Radiation Injury Treatment Network

-Fortuna Favet Paratis-

est. 2006

<INSERT SPEAKER CONTACT INFO HERE>

Refer to notes for talking points and draft script.

RITN@nmdp.org

www.RITN.net

<as of Feb 2023>

RITN Green Color:

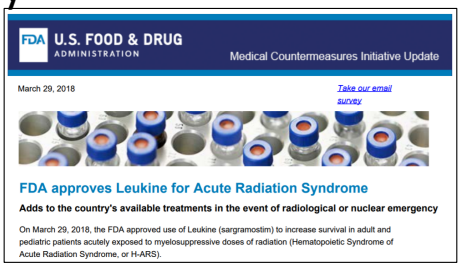
PPT RGB definition

Green: 166-206-57

Yellow: 255-242-0

Why Everyone Should Care

- Government Is Not Taking the Threat Lightly
- FDA Approves for treatment of ARS
  - Filgrastim (March 2015)
  - Pegfilgrastim (Nov 2015)
  - Sargramostim (March 2018)
  - Romiplostim (January 2021)
- These drugs being added to Strategic National Stockpile for a disaster

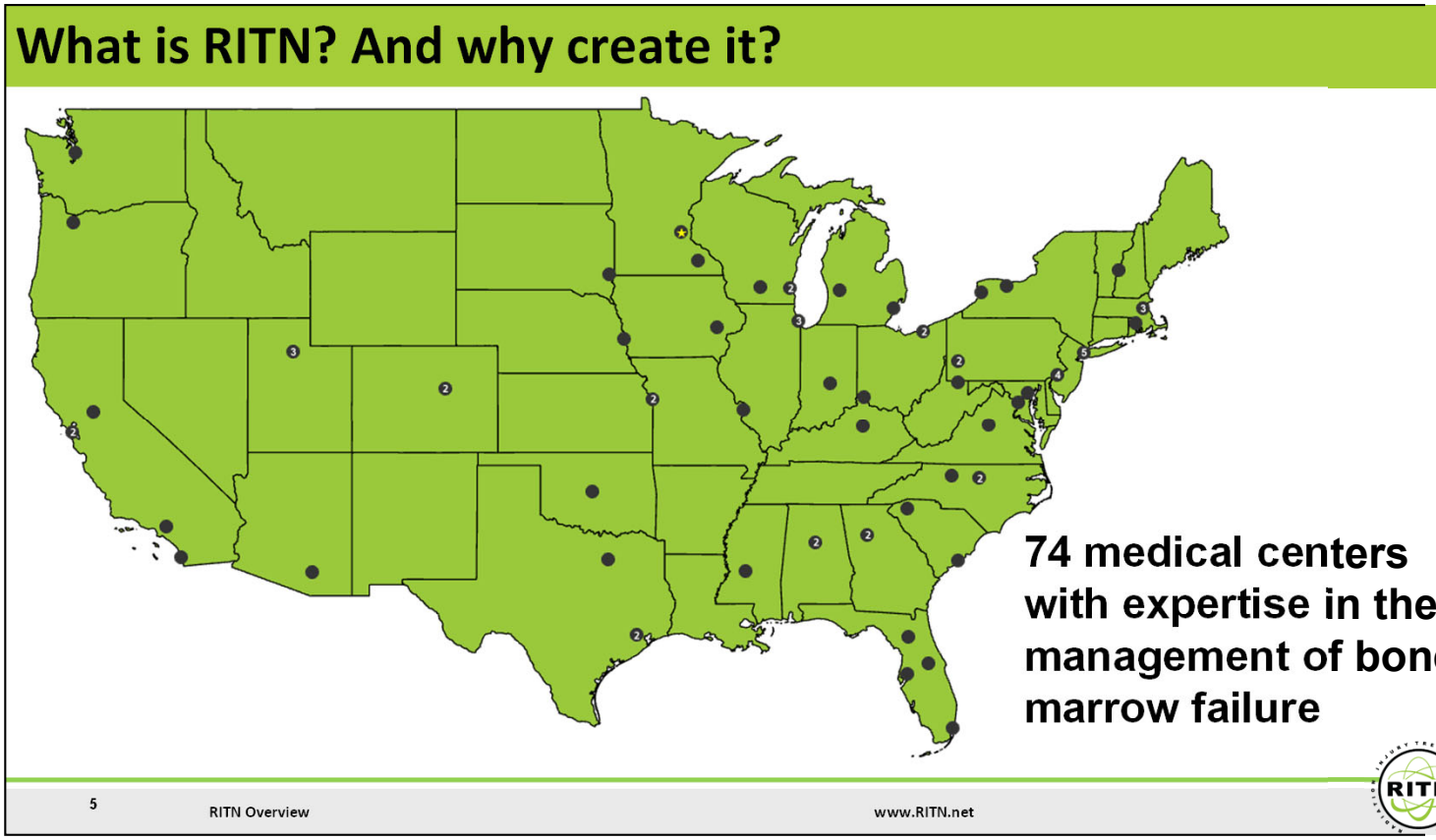


The government feels the threat to be real, it has stockpiled medicine and modified treatment authorization to use the best medication available to treat those exposed to radiation.

Agenda

- What is RITN?
- What RITN is preparing for
- How RITN fits into the response
- Casualty Profile & Care
- Resources

What is RITN?



What is RITN?

RITN is a collaborative effort, led by the NMDP-Be The Match and the ASTCT, of hospitals preparing for the medical surge resulting from a distant radiological incident

RITN hospitals prepare to provide specialized care to patients with Acute Radiation Syndrome (ARS) following a mass casualty radiological incident

Hospitals near the incident will not be activated as part of the RITN

RITN expertise is for “radiation only” injuries, trauma patients should be sent to other NDMS hospitals

Why was RITN Created?

The gap of specialized care for ARS patients was identified by the Assistant Secretary for Preparedness and Response, or ASPR, as well as the Office of Naval Research

Following the leadership of the Office of Naval Research, the NMDP-Be The Match was developing capacity at bone marrow treatment clinics in hospitals to prepare

In 2005 ASPR engaged the NMDP-Be The Match and American Society for Transplantation and Cellular Therapy (ASTCT) to collaborate on bridging the gap

ASTCT members are world leaders in transplantation

RITN Mission

Preparing to treat Acute Radiation Syndrome casualties from a distant radiological mass casualty disaster

It boils down to a simple statement: Preparing to treat Acute Radiation Syndrome casualties from a distant radiological mass casualty disaster

Vs.

The Radiation Injury Treatment Network® (RITN) is a national network of medical centers with expertise in the management of bone marrow failure and works with partners from other medical specialties to assist with managing acute radiation syndrome (ARS) and its health-related consequences. The mission of the RITN is to maximize health-related outcomes among casualties with ARS following a mass casualty disaster involving radiological, nuclear, or chemical agents with marrow toxicity.

To accomplish its mission:

Before the disaster, RITN develops treatment guidelines for managing hematologic toxicity among casualties of radiation exposure and educates health care professionals about pertinent aspects of radiation exposure management through training and disaster exercises.

During the disaster, RITN centers provide comprehensive evaluation and treatment in both inpatient and outpatient settings. The RITN control cell helps to coordinate the response and shares critical information about the disaster between RITN hospitals and governmental agencies, including the Department of Health and

Human Services (DHHS), Assistant Secretary of Preparedness and Response (ASPR).

After the disaster, RITN centers collect and share patient data for research through the Center for International Blood and Marrow Transplantation Research.

RITN is led by the National Marrow Donor Program and American Society for Transplantation and Cellular Therapy, with essential support from the US Office of Naval Research

Why Cancer Centers?

- Bone marrow is a the most sensitive organ in the body to ionizing radiation
- Doses >2 Gy** of ionizing radiation can cause Acute Radiation Syndrome (ARS)
- 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)
- Failure to restore would result in **death**

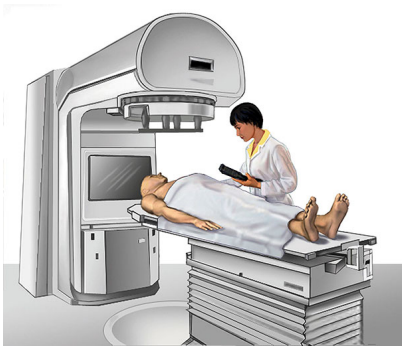


Image Source: NCI https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy/radiation-fact-sheet accessed 11/29/16

**Chest CT = 7 mSv : ~0.007 Gy == 2 Gy ~286 chest CTs
** PET/CT = 25 mSv : ~0.025 Gy == 2 Gy ~ 80 PET/CTs

Extremely small numbers of the long-term blood (hematopoietic) stem cells can repopulate the entire blood forming system
Survival boosts (LD50/60):

Left untreated ½ of radiation casualties will die from >3 Gy
With supportive care increase to ½ survive at 6 Gy
With Cytokines increase ½ survive at 8 Gy

Doses of ionizing radiation >2 Gy** can cause Acute Radiation Syndrome (ARS)

ARS mimics what BMT/hematology/oncology staff see daily from the treatment of blood cancers

Through cancer treatment process patients are irradiated or given chemotherapy to destroy their immune system

Dose treatment:

~< 2Gy is survivable without treatment

4 Gy is LD 50/60 without supportive care

LD 50/60 increases to ~6 Gy with supportive care (fluids, antibiotics, antifungals)

LD 50/60 increases to ~8 Gy with cytokines

Bone marrow is a the most sensitive organ in the body to ionizing radiation.

Bone marrow is the source of production of:

- Red blood cells ----- for oxygen
- White blood cells -- for immunity
- Platelets ---------- for clotting

<u>Failure to restore blood production following radiation injury would result in death.</u>

Untreated, many radiation casualties will die of marrow suppression from whole body exposure greater than 300 cGy (rad).

- Extremely small numbers of the long-term blood (hematopoietic) stem cells can repopulate the entire blood forming system.
- Hematopoietic stem cells are primarily in the bone marrow and also circulate in the blood.
- The hematopoietic stem cell, undamaged, is very sturdy and for transplantation can be obtained from a donor from the bone marrow from their hip or from the blood using apheresis.
- This focus of RITN leverages the expertise of marrow transplant specialists who are accustomed to providing the intensive supportive care required by patients with suppressed marrow function.

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Gy to Sv conversion... Approximation: http://www.convert-me.com/en/convert/radiation/rrgray.html?u=rrgray&v=2

Chest CT dose from: http://www.radiologyinfo.org/en/info.cfm?pg=safety-xray

Conversion from: http://www.convert-me.com/en/convert/radiation/rrmsievert.html?u=rrmsievert&v=7

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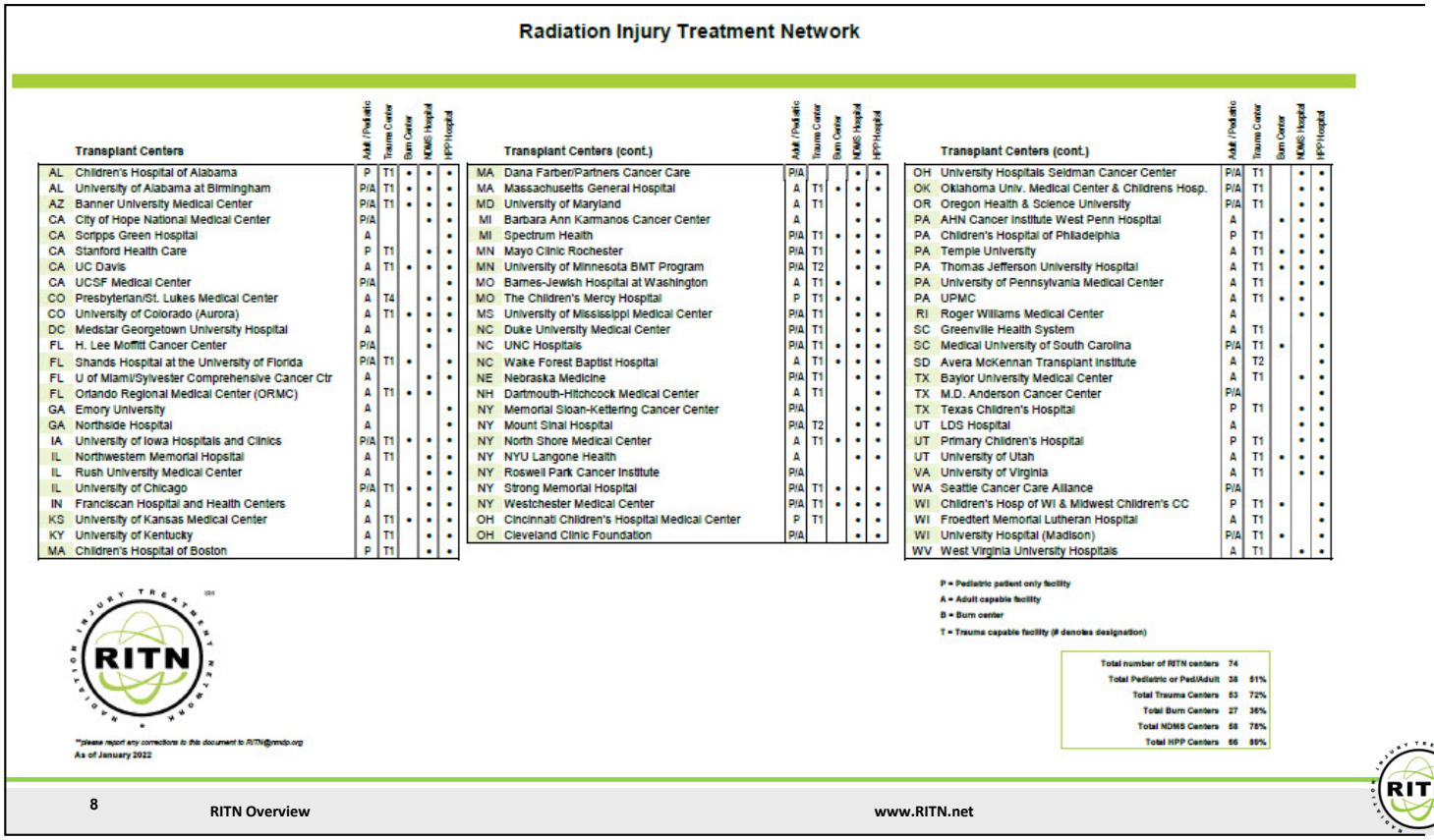

Radiation Injury Treatment Network

	Transplant Centers	Adult / Pediatric	Trauma Center	Burn Center	NDMS Hospital	HPP Hospital
AL	Children's Hospital of Alabama	P	T1	•	•	•
AL	University of Alabama at Birmingham	P/A	T1	•	•	•
AZ	Banner University Medical Center	P/A	T1	•	•	•
CA	City of Hope National Medical Center	P/A			•	•
CA	Scripps Green Hospital	A				•
CA	Stanford Health Care	P	T1		•	•
CA	UC Davis	A	T1	•	•	•
CA	UCSF Medical Center	P/A				•
CO	Presbyterian/St. Lukes Medical Center	A	T4		•	•
CO	University of Colorado (Aurora)	A	T1	•	•	•
DC	Medstar Georgetown University Hospital	A			•	•
FL	H. Lee Moffitt Cancer Center	P/A			•	
FL	Shands Hospital at the University of Florida	P/A	T1	•		•
FL	U of Miami/Sylvester Comprehensive Cancer Ctr	A			•	•
FL	Orlando Regional Medical Center (ORMC)	A	T1	•	•	
GA	Emory University	A				•
GA	Northside Hospital	A				•
IA	University of Iowa Hospitals and Clinics	P/A	T1	•	•	•
IL	Northwestern Memorial Hopsital	A	T1		•	•
IL	Rush University Medical Center	A			•	•
IL	University of Chicago	P/A	T1	•	•	•
IN	Franciscan Hospital and Health Centers	A			•	•
KS	University of Kansas Medical Center	A	T1	•	•	•
KY	University of Kentucky	A	T1		•	•
MA	Children's Hospital of Boston	P	T1		•	•

	Transplant Centers (cont.)	Adult / Pediatric	Trauma Center	Burn Center	NDMS Hospital	HPP Hospital
MA	Dana Farber/Partners Cancer Care	P/A			•	•
MA	Massachusetts General Hospital	A	T1	•	•	•
MD	University of Maryland	A	T1		•	
MI	Barbara Ann Karmanos Cancer Center	A			•	•
MI	Spectrum Health	P/A	T1	•	•	•
MN	Mayo Clinic Rochester	P/A	T1		•	•
MN	University of Minnesota BMT Program	P/A	T2		•	•
MO	Barnes-Jewish Hospital at Washington	A	T1	•		•
MO	The Children's Mercy Hospital	P	T1	•	•	
MS	University of Mississippi Medical Center	P/A	T1		•	•
NC	Duke University Medical Center	P/A	T1		•	•
NC	UNC Hospitals	P/A	T1	•	•	•
NC	Wake Forest Baptist Hospital	A	T1	•	•	•
NE	Nebraska Medicine	P/A	T1		•	•
NH	Dartmouth-Hitchcock Medical Center	A	T1			•
NY	Memorial Sloan-Kettering Cancer Center	P/A			•	•
NY	Mount Sinai Hospital	P/A	T2		•	•
NY	North Shore Medical Center	A	T1	•	•	•
NY	NYU Langone Health	A			•	•
NY	Roswell Park Cancer Institute	P/A				
NY	Strong Memorial Hospital	P/A	T1	•	•	•
NY	Westchester Medical Center	P/A	T1	•	•	•
OH	Cincinnati Children's Hospital Medical Center	P	T1		•	•
OH	Cleveland Clinic Foundation	P/A			•	•

	Transplant Centers (cont.)	Adult / Pediatric	Trauma Center	Burn Center	NDMS Hospital	HPP Hospital
OH	University Hospitals Seidman Cancer Center	P/A	T1		•	•
OK	Oklahoma Univ. Medical Center & Childrens Hosp.	P/A	T1		•	•
OR	Oregon Health & Science University	P/A	T1		•	•
PA	AHN Cancer Institute West Penn Hospital	A		•	•	•
PA	Children's Hospital of Philadelphia	P	T1		•	•
PA	Temple University	A	T1	•	•	•
PA	Thomas Jefferson University Hospital	A	T1	•	•	•
PA	University of Pennsylvania Medical Center	A	T1		•	•
PA	UPMC	A	T1	•	•	
RI	Roger Williams Medical Center	A			•	•
SC	Greenville Health System	A	T1			
SC	Medical University of South Carolina	P/A	T1	•		•
SD	Avera McKennan Transplant Institute	A	T2			•
TX	Baylor University Medical Center	A	T1		•	•
TX	M.D. Anderson Cancer Center	P/A				•
TX	Texas Children's Hospital	P	T1		•	•
UT	LDS Hospital	A			•	•
UT	Primary Children's Hospital	P	T1		•	•
UT	University of Utah	A	T1	•	•	•
VA	University of Virginia	A	T1		•	•
WA	Seattle Cancer Care Alliance	P/A				
WI	Children's Hosp of WI & Midwest Children's CC	P	T1	•		•
WI	Froedtert Memorial Lutheran Hospital	A	T1			•
WI	University Hospital (Madison)	P/A	T1	•		•
WV	West Virginia University Hospitals	A	T1		•	•

RITN

*Please report any corrections to this document to RITN@nmdp.org
As of January 2022

P = Pediatric patient only facility
A = Adult capable facility
B = Burn center
T = Trauma capable facility (# denotes designation)

Total number of RITN centers	74	
Total Pediatric or Ped/Adult	38	51%
Total Trauma Centers	53	72%
Total Burn Centers	27	36%
Total NDMS Centers	58	78%
Total HPP Centers	66	89%

8 RITN Overview www.RITN.net

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- The gap of specialized care for ARS patients was identified by the Assistant Secretary for Preparedness and Response, or ASPR, as well as the Office of Naval Research
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Federal Plans Involving the RITN

- White House: Planning Guidance for Response to a Nuclear Detonation
- FEMA: Nuclear/Radiological Incident Annex
- ASPR: Radiological Dispersal Device Playbook
- ASPR: Rad/Nuke Annex to All Hazards Plan
- ASPR: State & Local Planners Playbook for Medical Response to a Nuclear Detonation
- ASPR: Medical Planning and Response Manual for a Nuclear Detonation Incident
- NLM: REMM-RITN Prototype for Adult & Pediatric Medical Orders During a Radiation Incident

ASPR
ASSISTANT SECRETARY FOR PREPAREDNESS AND RESPONSE

FEMA

U.S. Department of Health & Human Services
REMM RADIATION EMERGENCY MEDICAL MANAGEMENT
www.remm.nlm.gov

ASPR CBRNE branch in Office of Emergency Management

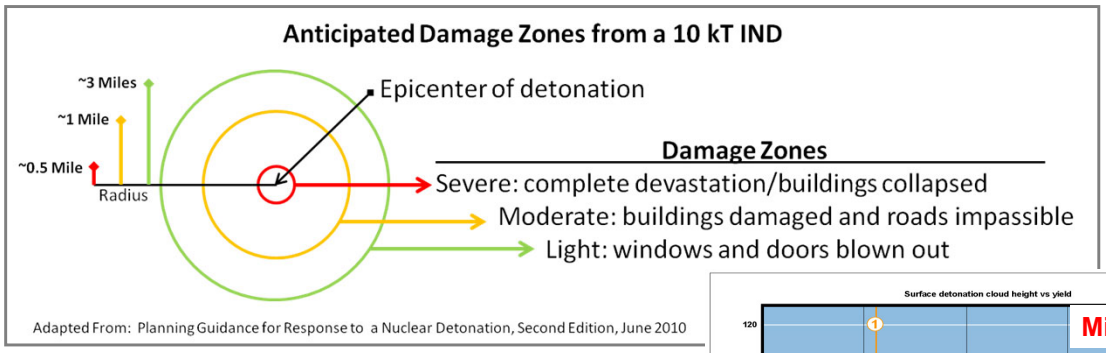
https://www.phe.gov/about/oem/cbrne/Pages/default.aspx

- RITN has memorandum of understanding, or MOU, with ASPR to coordinate preparedness and response efforts
- Work with the Chemical, Biological, Radiological, Nuclear, and high yield Explosives, or CBRNE, branch in Office of Emergency Management
- www.phe.gov

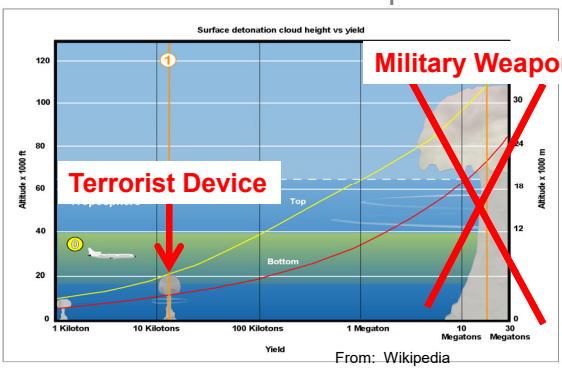
Concept of Operations…. ConOps

Wikipedia, June 2011

Damage will not be as Catastrophic as a Military Nuclear Weapon



Adapted From: Planning Guidance for Response to a Nuclear Detonation, Second Edition, June 2010



From: Wikipedia

Any incident that results in mass casualties with marrow toxic injuries is RITNs focus, the most likely incident would be from the detonation of an improvised nuclear device.

Even though an RED, RDD, industrial or nuclear power plant accident could result in victims with ionizing radiation exposure these likely would not result in mass casualties. Other **incidents that could involve RITN include a** nuclear power plant accident, radiological exposure device (RED) a.k.a. open source, radiological Dispersal Device (RDD) a.k.a. dirty bomb, an industrial accident, military grade nuclear weapon, a chemical exposure from mustard agent or some unknown incident we have not thought of.

Megaton bombs can devastate entire cities.

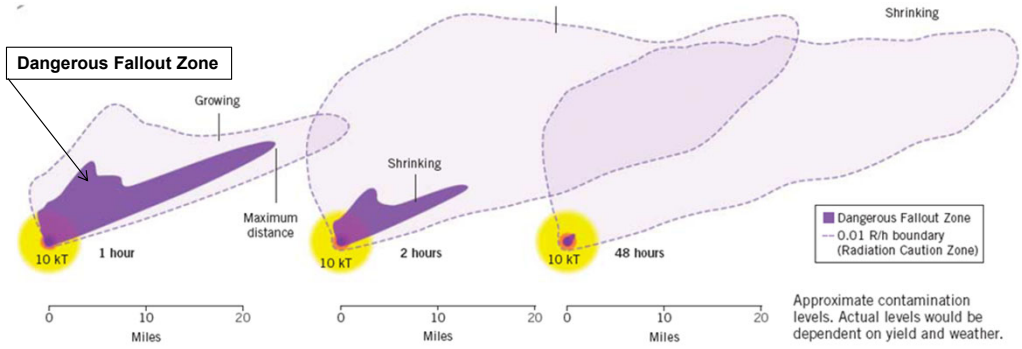
However, even though a 10 Kiloton bomb would destroy a ½ mile radius around the detonation site this level of damage quickly decreases the further away from the hypocenter (detonation site).

The old Duck and Cover response could still help those close to the hypocenter, within 3 miles.

But it will not be the level of devastation that is generally thought of.

Current planning expects that a detonation will be less than 10 Kilotons, this is far less than the Megatons of expected yield during the cold war.

Fallout May Cause the Most Radiation Injuries



•The dose in the Dangerous Fallout zone could cause marrow injury

•Sheltering-in-place is key to reducing dose, as the hazard dissipates relatively quickly

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

Illustration of the Dangerous Fallout zone from the ground burst detonation of an IND. The dose in the Dangerous Fallout zone could cause marrow injury. Sheltering-in-place is key to reducing dose, as the hazard dissipates relatively quickly.

•A hazard to many more people will be the radiation from fall out. However, this dissipates quickly. Within 12 hours the dangerous fallout zone in dark purple on the left image is expected to shrink back to within 3 miles of the detonation site.

•This means if people take shelter, they should be able to minimize their level of exposure and limit the dose of radiation they receive.

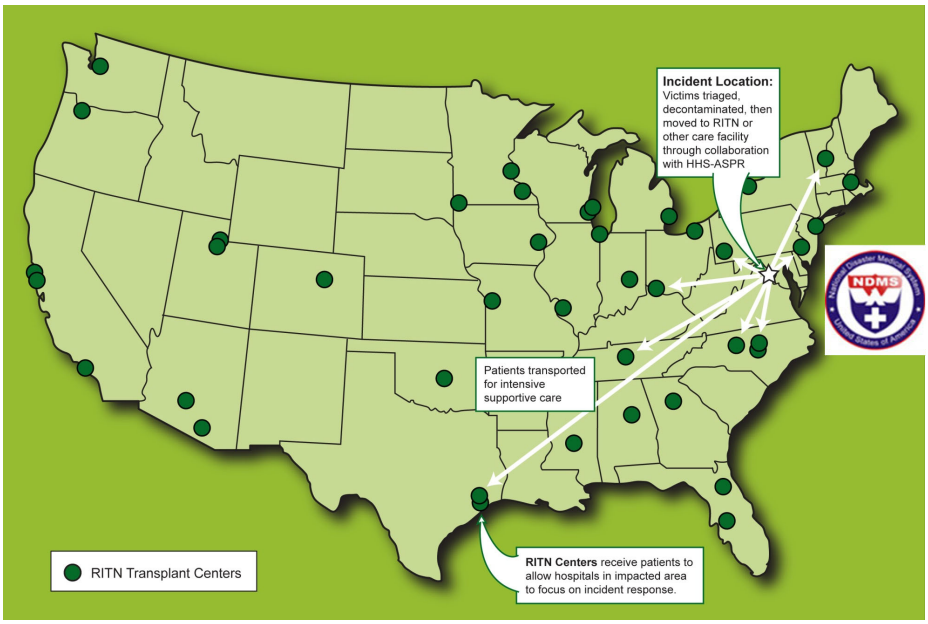
•The image on the right depicts the increased protection a person gains from different shelter locations…. A person in a basement of a wood house will receive 1/10th the exposure of someone who is outside or even sitting in a vehicle.

•In the end, the point is that it is not the end of the world; many, many people will survive.

It is not the Cold War…..
Nor is it a futile effort

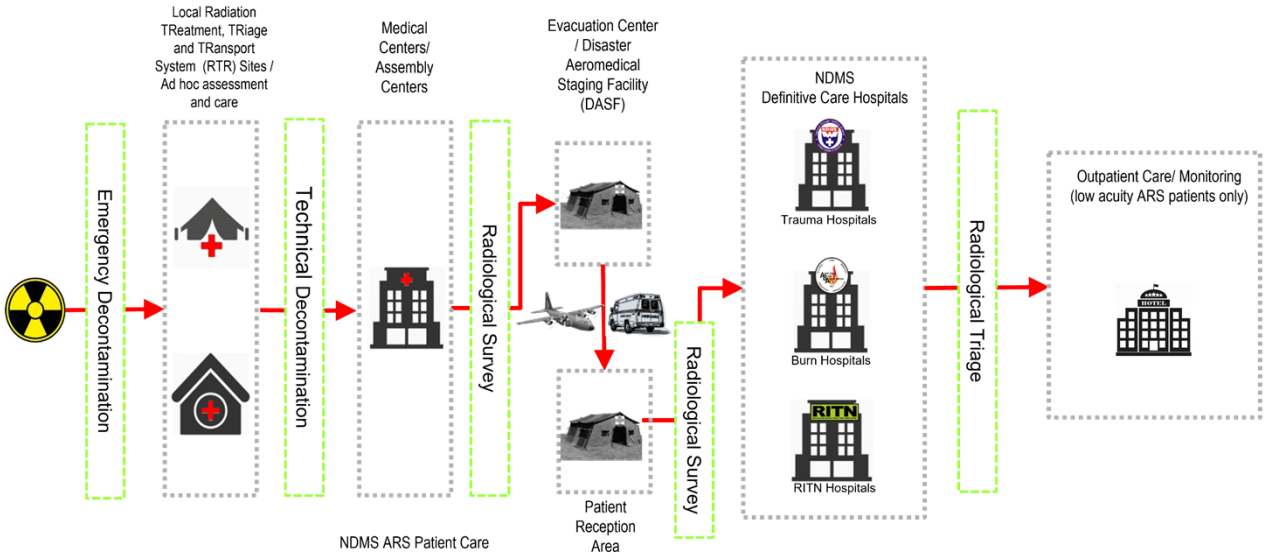
Too many people involved with preparedness for a radiological disaster immediately give up assuming that if a bomb were detonated in their community everyone would be dead; this stems from the perception from the Cold War where the USSR would detonate a 30-megaton device over a US city. This is multiple orders of magnitude larger than the 10kT device expected to be detonated by a terrorist organization.

Movement of patients through NDMS



- RITN centers plan to receive patients from the impacted area
- RITN centers are not first responders or a local response asset
- If an RITN center is near a disaster site it will be too busy handling the immediate surge to be preparing to receive additional radiation victims.
- However, other RITN centers could receive existing patients from a RITN center near a disaster site as patients are offloaded to accommodate the medical surge.

ARS Patient Movement



Bottom-line is that all of this will take time for the casualties to arrive at a RITN hospital… ~7-10 Days.

Casualties will be triaged and grossly decontaminated near the disaster then distributed when necessary to distant hospitals for appropriate care.

The boldness of the arrows decreases the further from the incident site as the casualties that are passed on to the next level of care decrease at each stage in the process.

Despite the magnitude of a disaster like this, RITN centers will have time before casualties arrive, possibly a week or more.

And there will be even more time to determine if a casualty requires a transplant, up to four weeks after exposure.

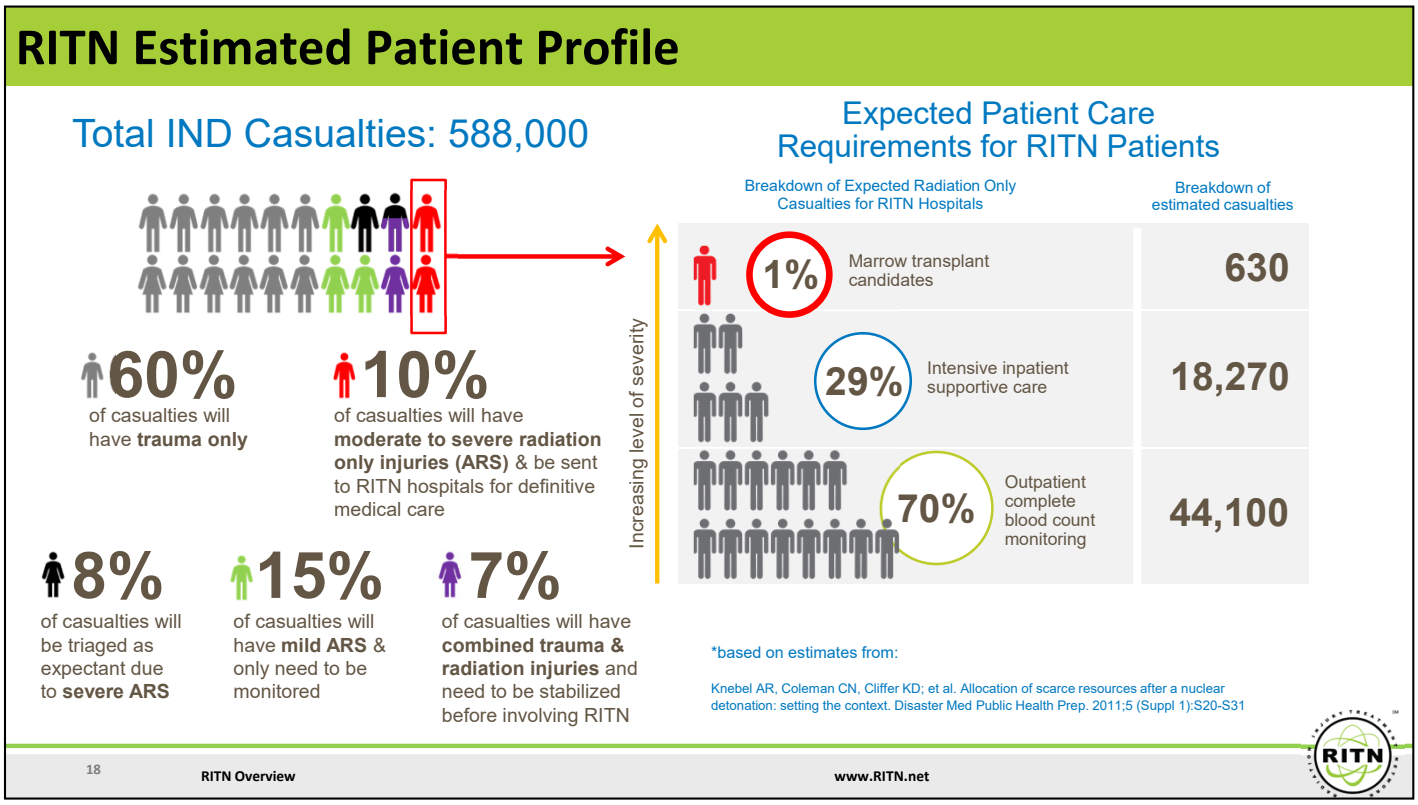
Only a small percentage would likely benefit from a transplant

10% of the casualties will have radiation injuries only.

Of those casualties, 29% will likely require inpatient care

Only 1% will likely be candidates for a marrow transplant.

The remaining 70% will need daily CBCs and minimal supportive care to monitor their recovery; ideally in an outpatient setting.



Those with ARS will need specialists. Approximately 10% will have ARS, they will need specialized supportive care to survive, care given every day at cancer centers around the world.** There is an additional 7% that will have combined trauma and radiation injuries that once stabilized for their trauma will require consultation with a RITN hospital for care of their ARS.

With Radiation exposure only victims with 2-6 Gy are likely to survive with specialized supportive care. Those with less than 2 Gy of exposure should not require significant medical resources for their care, they will self recover or survive with outpatient care.

The pyramid of treatment illustrates the small percentage of casualties with “radiation only” marrow-toxic injuries that likely would be moved through NDMS to RITN centers calculated 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

The composition of casualties is very difficult to estimate. This figure conveys the point that the majority of casualties will require supportive care, frequently as an outpatient. The percentages shown here are an estimate determined by RITN based on interpretation of current publications and medical experience.

Casualty Estimates adapted from ground burst 95th%tile column: 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

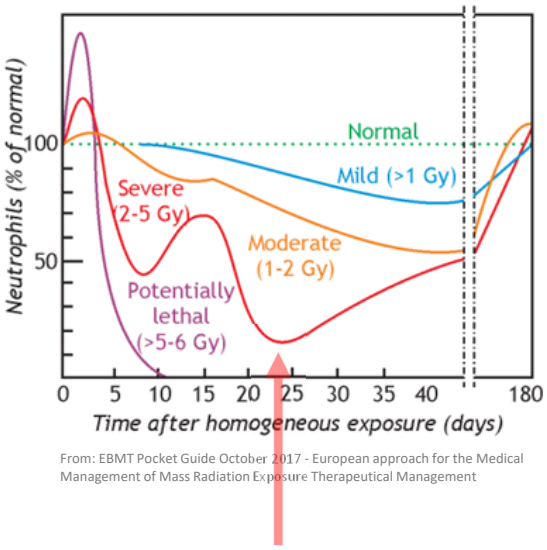
Those needing transplant estimated based on:

•Dainiak N, Chao N, Weinstock D, et al. Literature review and global consensus on management of acute radiation syndrome affecting nonhematopoietic organ systems. Disaster Med Public Health Prep. 2011 Oct;5(3):183-201. doi: 10.1001/dmp.2011.73. Epub 2011 Oct 10.

•Dainiak N, Chao N, Weinstock D, et al. First global consensus for evidence-based management of the hematopoietic syndrome resulting from exposure to ionizing radiation. Disaster Med Public Health Prep. 2011 Oct;5(3):202-12. doi: 10.1001/dmp.2011.68. Epub 2011 Oct 10.

With Acute Radiation Syndrome There is Time

- ARS takes time to progress
- Even potentially lethal doses (purple) take days to develop
- With severe doses (red) the casualties could have up to three weeks for the full illness to mature



From: EBMT Pocket Guide October 2017 - European approach for the Medical Management of Mass Radiation Exposure Therapeutical Management

With ARS there is time before the casualties symptoms fully develop.

Patients with this syndrome can manifest one or more sub-syndromes depending on the dose of radiation received.

The higher the dose received the more severe the illness and the earlier the onset of clinical manifestations

Patients who are transferred to a RITN center are those who are likely to develop the Hematopoietic subsyndrome of ARS (H-ARS)

Currently, patients who develop the gastrointestinal or the neurovascular sub-syndromes of ARS are not likely to survive

The presence of comorbid injuries or concomitant trauma or burns will greatly increase the severity of the illness and worsen the prognosis for recovery

Bone marrow sub-syndrome

Also referred to as hematopoietic syndrome or H-ARS)
The primary cause of death is the destruction of the bone marrow, resulting in infection and hemorrhage

Cutaneous sub-syndrome

Usually accompanied by some skin damage

It is also possible to receive a damaging dose to the skin without symptoms of ARS (e.g. Beta burns)

Gastrointestinal (GI) sub-syndrome

Survival is extremely unlikely with this syndrome. Destructive and irreparable changes in the GI tract and bone marrow usually cause infection, dehydration, and electrolyte imbalance. Death usually occurs within 2 weeks.

Cardiovascular (CV)/ Central Nervous System (CNS) sub-syndrome

Death occurs within 3 days. Likely due to collapse of the circulatory system as well as increased intracranial pressure.

RITN ARS Treatment Guidelines full guidelines @ www.RITN.net/treatment

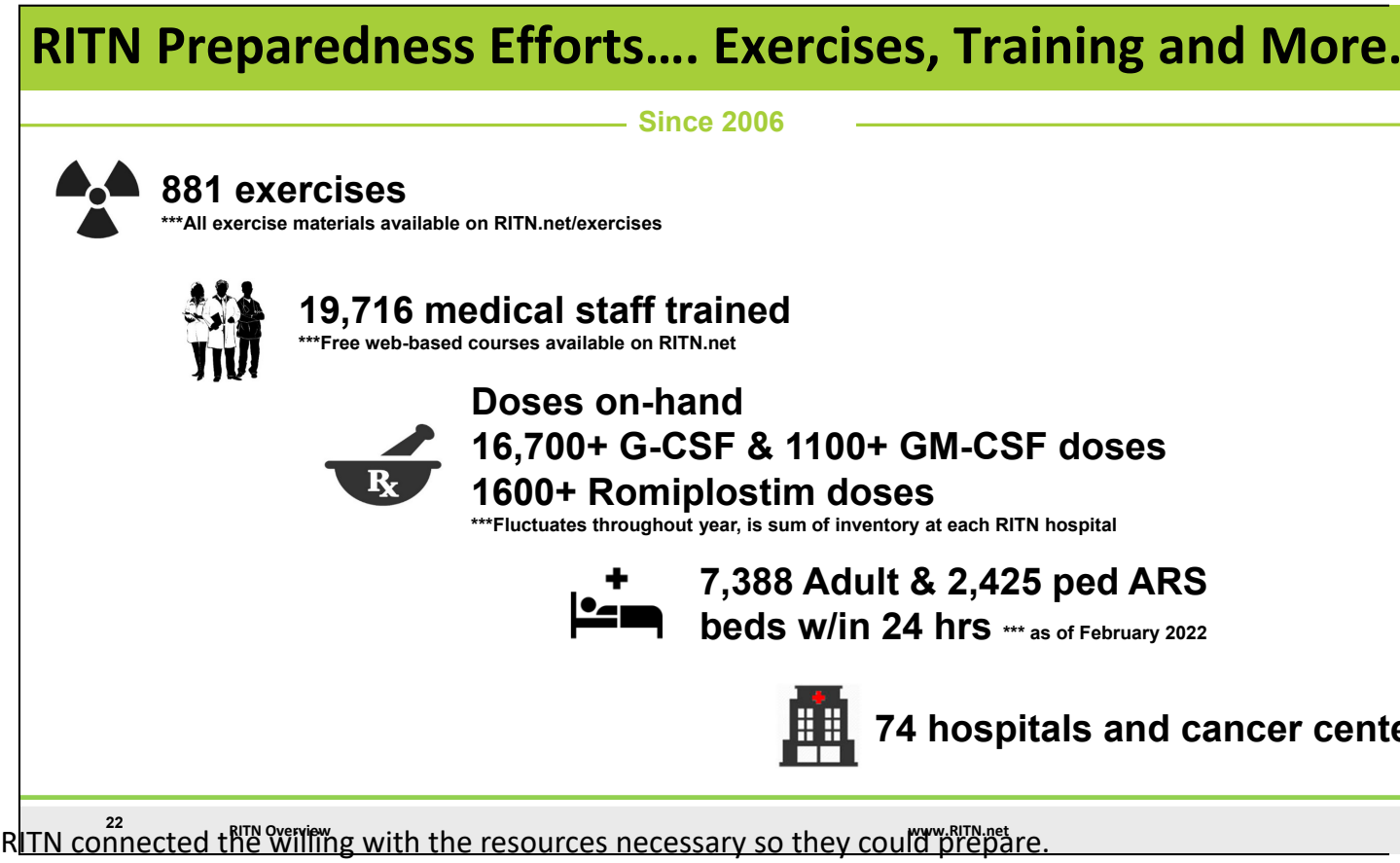
- **Follow standard approaches for patients with bone marrow toxicity from chemotherapy**
- **Based on severity of cytopenias and presence of complications (e.g. neutropenic fever)**
  - Irradiated, leukoreduced transfusions
  - Antibiotics
  - IV fluid and other support
  - G-CSF
  - Hospitalization when indicated
- **Daily CBCs to determine clinical need for treatment**
- **Biodosimetry**
  - Using online algorithms (REMM & BAT)
  - Blood counts (before and after arrival at RITN centers)
  - Geographic dosimetry
  - Opportunity to apply new biodosimetry approaches

Approaches to care are not new

Clinicians and RITN bone marrow transplant centers are experts in treatment of these symptoms

Possibility of implementing new mitigation approaches based on the governments efforts to develop medical countermeasures

Resources

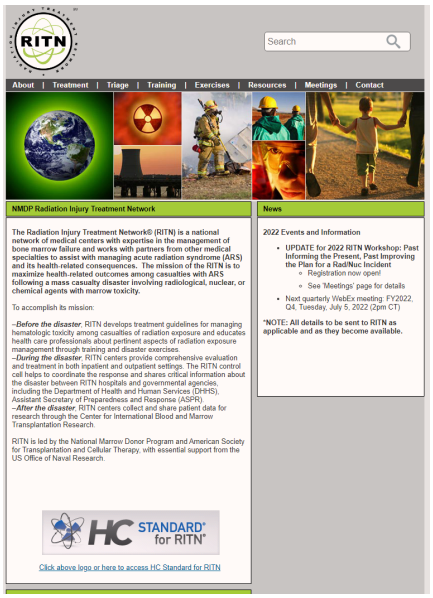


RITN connected the willing with the resources necessary so they could prepare. Coordinating exercises, training and tracking of medical resources.**

The exercises RITN has conducted include mostly tabletop exercises where we provide a scenario and discussion questions for each hospital, and they review them in a low stress meeting type environment. Then they submit their answers to the discussion questions online. We post all of these exercises and summary data on RITN.net/exercises. In 2014 we began providing funding to hospitals to conduct functional and full-scale exercises which activate portions of a response plan or the entire plan including partner organizations respectively.

Resources

- Medical Guidance www.RITN.net/treatment
  - ARS Treatment Guidelines
  - Referral Guidelines
  - Adult and Pediatric Medical Orders in collaboration with REMM
- Training www.RITN.net/training
  - Mobile REAC/TS course
  - ARS Medical Grandrounds training
  - Web based training courses (basic radiation, ConOps, etc...)
  - Non-medical Radiation Awareness Course Adopted by NNSA for USAID staff
- Operations
  - Exercises
  - Web based data collection for ARS patients
  - RITN hospital “bed report +” integrated into GEO Health



MOU with ASPR

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- Non-medical Radiation Awareness Course Adopted by NNSA for USAID staff

Operations

- Web based data collection for ARS patients
- RITN hospital “bed report +” integrated into GEO Health

Federal Plans Involving the RITN

- White House: Planning Guidance for Response to a Nuclear Detonation
- FEMA: Nuclear/Radiological Incident Annex

ASPR: Radiological Dispersal Device Playbook

ASPR: Rad/Nuke Annex to All Hazards Plan

ASPR: State & Local Planners Playbook for Medical Response to a Nuclear Detonation

ASPR: Medical Planning and Response Manual for a Nuclear Detonation Incident

NLM: REMM-RITN Prototype for Adult & Pediatric Medical Orders During a Radiation Incident

Adult & Pediatric Medical Orders: REMM.HHS.GOV & RITN.net/treatment

Adult Medical Orders

REMM
Prototype / Template for
Adult Hospital Orders
During a Radiation Emergency
Version: Jan 25, 2019

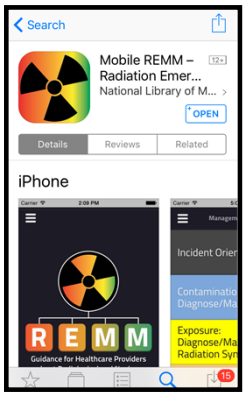
Cautions
- Authored by REMM and RITN physicians, this set of orders is a prototype only.
- **Orders must be customized for each patient and incident.**
- Specific drugs are suggested for function only. Patients may not need any/every category of drug listed.
- No HHS, CDC, FDA, or other US government entity endorsement of specific drugs or drug doses is intended or implied by inclusion in this order set.
- Consult the notes at the end of this document for additional, key information.

Internal contamination (decorporation treatments)
- This **Adult Orders Prototype** lists only FDA-approved medications as radioisotope countermeasures.
- Some, but not all of these drugs are currently in the Strategic National Stockpile.
- Prescribers should consult the FDA drug label for complete prescribing information.
- Decorporation drugs should be used in children and pregnant women with great caution.
- The online version of REMM has additional recommendations about additional countermeasure drugs that may be considered.
- This prototype does **not** address threshold levels of internal contamination that would trigger initiation, continuation, or discontinuation of decorporation treatment.
- See REMM Countermeasures Caution and Comment, which discusses this issue.

Drug dosages
- All adult drug doses in this prototype are based on a 70 kg adult with normal renal and hepatic function.
- Appropriate dose adjustments should be made based on age, weight, drug-drug interactions, nutritional status, renal, and hepatic function.

U.S. Department of Health & Human Services
REMM RADIATION EMERGENCY MEDICAL MANAGEMENT

www.REMM.HHS.gov



Pediatric Medical Orders

REMM
Prototype / Template for
Pediatric Hospital Orders
During a Radiation Emergency
Version: Jan 25, 2019

Cautions
- Authored by REMM and RITN physicians, this set of orders is a prototype only.
- **Orders must be customized for each patient and incident.**
- Specific drugs are suggested for function only. Patients may not need any/every category of drug listed.
- No HHS, CDC, FDA, or other US government entity endorsement of specific drugs or drug doses is intended or implied by inclusion in this order set.
- Consult the notes at the end of this document for additional, key information.

Internal contamination (decorporation treatments)
- This **Pediatric Orders Prototype** lists only FDA-approved medications as radioisotope countermeasures.
- Some, but not all of these drugs are currently in the Strategic National Stockpile.
- Prescribers should consult the FDA drug label for complete prescribing information.
- Decorporation drugs should be used in children and pregnant women with great caution.
- The online version of REMM has additional recommendations about additional countermeasure drugs that may be considered.
- This prototype does **not** address threshold levels of internal contamination that would trigger initiation, continuation, or discontinuation of decorporation treatment.
- See REMM Countermeasures Caution and Comment, which discusses this issue.

Drug dosages
- All drug doses in this prototype should be customized for each patient.
- All pediatric drug doses should be prescribed as appropriate for **age**, **weight**, and any **clinical issues**, including allergies.
- Appropriate dose adjustments should be made based on age, weight, drug-drug interactions, nutritional status, renal, hepatic function, and risk/benefit calculus.

Treatment Guidelines on RITN.net/treatment

RITN Acute Radiation Syndrome Treatment Guidelines

October 2020

Table of Contents

Decision to perform HLA typing and recruitment of a donor

Factors favoring HLA typing*

- Estimated whole body dose > 3 Gy
- Neutrophil count < 100/µl by day 6
- Rapid drop of platelets
- Expected to survive other injuries

Expedited HLA typing will be available using buccal swab, with high resolution DNA typing of HLA-A, -B, -C, -DRB1, and -DQB1

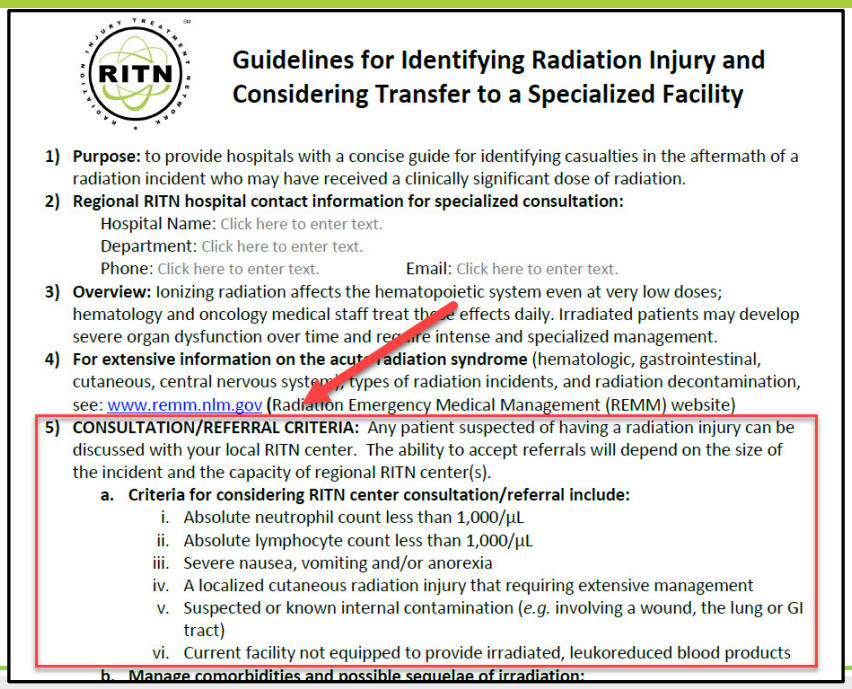
*Guidance for obtaining HLA-typing can be obtained by contacting the NMDP or the closest RITN center:

- NMDP HLA-typing guidance: 1 (800) MARROW2 or (612) 627-5800
- For an updated map and list of RITN centers: http://www.ritn.net/About/
- *RITN Participating Centers General Contact Directory*: http://www.ritn.net/Contact/

Decision to recruit a donor for evaluation

- If patient remains aplastic for >14 days
- Suitable donor is available:
  - 8/8 match (HLA-A, B-C, DRB1) using bone marrow or PBSCs
  - Alternatives, if a matched donor is unavailable:
    - At least 4/6 matched umbilical cord blood of adequate cell number (potentially 2 cord blood units for adults, 1 cord blood unit for children)
    - Haploidentical donor who has not had radiation exposure
    - Mismatched, related or unrelated donor with T-cell depletion

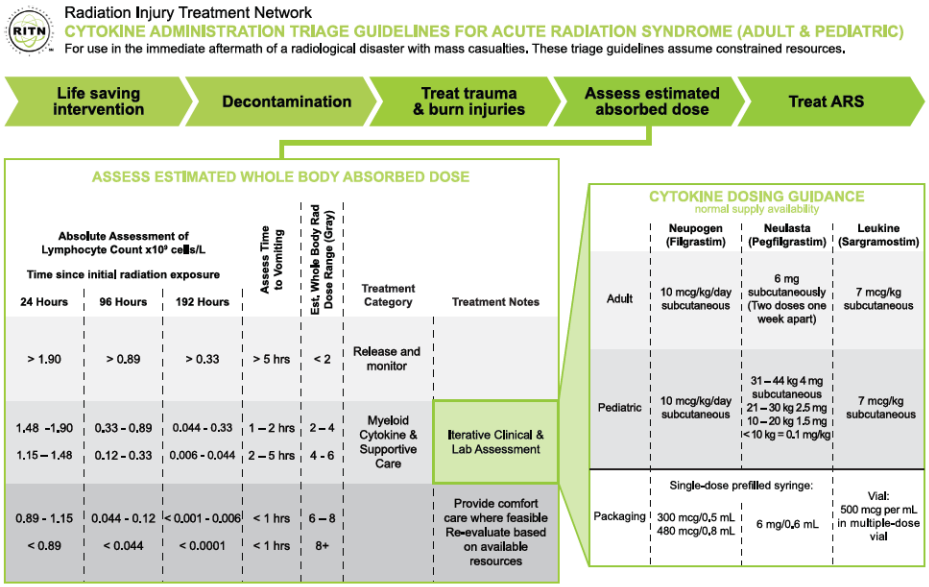
Referral Guidelines: www.RITN.net/triage



Guidelines for Identifying Radiation Injury and Considering Transfer to a Specialized Facility

1) **Purpose:** to provide hospitals with a concise guide for identifying casualties in the aftermath of a radiation incident who may have received a clinically significant dose of radiation.
2) **Regional RITN hospital contact information for specialized consultation:**
   Hospital Name: Click here to enter text.
   Department: Click here to enter text.
   Phone: Click here to enter text. Email: Click here to enter text.
3) **Overview:** Ionizing radiation affects the hematopoietic system even at very low doses; hematology and oncology medical staff treat these effects daily. Irradiated patients may develop severe organ dysfunction over time and require intense and specialized management.
4) **For extensive information on the acute radiation syndrome** (hematologic, gastrointestinal, cutaneous, central nervous system), types of radiation incidents, and radiation decontamination, see: www.remm.nlm.gov (Radiation Emergency Medical Management (REMM) website)
5) **CONSULTATION/REFERRAL CRITERIA:** Any patient suspected of having a radiation injury can be discussed with your local RITN center. The ability to accept referrals will depend on the size of the incident and the capacity of regional RITN center(s).
   a. **Criteria for considering RITN center consultation/referral include:**
      i. Absolute neutrophil count less than 1,000/µL
      ii. Absolute lymphocyte count less than 1,000/µL
      iii. Severe nausea, vomiting and/or anorexia
      iv. A localized cutaneous radiation injury that requiring extensive management
      v. Suspected or known internal contamination (*e.g.* involving a wound, the lung or GI tract)
      vi. Current facility not equipped to provide irradiated, leukoreduced blood products
   b. Manage comorbidities and possible sequelae of irradiation:

Cytokine Triage Guidelines: www.RITN.net/triage/



Radiation Injury Treatment Network

CYTOKINE ADMINISTRATION TRIAGE GUIDELINES FOR ACUTE RADIATION SYNDROME (ADULT & PEDIATRIC)

For use in the immediate aftermath of a radiological disaster with mass casualties. These triage guidelines assume constrained resources.

Life saving intervention → Decontamination → Treat trauma & burn injuries → Assess estimated absorbed dose → Treat ARS

ASSESS ESTIMATED WHOLE BODY ABSORBED DOSE

Absolute Assessment of Lymphocyte Count x10⁹ cells/L — Time since initial radiation exposure: 24 Hours	96 Hours	192 Hours	Assess Time to Vomiting	Est. Whole Body Rad Dose Range (Gray)	Treatment Category	Treatment Notes
> 1.90	> 0.89	> 0.33	> 5 hrs	< 2	Release and monitor	
1.48 -1.90 1.15 – 1.48	0.33 - 0.89 0.12 - 0.33	0.044 - 0.33 0.006 - 0.044	1 – 2 hrs 2 – 5 hrs	2 – 4 4 - 6	Myeloid Cytokine & Supportive Care	Iterative Clinical & Lab Assessment
0.89 - 1.15 < 0.89	0.044 - 0.12 < 0.044	< 0.001 - 0.006 < 0.0001	< 1 hrs < 1 hrs	6 – 8 8+		Provide comfort care where feasible Re-evaluate based on available resources

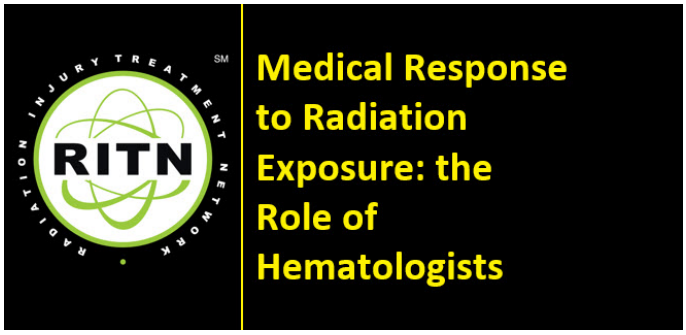
CYTOKINE DOSING GUIDANCE

normal supply availability

	Neupogen (Filgrastim)	Neulasta (Pegfilgrastim)	Leukine (Sargramostim)
Adult	10 mcg/kg/day subcutaneous	6 mg subcutaneously (Two doses one week apart)	7 mcg/kg subcutaneous
Pediatric	10 mcg/kg/day subcutaneous	31 – 44 kg 4 mg subcutaneous 21 – 30 kg 2.5 mg 10 – 20 kg 1.5 mg < 10 kg = 0.1 mg/kg	7 mcg/kg subcutaneous
Packaging	Single-dose prefilled syringe: 300 mcg/0.5 mL 480 mcg/0.8 mL	6 mg/0.6 mL	Vial: 500 mcg per mL in multiple-dose vial

- Cytokine Administration Triage Guidelines for Acute Radiation Syndrome (Adult and Pediatric)
- Sizes to download:
  - 4”x6”
  - 8.5” x 11”
  - 24” x 36”

Training: Medical Grand Rounds on RITN.net/training



Agenda

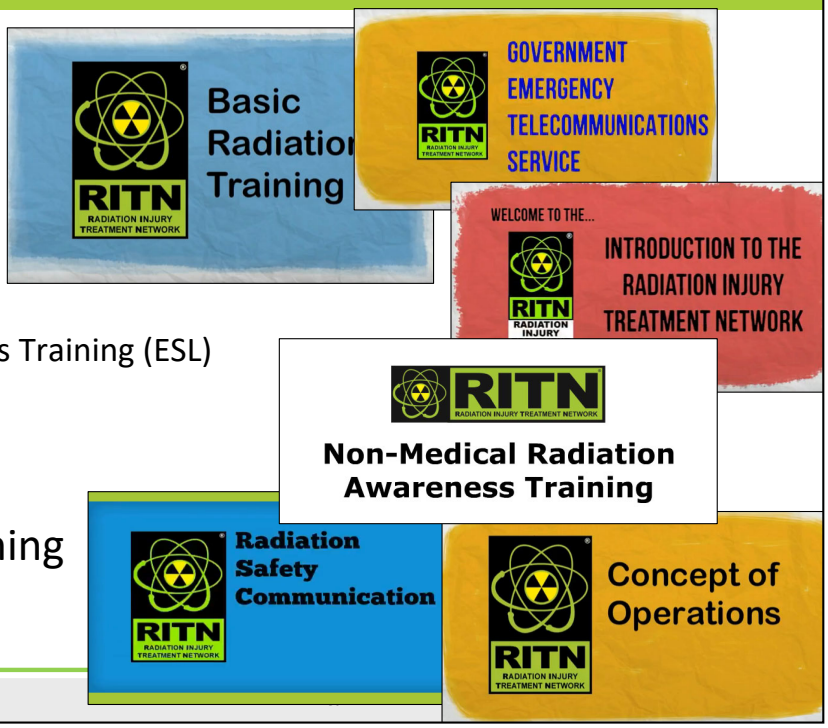
- Radiation Injury Treatment Network
- Radiological Event Scenarios
- Radiation Biology
- Dosimetry
- Acute Radiation Syndrome
- Mitigation and Treatment
- Available resources

Web Based Training on RITN.net/training (FREE TRAINING)

- Web based training
  - Intro to RITN
  - Basic Radiation Training
  - RITN Concept of Operations
  - Radiation Safety Communication
  - GETS Card 101
  - Non-Medical Radiation Awareness Training (ESL)

Adopted by NNSA for USAID training

- Medical Grand Rounds training



Exercise Materials on RITN.net/exercises

- Tabletop SITMANs (16 years of exercises and results)
- Regional Tabletop and Full-scale exercise materials
- Data from exercises
- AARs


Big Rad Apple
10 Kiloton Nuclear Explosion
Regional Radiation Injury Treatment Network Tabletop Exerc

June 23, 2014

AFTER ACTION
REPORT/IMPROVEMENT PLAN

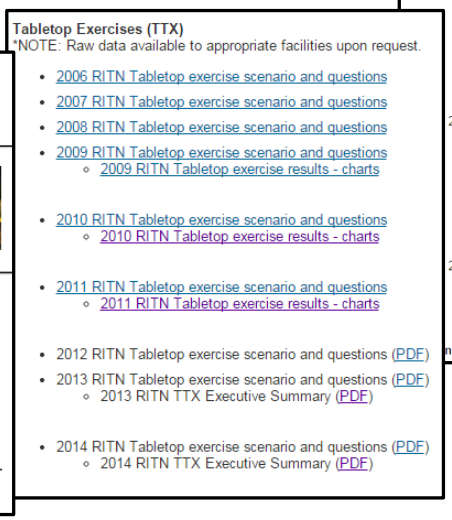
FINAL DRAFT – August 21, 2014

GREATER NEW YORK HOSPITAL ASSOCIATION GNYHA
RITN RADIATION INJURY TREATMENT NETWORK
NYC Health

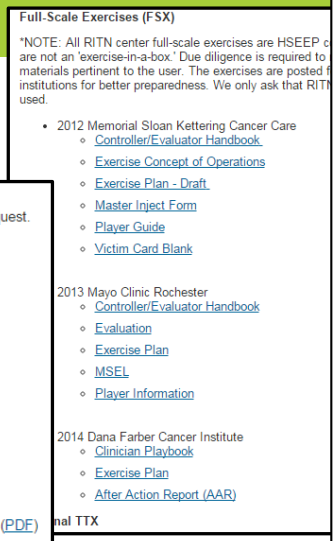

RITN RADIATION INJURY TREATMENT NETWORK

RITN Midwest Coordination & Treatment of a Radiation Mass Casualty Incident Tabletop Exercise

After-Action Report/Improvement Plan
August 2013


Tabletop Exercises (TTX)
*NOTE: Raw data available to appropriate facilities upon request.

- 2006 RITN Tabletop exercise scenario and questions
- 2007 RITN Tabletop exercise scenario and questions
- 2008 RITN Tabletop exercise scenario and questions
- 2009 RITN Tabletop exercise scenario and questions
  - 2009 RITN Tabletop exercise results - charts
- 2010 RITN Tabletop exercise scenario and questions
  - 2010 RITN Tabletop exercise results - charts
- 2011 RITN Tabletop exercise scenario and questions
  - 2011 RITN Tabletop exercise results - charts
- 2012 RITN Tabletop exercise scenario and questions (PDF)
- 2013 RITN Tabletop exercise scenario and questions (PDF)
  - 2013 RITN TTX Executive Summary (PDF)
- 2014 RITN Tabletop exercise scenario and questions (PDF)
  - 2014 RITN TTX Executive Summary (PDF)


Full-Scale Exercises (FSX)

*NOTE: All RITN center full-scale exercises are HSEEP c
are not an 'exercise-in-a-box.' Due diligence is required to
materials pertinent to the user. The exercises are posted f
institutions for better preparedness. We only ask that RITN
used.

- 2012 Memorial Sloan Kettering Cancer Care
  - Controller/Evaluator Handbook
  - Exercise Concept of Operations
  - Exercise Plan - Draft
  - Master Inject Form
  - Player Guide
  - Victim Card Blank

2013 Mayo Clinic Rochester
- Controller/Evaluator Handbook
- Evaluation
- Exercise Plan
- MSEL
- Player Information

2014 Dana Farber Cancer Institute
- Clinician Playbook
- Exercise Plan
- After Action Report (AAR)

nal TTX

www.RITN.net

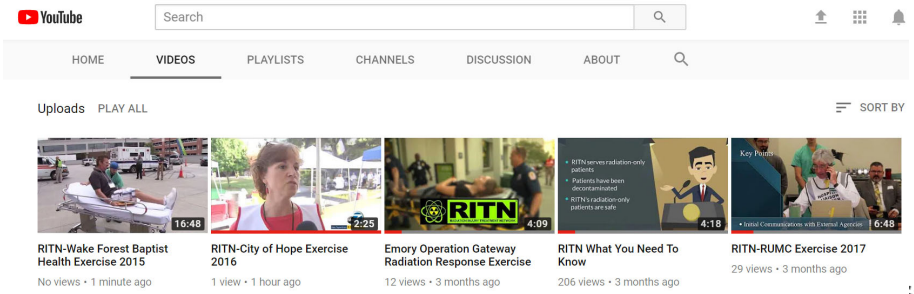
RITN

RITN YouTube Channel https://www.youtube.com/watch?v=v-qW-z7qXRw

- RITN What You Need to Know (Video): 4 min overview video

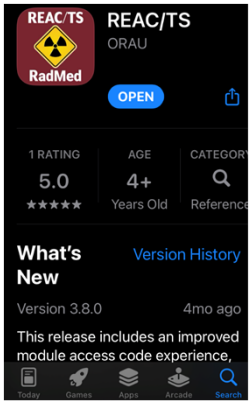
+

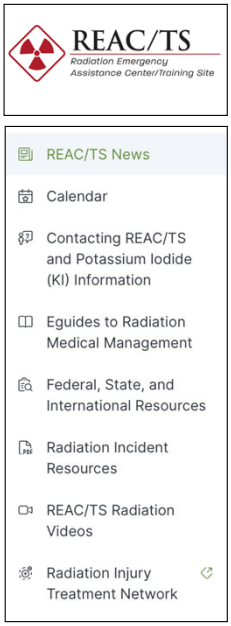
- Exercise videos
- Just-in-Time Training videos

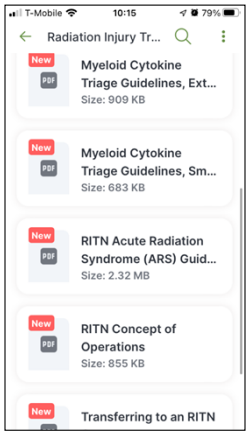


https://www.youtube.com/watch?v=v-qW-z7qXRw

RITN Added to REACT/TS App







Radiation Emergency Assistance Center/Training Site (REAC/TS)
www. https://orise.orau.gov/reacts/index.html

The Radiation Emergency Assistance Center and Training Site (REAC/TS) is located outside Knoxville, TN and has been providing crisis response to radiological accidents since 1976. REAC/TS staff include physicians and health physicists. REAC/TS maintains a stockpile of decorporation agents as well.

I suggest you also familiarize yourself with their website. They have an APP in the Apple store and the Android store, and there are links to RITN found here as well.

Radiation Readiness Radiation Training for Public Health

- National Alliance for Radiation Readiness Radiation Training Modules for Public Health
  - https://www.radiationready.org/posted-tools/national-alliance-for-radiation-readiness-radiation-training-modules-for-public-health/

Resources continued

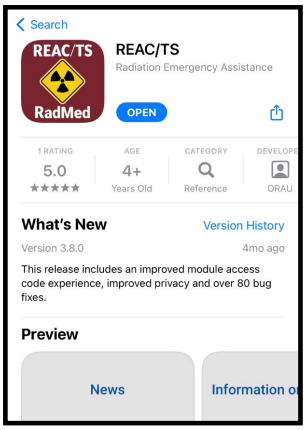
Radiation Emergency Assistance Center/ Training Site (REAC/TS)

www. https://orise.orau.gov/reacts/index.html

ANDROID APP ON Google play

Available on the App Store

Downloadable from Google Play or the App Store



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I suggest you also familiarize yourself with their website. They have an APP in the Apple store and the Android store, and there are links to RITN found here as well.

RITN has worked to develop partners that also are preparing for similar incidents as well as professional organizations that can assist in getting the word out about the importance of preparedness for mass casualty incidents that result in marrow toxic injuries.

www.remm.nlm.gov

www.radiationready.org