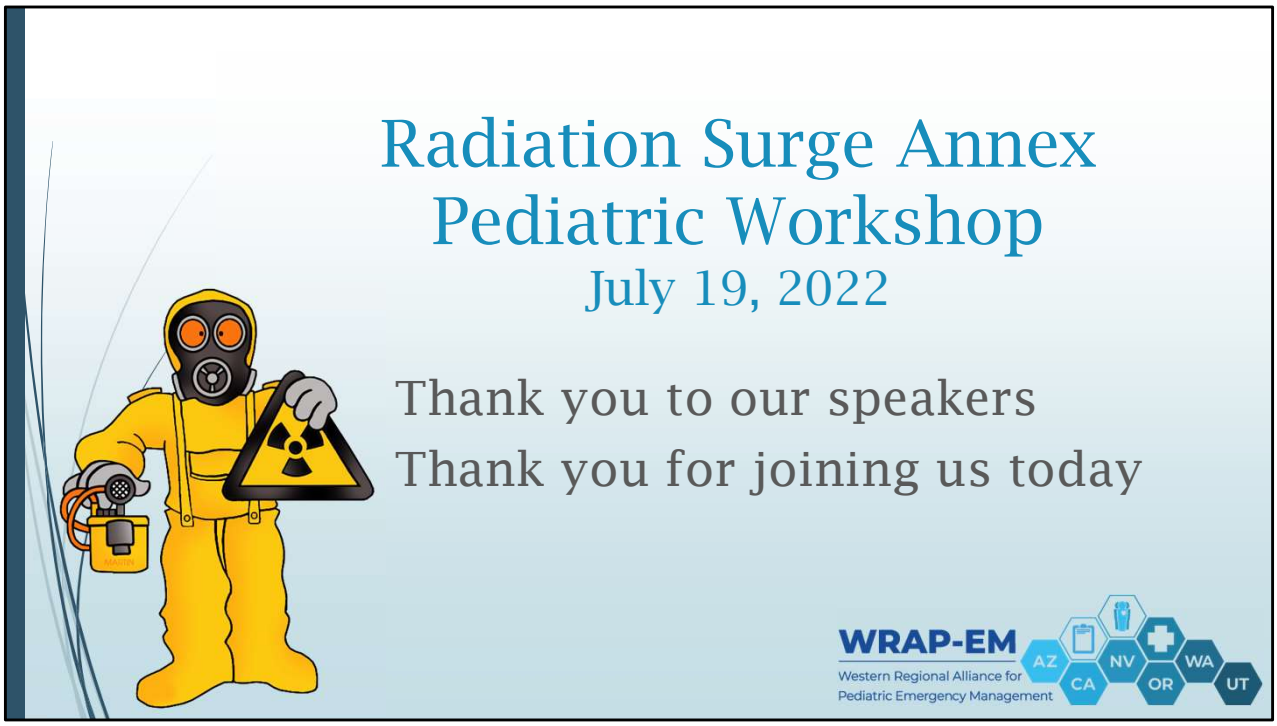

Thank you Dr Walter