Radiation Event Medical Management (REMM)

Guidance on Diagnosis and Treatment of Radiation Events for Health Care Providers

http://remm.nlm.gov

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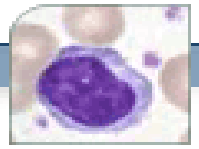
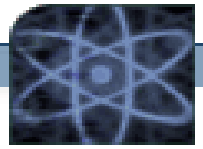
Specialized Information Services
National Library of Medicine

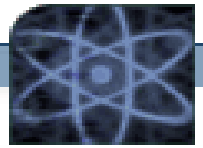




REMM Partners

Department of Health and Human Services (HHS)

- Assistant Secretary for Preparedness and Response (ASPR)
- National Institutes of Health (NIH)
  - National Library of Medicine (NLM)
  - National Cancer Institute (NCI)
- Centers for Disease Control and Prevention (CDC)



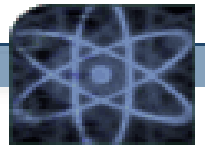


Need for REMM

Need to know how to respond to mass casualty radiation events:

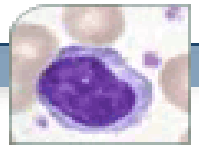
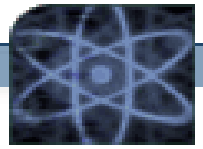
- Provide guidance for health care providers about clinical diagnosis and treatment during mass casualty radiological/nuclear events
- Provide evidence-based, practical information for those *without* formal radiation medicine expertise
- Provide web-based information that is also downloadable in advance, for availability even if the Internet is not accessible during a disaster





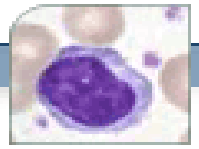
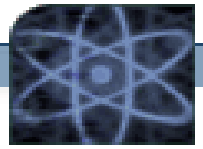
Are we prepared?

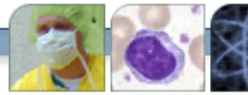
- Most physicians/health care providers are not trained to handle mass casualty radiation events
- Disaster preparedness and response:
  - Hospitals need to develop response plan that includes radiation events
  - Need practical information and guidance before, during, and after the event

Is your institution prepared?

- Do you know how to access REMM on the internet?
- Do you have REMM downloaded on one or more computers?
- Have you trained (or even told) health care providers about REMM?



WHAT KIND OF EMERGENCY?

- Radiological Dispersal Devices: Dirty Bomb, Other Dispersal Methods, Hidden Sealed Source
- Nuclear Explosions: Weapons, Improvised Nuclear Devices
- Nuclear Reactor Accidents
- Transportation Accidents
- Discovering an Event

INITIAL EVENT ACTIVITIES

- Onsite Activities
- Triage Guidelines
- Hospital Activities

OTHER AUDIENCES

- First Responders in the Field
- Mental Health Professionals
- Hospitals
- Public Information Officers
- Radiation Safety and Protection
- Preplanning
- Practices and Drills

ABOUT THIS SITE

- What Are the Goals of This Site?
- Who Produced This Site?
- Disclaimers
- List of Consultants
- Join the REMM ListServ
- Contact us: Provide Site Feedback
- Download REMM to Your Computer
- System Requirements (e.g., Allow Pop-ups)

PATIENT MANAGEMENT

- Choose Appropriate Algorithm: Evaluate for Contamination/Exposure
- Contamination
- Exposure (Acute Radiation Syndrome)
- Exposure + Contamination

MANAGEMENT MODIFIERS

- Radiation + Trauma
- Burn Triage and Treatment
- Mass Casualty
- Psychological Issues
- Specific Populations

TOOLS & GUIDELINES

- Dose Estimator for Exposure
- Template for Hospital Orders
- Use of Blood Products
- Follow-up Instructions
- Manage Long-Term Monitoring
- Management of the Deceased
- Develop a Hospital Medical Response Team
- Develop a State Response Plan
- Equip an Emergency Room for Decontamination

REFERENCE/DATA CENTER

- Dictionary
- Animations, Illustrations, Photos
- Emergency Contacts
- Abbreviations
- Understanding Radiation
- Sources of Radiological/Nuclear Information

FEATURES

- Polonium-210 Information: Properties, Treatment, and Fact Sheeets
- NIH Radiation Countermeasures Strategic 6/2005 (NIH/NIAID)
- Medical Countermeasures Program Agains Radiological and Nuclear Threats (NIH/NIA

QUICK LINKS

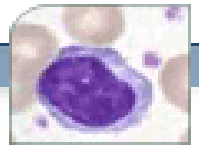
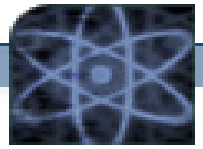
- **New Users: Where Do I Start?**
- Isotopes of Interest
- Countermeasures
- Dose Estimator for Exposure
- Manage ARS Subsyndromes
- Hematopoietic Subsyndrome
- Time/Dose Effects in ARS
- Strategic National Stockpile
- Animations, Illustrations, Photos
- Dictionary
- Emergency Contacts
- Download This Site
- Print Algorithms & Tables

OTHER WEB RESOURCES

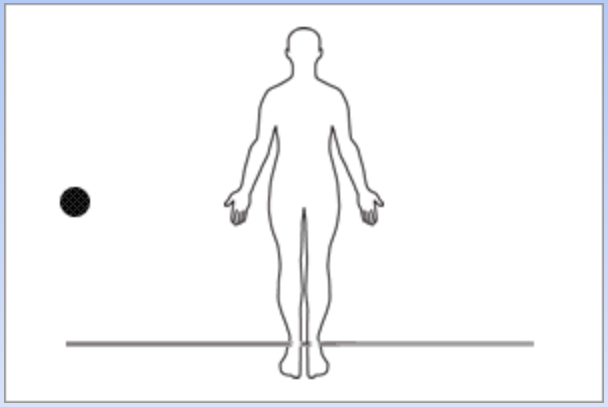
- AFRRI
- AHRQ
- CDC
- DHS
- DOE
- EPA
- FDA
- HHS
- IAEA
- NCRP
- NRC
- OSHA
- REAC/TS
- WHO

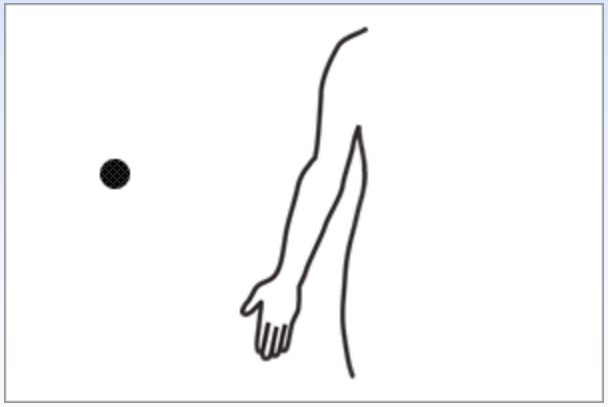
Types of events

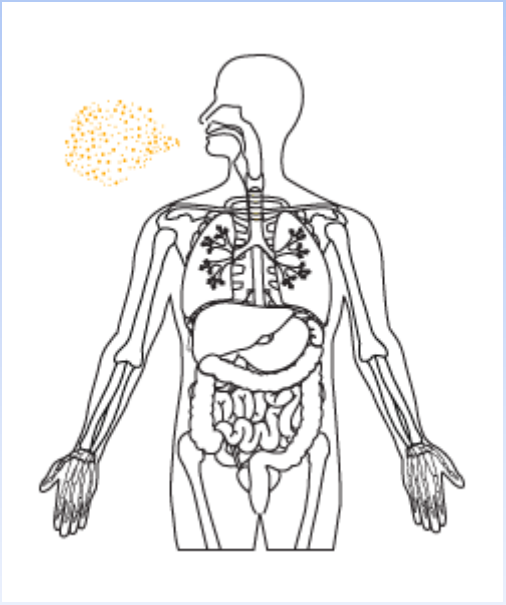
- Four types of events covered in REMM:
  - RDD (Dirty bomb)
  - Nuclear explosion (nuclear bomb)
  - Nuclear reactor accidents
  - Transportation accidents
- Health effects from:
  - Contamination (external or internal)
    - Radioactive material gets on or into the body
  - Exposure
    - X rays = low dose; no adverse effects
    - Acute radiation syndrome = very high dose to entire body

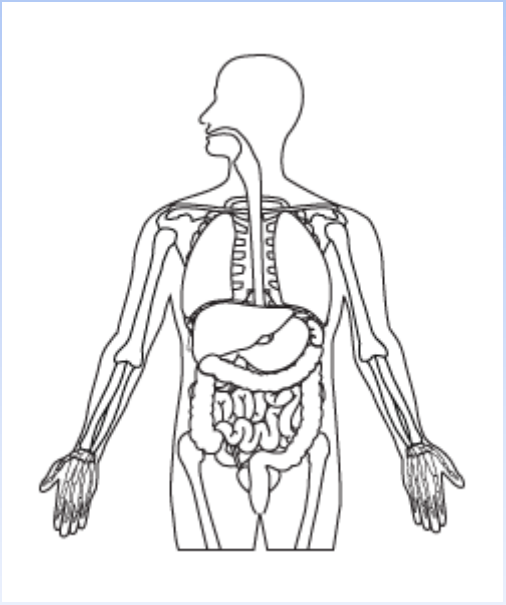




External and Internal Contamination

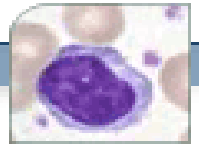


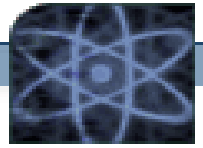






Animations demonstrating the concepts of external and internal contamination

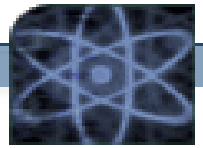




Dirty Bomb Scenario - Contamination

- **Patient management algorithm**
  - How do you know an event occurred
  - Initial onsite activities
  - Decontamination procedures for external contamination
  - Assess internal contamination/identify isotopes
  - Countermeasures/Treatment





Dirty Bomb - Contamination

Medical Facility

No

Admit into Medical Facility

- Treat life-threatening physical injuries/burns
- Obtain sequential CBCs with differential to rule out whole-body exposure and ARS
- Remove any remaining radioactive shrapnel

Assess Internal Contamination

- Scan patient with radiation survey meter
- Event responders or radiation safety officer will identify the isotope(s)
- Swab body orifices (e.g., nostrils, ears, mouth, rectum) to help estimate body burden of isotope
- Collect 24-hr stool for isotope measurement (baseline and sequential after management)
- Collect 24-hr urine for isotope measurement
- Label all specimens with time and name
- Perform total body count if available; consider hospital nuclear medicine equipment

Treat Internal Contamination of Specific Isotope

- Isotopes of Interest Table
- Countermeasures Table
- Decision to treat will depend on
  - Size of radiation event
  - Availability of resources/personnel
  - Likelihood that patient will survive

Recovery

No Recovery

Arrange for Continuing and Long-term Follow-up

- Send home with follow-up instructions
- Register patient in long-term follow-up database

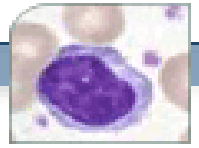
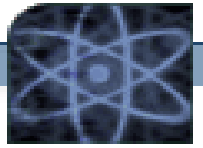
Handle the Deceased

- Management of the deceased
- Register data into event database

Isotopes of Interest

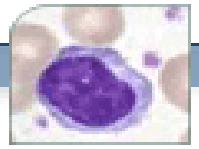
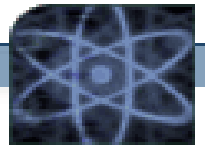
Properties, Treatment, and Fact Sheet

Isotope Name & Symbol	Ionizing Radiation Type	Radiological Half-life	Biologic Half-life (days)	Exposure Type	Mode of Contamination	Focal Accumulation in Body	Treatment	Related Isotopes: Fact Sheets (CDC, ATSDR, EPA, Argonne Natl. Lab)
Americium (Am-241)	α	458 years	73,000	Internal	Inhalation, skin wounds	Lungs, liver, bones, bone marrow	Chelation with DTPA‡	CDC (PDF - 73 KB); ATSDR (PDF - 24 KB); EPA; Argonne (PDF - 39 KB)
Californium (Cf-252)	α, γ	2.6 years		Internal	Lungs, GI tract	Bone, liver	Chelation with DTPA†	Argonne (PDF - 39 KB)
Cesium (Cs-137)	β, γ	30 years	70	External, Internal	Lungs, GI tract, wounds, follows potassium	Renal excretion	Ion exchange resins, Prussian blue‡	CDC; ATSDR (PDF - 25 KB); EPA; Argonne (PDF - 39 KB)
Cobalt (Co-60)	β, γ	5.26 years	9.5	External, Internal	Lungs	Liver	Gastric lavage; FDA reports that DTPA, EDTA, L-cysteine, NAC (N-Acetyl-Cysteine) and glutathione are effective in increasing urinary excretion §	CDC (PDF - 74 KB); ATSDR (PDF - 25 KB); EPA; Argonne (PDF - 38 KB)
Curium (Cm-244)	α, γ, neutron	18 years	7300 (liver) 18,250 (bone)	Internal	Inhalation, GI tract	Liver, bones (soluble Cm compounds)	Chelation with DTPA‡	Argonne (PDF - 42 KB)

Countermeasures

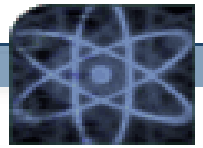
Medication	Administered for Isotopes	Route of Administration & Dosage	Duration	Mechanism of Action
Aluminum hydroxide†	Strontium-90	**PO**: 60-100 mL	Once	Decreased gut absorption
Aluminum phosphate gel†	Strontium-90	**PO**: 100 mL immediately after exposure	Once	Decreased gut absorption
Ammonium chloride†	Strontium-90, Radium-226	**PO**: 1-2 g q.i.d	6 days	Increased excretion
Calcium†	Strontium-90, Radium-226	**PO**: Generous doses		Increased excretion
Ca-DTPA‡, Zn-DTPA‡	Plutonium-239, Americium-241, Curium-244, Californium-252§, Yttrium-90§	**IV**: 1 g in 250 mL NS or 5% glucose, given in 1-2 h, or bolus over 3-4 min **Inhalation**: 1g in 1:1 dilution with water or NS over 15-20 min **IM**: 1 g; not recommended because of pain	Up to 5 days	Chelating agent
Calcium gluconate†	Strontium-90, Radium-226	**IV**: 5 ampules (500 mg calcium each) in 500 mL D5W over 4 h	6 days	Increased excretion
Dimercaprol†	Mercury, Lead, Arsenic, Gold, Polonium-210	**IM**: 300 mg/vial for deep IM use, 2.5 mg/kg (or less) q4h x 2 days, then bid for 1 day, then qd for days 5-10	10 days	Chelating agent

Exposure Scenario
Nuclear Weapon, Improvised Nuclear Devices, Hidden Sealed Source

- **Patient Management Algorithm**
  - How do you know an event occurred
  - Initial onsite activities
  - Estimate exposure dose (use dose estimators)
    - Symptoms
    - Lab values
  - Acute Radiation Syndrome treatment
  - ARS subsyndromes management





Radiation Exposure

Consensus Guidance for Treatment, Based on Exposure Dose and Event Size [9]

- View recommendations by clicking on whole-body dose (Clear)
  1. Click on a whole-body dose (Gy)
  2. View consensus treatment guidance based on
     - Number of casualties
     - With or without injury/burn

  or,
- Show recommendations for all doses/scenarios (Clear)

Consider Treatment	Whole-body Dose (Gy) What is Gy (Gray)?										Event Size, ± Injury/Burn (Small event: ≤ 100 victims Mass event: > 100 victims)
	1	2	3	4	5	6	7	8	9	10	
			⇩								
NOTE: All potential treatments may not be feasible in a large size event.											
Prophylactic Antibiotics†			✓								Small/no injury
			✓								Mass/no injury
			✓								Small/injury + burn
			✓								Mass/injury + burn
Cytokines/ Bone Marrow Growth Factors‡			✓								Small/no injury
			✓								Mass/no injury
			✓								Small/injury + burn
			✓								Mass/injury + burn, if resources available
Stem-cell Transplantation (Allogeneic)[9]											Small/no injury
											Mass/no injury, if resources available
Stem-cell Transplantation (Autograft or Syngeneic)[9]											Small/no injury
											Mass/no injury, if resources available

† **Prophylactic Antibiotics** [9,13-16]

What else is in REMM?

Sample hospital order template, triage tag, body survey diagram, follow-up instructions

Prototype for Adult Medical Facility Orders During a Radiation Event

-Orders must be customized fo
-See notes about individual dr
-Consider early consultation w

- Oncology services: me
- Transfusion medicine
- Radiation Safety
- Nuclear medicine

1. Admit to:

__Hospital ward

Team:

Physician:

__Area:

__ICU:

__Other:

2. Diagnosis:

__Radiation contamination "

__External

Isotope

__Internal

FRONT

Personal Property
Receipt/Evidence Tag

Barcode Here

Caution

Destination_____
Via_____

PERSONAL INFORMATION

Name:

Gender/DOB/Age:

Address:

City

Pho

CO

Ti

Tim

Mo

No

How to Perform a Survey for Radiation Contamination

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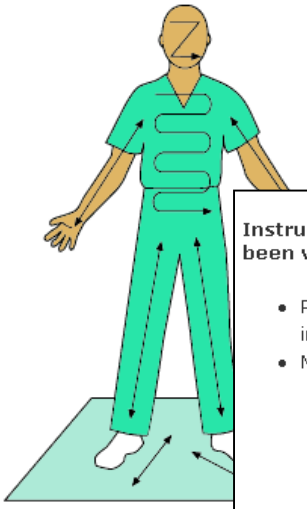


- Survey with Geig
  - Probe held
  - Move at a
  - Follow a sy
  - Document
  - Compare ra

Body Chart for Recording Results of Radiation Survey

Instructions for all persons involved in a radiological/nuclear event (victims, persons concerned they may have been victims, and all responders) (PDF - 49 KB)

- Register with an official government agency (federal, state, or local) charged with collecting the names of all persons involved in the incident, so that appropriate monitoring can be arranged later.
- Monitoring is appropriate for all persons connected with the incident, including:
  - Persons who had any radiation-related health effects identified at the time of the incident
  - Persons who may not have had radiation-related health effects at the time but who were near the scene of the incident
  - Persons who participated in the response to the radiation event: e.g., health care providers, EMS personnel, hospital personnel, security personnel, etc.
- Listen for follow-up instructions from authorities managing the event.
  - Since every incident is different, you should try to find out what recommendations are made by authorities after more is known about the whole incident.
  - Listen for how to contact officials who may be able to provide you with additional information or answer any questions you may have.
- ***It is normal to feel psychologically affected by the incident (fear, anxiety, depression, hopelessness, etc.) and you should speak with your doctor about these feelings.***

What else is in REMM?

Multi-media collection

References from peer-reviewed sources

Sources of Radiological/Nuclear Information

Radiation Event Medical Management

Animations, Illustrations, Photos

- Radiation Concepts
- Decontamination
- Radiation Effect on Blood Counts
- Radiation Safety
- Radiation Survey Equipment
- Clinical Pictures
- Radiation Control Zones
- Nuclear Explosions
- Miscellaneous

tion Events

A. **Radiation Concepts**
1. Learn the Basics:
   - Video: Radiation Principles (HHS/
   - Video: Types of Ionizing Radiatio
2. **Contamination**
   - **External Contamination**
     - Full Body
     - Partial Body
     - Wound Contamination with
   - **Internal Contamination**
     - via Respiratory Tract
     - via Digestive Tract
     - via Radioactive Dust in Ope
   - **Incorporation**
3. **Exposure**
   - Whole Body
   - Partial Body
4. Dose Rate Effect of Radiation Exposure
5. Types of Ionizing Radiation and Shieldi
6. Electromagnetic Radiation: Ionizing and
7. Decay rate/half-life of radioisotopes
8. Atomic Number and Atomic Mass

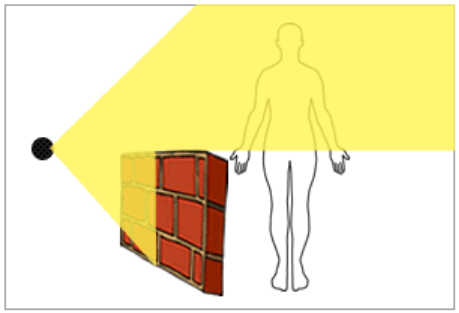
Exposure: Partial Body - Animation

Print this page

Exposure
- Whole Body
- **Partial Body**

Patient Management:

Exposure Only Management Algorithm



Replay

Exposure:
- Exposure occurs when all or part of the body receives **penetrating** radiation (e.g., gamma rays or x-rays, or high-energy beta particles) from an external source.
- **Acute Radiation Syndrome (ARS)** may result if the whole body exposure dose is high enough.
  - Diagnosis of ARS usually requires specific blood tests and clinical findings.
- An individual exposed to radiation is **NOT radioactive or contaminated** and may be approached without risk, just like after a chest x-ray or CT scan.
  - Radiation from exposure is either absorbed without the body becoming radioactive, or it can pass through the body completely.
  - Therefore, if a person is scanned with radiation detection equipment, it will not register radiation above background level.
- Exposure stops when the person leaves the area of the source, the source is shielded completely, or the process causing exposure ceases.
- Types of **exposure**:
  - **Whole body exposure**: entire person re ceives penetrating radiation, i.e., no portion of the body is shielded
  - **Partial body exposure**: shielding of sufficient thickness blocks a significant portion of the person from receiving penetrating radiation

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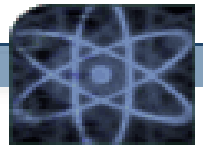
Summary

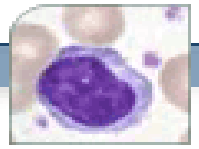
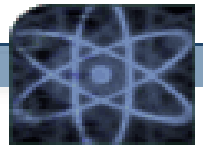
- REMM can be used for:
  - Disaster Preparedness and Response
    - Recognize a radiation or nuclear event
    - Know how to respond to an event
  - Hospital planning
    - How to develop a radiation response team
    - Equip an emergency room for decontamination
  - Training module for health care providers
    - Part of hospital preparedness activities
    - Practices and drills
  - Resource for researchers and teachers





Next Steps

- Tutorial/Other training tools
- CD distribution to all NN/LM members
- PDA version
- Management of chronic effects of radiation
- Population monitoring
- Collaboration with other agencies

Visit and Download REMM

- http://remm.nlm.gov

- Contact information:
  nlmremm@nlm.nih.gov