Ready for Some Radiation?

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Radiation Basics – Three Flavors



External Exposure/Irradiation – NO contamination



Contamination (may have had irradiation also!)



Radiation Protection

- Detection
- •Dose
- •Time
- Distance
- Shielding





Radiation Protection – Inverse Square Law





Radiation Injury Illness and Death

	Days	Symptoms	Treatment
Early (prodromal) phase	1-3	N/V, diarrhea, HA, etc.	Cytokines, trauma (OR within 48h), supportive
Latent	3-14	Minimal	Evacuation to definitive care, follow labs, consider antibiotics
Late	>14	Infections, sepsis, bleeding, death	Antibiotics, isolation, transfusions, supportive care

Note:

- The worse the radiation injury the more rapid the progression
- Timeframes are for moderate radiation injury salvageable victims
- WBC in circulation at time continue to protect the body until they die about 2 weeks later
- Bone marrow injury means no WBC, platelets to replace them (RBCs last longer) therefore no
 protection against infection

Radiation event types / threats

	Impact	ARS	Fallout	Major threat
Transportation / Lab	Local	Rare	No	Contamination, occasional ARS
Nuclear Power Plant	Local to regional	Rare	No	Environmental contamination
RDD	Local	Rare	No	Trauma Contamination – internal and external
Nuclear detonation	Catastrophic, national impact	Massive numbers	Yes	Trauma, irradiation injury from fallout



Myths of a 'dirty bomb'

- Responders and victims are likely to get radiation-related illness
- The damage from a radioactive bomb is much greater than usual bombs
- There will be fallout
- The radiation is the main threat during the response

RDD Focus

- Trauma care
- Detection including alpha
- Containment
- Decontamination scene, hospital (for injured), CRC
 - Environmental decontamination problematic!
- Community Reception Center operations sorting
- Risk communication



Perimeters



Personal Protective Equipment

- Protect your respiratory tract
 - Respirator, surgical mask, etc.
- Protect your skin
 - Gloves!
 - Outer clothing
 - Chemical suit (Tyvek or other) may be worn once available / radiation detected
- Key point PPE for RDD is the same as you should be wearing at ANY blast scene

Victim care

- Injured transport with clothing control only
- Not injured
 - No contamination go home
 - Contamination write CPM (counts per minute) ON the patient (and patient card if possible)
 - < 10,000 CPM home with decon card
 - 10,000 25,000 CPM dry decon and home
 - 25,000 -100,000 CPM wet decon if possible and home
 - > 100,000 CPM (rare) refer to hospital

Hospital Program

- Plan
- Policy
- Procedures
- Personnel
- Equipment
- Education
- Exercise

- Detect
- Decontaminate
- Dose assessment / Disposition
- Disposal

Detect

- Beta-gamma ONLY
- Portal monitors
 - Portable
 - Fixed location alarm issues
- Be careful not to contaminate the footplate / floor!
 - Use booties and/or walk-off mats
- Dosimeters
- G-M counters













Radiation Exposure Algorithm Treat life/limb threatening injuries before decontamination¹ Radiation detected Discharge home Irradiation No No after recording by monitor (portal or exposure?² contact information hand-held) at threshold levels? Yes Alpha – level >2x background No decontamination •Contain clothing/reduce cross-Beta / gamma – levels contamination between patients > 0.1mR/h or Consult Poison (PCC) 1-800-222-1222 > 300cpm over background Involve health physicist or radiation (cpm = counts per minute) safety officer (PCC or facility resource) Yes Treat symptoms³

• Survey body with hand-held counter and record initial cpm on body map

(in disaster, write max cpm on patient's forearm with indelible marker)

- Obtain nasal swabs (moist Q-tip swabs of internal nares, survey swabs)
- Soap and water decontamination of contaminated areas
- Decontaminate open wounds first, then cover and decon intact skin
- Re-screen using counter and document results
- Consider clean when < 2x background or < 1mR/h⁴
- Assess and treat injuries per usual care
- Obtain isotope information via MnTrac, MRCC, or on-site equipment (if available)
- Consult PCC for information about additional treatments and testing

1 - If known contamination event try to contain clothing/reduce cross-contamination during patient care but do not delay usual interventions - providers should wear barrier precautions and masks

- 2 Exposure to high energy gamma source of radiation (e.g.: nuclear power plant fuel, exposed medical radiotherapy source, nuclear weapon detonation, certain industrial sources - but not a 'dirty bomb')
- 3 Vomiting is a nonspecific finding and other causes evaluated (e.g.: anxiety, chemical exposure, head injury)
- 4 If decon x2 does not reduce counts consider embedded material consult poison control and involve health physicist, may recommend gentle scrub with powdered detergent with/without use of dilute bleach

1. PPE – Filtering facemask with splash protection, barrier precautions for hands and body

Radiologic Decontamination

2. Perform life-saving interventions BEFORE decontamination

3. Survey skin with G-M counter and document counts on body map

• Survey about 1 inch / second about 1 inch from the surface

• If FACIAL contamination is present obtain swabs of nasal cavity, place in small bag for later surveying – document counts and time on bag

Scan front, back, and soles of feet

4. First - decontaminate wounds

- Isolate wounds with chux / drapes
- Use gauze sponges with water and gentle detergent
- Hold sponges with McGill forceps
- Wipe ONCE and discard

 Consult radiation safety officer for managing any embedded or removed radioactive debris

5. Second – surface decontamination

- Eyes and mucous membranes rinse with water
- Skin soap and water gentle cleaning
- Hair and nails soap and water, clip if required

6. Re-survey with G-M counter

• If counts not reduced by 50% after 5 minutes contact radiation safety officer

- Consider gentle scrub with powdered detergent if wounds stay contaminated OR use standard bleach diluted 10x
- Clean = less than 2x background or < 1mr/h



Dose Assessment

- External count correlation
- Internal contamination
 - Urine, stool monitoring
 - Gamma camera
- Serial ALC
- Modeling / mapping
- Interventions?
- Follow up?

Patterns of early lymphocyte response in relation to dose.



Disposal

- Work with RSO and state
- Determine based on isotope and activity what must be handled as hazardous waste and what can be discarded
- Isolate any high-emission waste as soon as possible (lead container, distance/shielding)









Key Points - RDD

- Must have a plan involving all coalition stakeholders
 - Roles and responsibilities negotiate this between agency leads BEFORE the tabletop or any training starts
- Community-based shelter and decontamination
- Assumptions and thresholds must be agreed on
- CRC plans and processes
- Equipment availability and awareness
- Personnel education
- SME availability and engagement is key!
- Risk communication is CRITICAL

Questions / Resources

Major Radiological or Nuclear Incidents: Potential Health and Medical Implications (and Topic Collection) – ASPR TRACIE 2018 (asprtracie.hhs.gov)

Radiation Emergency Medical Management (REMM – remm.nlm.gov)

Radiation Emergency Asst. Center/Training Site (REAC/TS) – orise.orau.gov







Radiological Emergency Preparedness (REP) Program

Patrick McLaughlin





REP Program History

March 1979

 Three Mile Island nuclear power plant accident in Pennsylvania

December 7, 1979

 President Carter transferred the Federal lead role in offsite REP activities from the NRC to FEMA.





REP Program History

- FEMA established the REP Program to:
 - Ensure that the public health and safety around nuclear power plants would be adequately protected.
 - Inform and educate the public about radiological emergency preparedness.



Program Manual

Radiological Emergency Preparedness FEMA P-1028 / December 2019





Montícello Nuclear Generatíng Plant



Prairie Island Nuclear Generating Plant

MN Statute Chapter 12

MINNESOTA STATUTES 2010

12.21

12.21 GOVERNOR.

Subdivision 1. General authority. The governor (1) has general direction and control of emergency management, (2) may carry out the provisions of this chapter, and (3) during a national security emergency declared as existing under section 12.31, during the existence of an energy supply emergency adeclared an existing under section 216C.15, or during the existence of an emergency resulting from an incident at a nuclear power plant that poses a radiological or other health hazard, may assume direct operational control over all or any part of the emergency management functions within this state.

Subd. 2. Cooperation. In performing duties under this chapter, the governor may cooperate with the federal government, with other states, with Canadian provinces, and with private agencies, in all matters performing duties and of the national states and states and of the national states and states

MINNESOTA STATUTES 2010

12.13

12.13 NUCLEAR POWER PLANT EMERGENCY RESPONSE PLANNING.

Subdivision 1. **Plan development.** The state director, in cooperation with the commissioner of health and affected political subdivisions, shall develop the state and local portions of the emergency operations plans specified in the licensing of each nuclear power plant located in Minnesota.

Subd. 2. Need assessment; program development. In addition to requirements imposed by federal law, the state director shall assess the need for protective actions required to mitigate the effect of an incident at a nuclear power plant, and carry out nuclear power plant emergency operations planning including, but not limited to:

the state and polit

Subd. 2. Need assessment; program development. In addition to requirements imposed by federal law, the state director shall assess the need for protective actions required to mitigate the effect of an incident at a nuclear power plant, and carry out nuclear power plant emergency operations planning including, but not limited to:

...ogram of this state, procure supplies, equipment, and facilities; institute training programs and public information programs; and take all other preparatory steps, including the partial or full activation of emergency management organizations in advance of actual disaster to ensure the furnishing of adequately trained and equipped forces of emergency management personnel in time of need;

(4) make studies and surveys of the industries, resources, and facilities in this state as may be necessary to ascertain the capabilities of the state for emergency management and to plan for the most efficient emergency use of those industries, resources, and facilities;

(5) on behalf of this state, enter into mutual aid arrangements or cooperative agreements with other states, tribal authorities, and Canadian provinces, and coordinate mutual aid plans between political subdivisions of this state;

(6) delegate administrative authority vested in the governor under this chapter, except the power to make rules, and provide for the subdelegation of that authority;

(7) cooperate with the president and the heads of the armed forces, the Emergency Management Agency of the United States and other appropriate federal officers and agencies, and with the officers and agencies of other states in matters pertaining to the emergency management of the state and nation, including the direction or control of:

(i) emergency preparedness drills and exercises;

 (ii) warnings and signals for drills or actual emergencies and the mechanical devices to be used in connection with them;

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History: 1980 c 611 s 2; 1996 c 344 s 7

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- Emergency Planning Zone (EPZ)
 - 10 mile radius from the plant
 - Direct radiation exposure
- Ingestion Planning Zone (IPZ)
 - 50 mile radius from the plant
 - Radioactive materials could contaminate water supplies, food crops and livestock



REP - The Big Picture



Emergency Classification Levels (ECLs)



- The plant declares an ECL based on specific plant conditions
- Off-Site actions in the plan are driven by the level of consequence that ECL implies



General Emergency Site Area Emergency Alert

ECLS

Notification of Unusual Event



Precautionary Measures at SAE



 MN Department of Human Services may activate Reception Centers



 Congregate Care Centers may be activated near the Reception Centers





Reception Centers



Reception Centers

- Monticello:
 - Rogers
 - Princeton
 - St. Cloud
- Prairie Island:
 - Cottage Grove
 - Wabasha









- North Memorial Health Hospital/North Memorial Amblunce
- M Health Fairview Northland Medical Center/ North Memorial Ambulance
- CentraCare St. Cloud Hospital/ Mayo Clinic Ambulance
- Regions Hospital/ Cottage Grove Ambulance
- Gundersen St. Elizabeth Hospital/Wabasha Ambulance Service







Actions at GE

Reception Centers begin receiving evacuees









Ambulance

- Stage at reception centers
- Transport contaminated/potentially contaminated patient to the hospital
- Limit contamination as much as possible







Hospital

- Prepare decontamination room at the hospital
- Receive patient from reception center
- Treat patient while minimizing contamination as much as possible







Addition Resources

- HSEM Website
 - Training videos
 - <u>https://dps.mn.gov/divisions/h</u> <u>sem/radiological-emergency-</u> <u>preparedness/Pages/rep-</u> <u>training.aspx</u>

REAC/TS

 Available for any radiological emergency



-Fortuna Favet Paratis-

est. 2006

Radiation Injury Treatment Network

Cullen Case Jr.

RITN Program Director

Operated by the National Marrow Donor Program/Be The Match

CCase@nmdp.org | 763.406.8402 wk | 612.214.3549 cell

www.RITN.net

February 15, 2023

Preparing to treat Acute Radiation Syndrome casualties from a <u>distant</u> radiological mass casualty disaster



Why Bone Marrow/Cancer Centers?

- RITN is led by the NMDP-Be The Match and funded by the Office of Naval Research
- Bone marrow transplant units preparing for the medical surge resulting from a distant radiological incident
- Bone marrow transplants are typically done for blood cancers
- ARS mimics what BMT/hematology/oncology staff see daily while treating patients with blood cancers
- Through cancer treatment process patients are irradiated or given chemotherapy to destroy their immune system (marrow)
- Bone marrow is a the most sensitive organ in the body to ionizing radiation
- Exposure causes Acute Radiation Syndrome
- Failure to restore would result in death



Image Source: NCI <u>https://www.cancer.gov/about-</u> cancer/treatment/types/radiation-therapy/radiation-factsheet accessed 11/29/16



RITN Hospitals (see list of hospitals RITN.net/About)









Will not be as Catastrophic as a Military Nuclear Weapon





First 2 hours of Fallout



Courtesy of Brooke Buddemeier and Lawrence Livermore Laboratory



Fallout Extent at 2 Hours



Courtesy of Brooke Buddemeier and Lawrence Livermore Laboratory



Fallout Dissipation



Illustration from: Knebel AR, Coleman CN, Cliffer KD; et al. Allocation of scarce resources after a nuclear detonation: setting the context. Disaster Med Public Health Prep. 2011;5 (Suppl 1):S20-S31







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www.RITN.net

With Acute Radiation Syndrome There is Time



From: Medical Management of Radiological Casualties (Fourth Edition – July 2013) Military Medical Operations, Armed Forces Radiobiology Research Institute, Bethesda, Maryland 20889-5603 https://www.usuhs.edu/afrri/productsandpublications accessed 11/29/16





Proximity Will Not Preclude Involvement





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RITN Preparedness Practicum February 2023

Some Considerations

- Distance will not keep cities from being involved in the response
- Injuries will be complicated
 - Combined trauma and radiation significantly decreases survivability
- Dose estimates will be unclear
 - Most research on treatment and outcomes is based on whole body dose
 - Most will likely have partial body exposures
- Triage for scarce resource allocation will be essential
 - Medical countermeasures will help but not likely enough for everyone
 - Many with low doses can be sent home or outpatient (daily CBC+diff)
- Difficult decisions will have to be made on who to prioritize; the closer to the disaster the messier it will be





Critical to Success



RITN