RITN Concept of Operations (CONOPS)

November 13, 2020

Contents

Introduction

This document outlines the anticipated integration of the Radiation Injury Treatment Network® (RITN) into the national response to a mass casualty incident resulting in marrow-toxic injuries. RITN centers are affiliated with the National Marrow Donor Program (NMDP) network of care providers, and include medical centers (academic medical centers, tertiary care centers, and cancer centers) with expertise in hematology-oncology patient management, including hematopoietic cell transplantation ("marrow transplantation" for the purposes of this document), blood donor centers, and umbilical cord blood banks. These institutions are stand-alone entities that are voluntarily preparing for the response to incidents that result in marrow toxic injuries.

There are multiple sources of a mass casualty incident resulting in marrow toxic injuries, the focus for this Concept of Operations is the detonation of an Improvised Nuclear Device (IND) which would extensively stress the Nation's response capabilities. Casualties from such an incident will include severe trauma to those without radiation exposure, and those with some combination. The intensity of these types of injuries will also vary widely, from relatively insignificant to invariably fatal. However, RITN's specialized treatment centers plan to focus on casualties with radiation injuries only; the vast majority of these casualties will be the result of exposure to radiation in the dangerous fallout zone.

Irradiated casualties will be decontaminated by local or federal entities before movement through the National Disaster Medical System (NDMS) to specialty care facilities which include RITN medical centers. The NDMS has well -established processes for patient distribution through Federal Coordinating Centers (FCC). FCCs then coordinate with local hospitals and local public health agencies to distribute patients to the appropriate destination for care. After a mass casualty incident, formal transport of patients to distant RITN centers is expected to be delayed by at least 96 hours.

Bone marrow injury could result from significant exposure to either ionizing radiation or marrow suppressive chemicals such as mustard agents. Hematologists and oncologists have expertise in the management of marrow toxicity as this is a common effect of therapeutic radiation and chemotherapy. Radiological/nuclear incident casualties would likely require similar approaches to care. The primary management will be supportive care with a very limited number of marrow transplants anticipated. RITN centers plan to primarily receive casualties with radiation injuries only, as these casualties have greater survivability than those with combined trauma and radiation injuries. The vast majority of these casualties will have received exposure to fallout radiation.

RITN has established treatment guidelines that include the principles of ARS management, template hospital admission orders, approaches for casualty triage and selection of candidates for HLA-typing and marrow transplantation. Finally, RITN centers will collect patient demographic, clinical and treatment data through the standard NMDP data collection process. The resulting data will be made available to assist with future research and planning.

Planning Assumptions

- Casualties that would benefit from receiving care at a specialized RITN center will be identified as they move through Evacuation Centers (ECs) or Assembly Centers (ACs) established as part of the ASPR Radiological TRiage TRansport TReatment (RTR) process by local, state and federal agencies following a large scale radiological incident.
- Casualties may be evacuated directly from the incident area or transported from another hospital where they were receiving medical care. In both cases patient movement will be regulated by the National Disaster Medical System (NDMS) and the receiving Federal Coordinator Center (FCC).
- Given the priority of medical care, casualties with radiological only injuries will not be evacuated first. Generally, RITN hospitals should plan on patient arrival beginning several days post event for a large-scale incident (i.e. IND).
- Casualties being transported will have had a radiological screening and if needed gone through decontamination prior to being evacuated from the incident area.

RITN Activation and Response

RITN Activation Scenarios

There are several possible sources of mass casualty incidents that could result in marrow toxic injuries, including: an Improvised Nuclear Device (IND), a Radiological Dispersal Device (RDD – a.k.a. "dirty bomb"), a Radiological Exposure Device (RED), a catastrophic nuclear power plant accident, or exposure to a mustard agent. Of these the detonation of a nuclear device is the one likely to require the full scope of RITN services. Despite the possibility of industrial accidents, an incident resulting in mass casualties would most likely be the result of a terrorist attack. This document will focus on a terrorist IND, as this is the most catastrophic radiation scenario.

RITN Center Capabilities

After a marrow toxic incident resulting in mass casualties, RITN centers will be asked to:

- Accept casualties from a distant incident
- Provide supportive care for casualties with marrow toxic injuries
- Provide treatment expertise to practitioners caring for casualties at other locations
- Collect data on casualties treated at their treatment facility
- Facilitate marrow transplantation for the small percentage of casualties who require hematopoietic cell transplantation

Scope of RITN Response

RITN typically would be activated by the Office of the Assistant Secretary for Preparedness and Response (ASPR) at the US Department of Health and Human Services (HHS) to receive casualties from a mass casualty incident with marrow toxic injuries. RITN facilities near the incident site would likely be part of the immediate local or regional response and not the more distant RITN response.

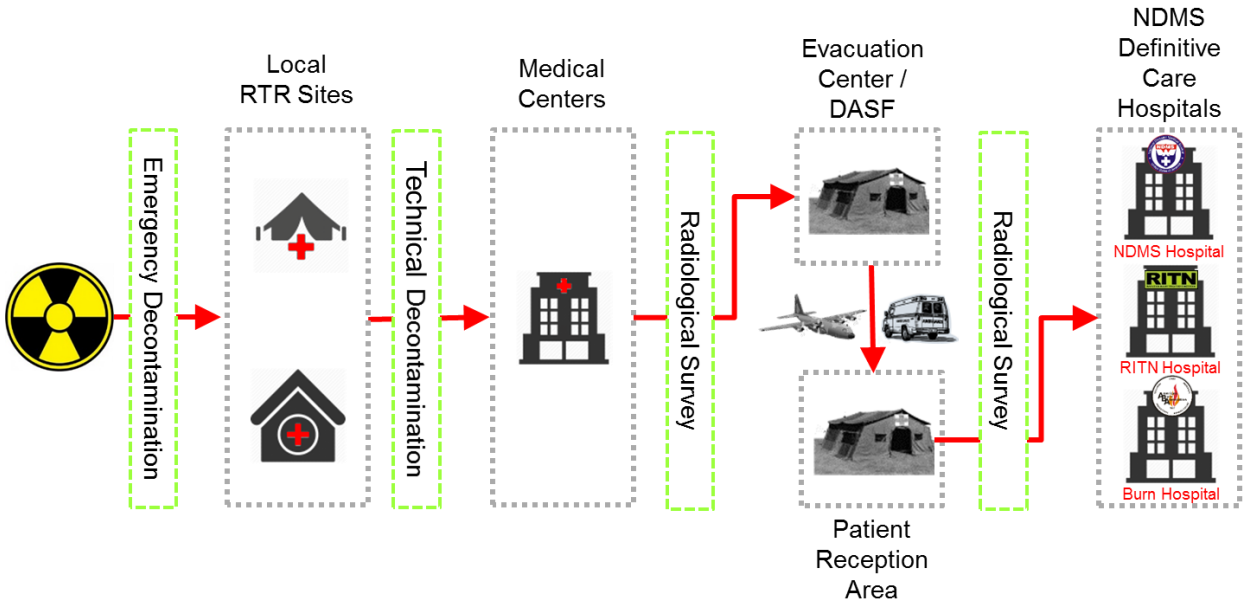
Four key tenants of the RITN response should be remembered:

1. RITN is not a local asset
   RITN centers near the incident will likely be overwhelmed by the immediate response in their area. RITN centers 100+ miles away will receive the radiation casualties for monitoring and treatment.
2. Not immediate
   Radiation only casualties will develop their symptoms gradually to rapidly; regardless of the speed of onset there is time before they must receive definitive care. NOTE: Immediate administration of cytokines is considered to be necessary for effectiveness.
3. Radiation injury only
   Casualties that RITN centers treat should only have radiation injuries, RITN centers are the Hematology and Oncology departments of hospitals. These departments are not equipped to treat trauma patients. Any trauma in combination with radiation significantly decreases the chance of survival.
4. Majority of radiation injury only patients will need monitoring only
   In contrast to most other incidents, NDMS may evacuate many patients to a RITN center that do not require hospitalization, but will require ongoing monitoring and potentially treatment (such

as cytokines) for a period of time, with most recovering, but some developing complications that require hospitalization. RITN centers need to work with local emergency management and public health to ensure the community has a plan to shelter and support these victims and that RITN expertise and medical services are prepared to support these victims in the outpatient setting.

Conceptual Movement of Patients to a RITN Center

The below diagram shows how patients will be moved from the incident to definitive care hospitals via the National Disaster Medical System (NDMS).



HHS ASPR Radiological TRiage, TRansport, and TReatment (RTR) Sites

The major functions at RTR sites are identification, triage, medical stabilization (or provision of palliative care), and transport of victims, when possible. Gross decontamination also may be performed at these sites as permitted, though stabilizing serious injuries takes precedent over decontamination.

Medical Centers or Definitive Care Sites

Medical care sites are venues where sophisticated medical care will be administered. These include hospitals, clinics, and medical centers. They are the focal points for the delivery of expert medical personnel and supplies.

Assembly Centers

Assembly centers will be evacuee receiving and registry centers as well as temporary shelters where people may receive food and shelter and/or can check in with authorities so that they can be accounted for after the event. These sites are for those with no or minimal requirements for medical care. Some may arrive directly or may have been directed from RTR and medical care sites.

Evacuation Centers
Evacuation centers and drop zones should not be confused with assembly center sites, as the former are hubs for major victim and evacuee transport by land, rail, air, and/or water. Some hubs may be designated for incoming supplies and personnel and others for outgoing, while others may transport persons or goods both in and out.

Patient Reception Area (PRA)
Patient reception areas are pre-identified sites that will receive and coordinate the distribution of incoming National Disaster Medical System (NDMS) patients to definitive care hospitals.

RITN Casualty Overview & Treatment

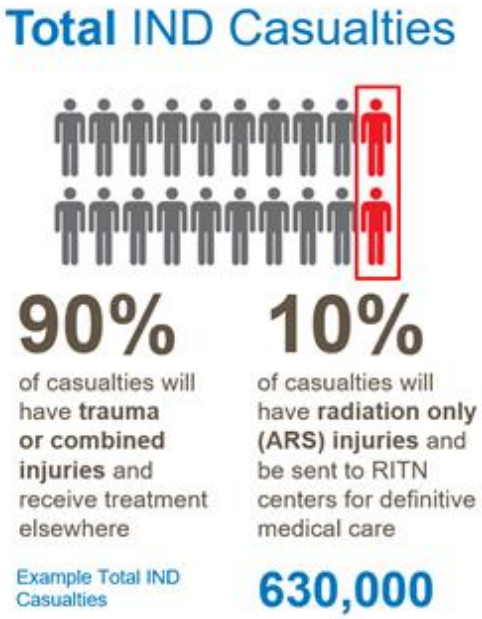
Casualty Estimates

Bone marrow is the source of the human blood and immune systems. Casualties with significant marrow toxic injuries will require supportive care to recover. Supportive care may include the application of cytokines (that boost the production of new marrow cells), transfusions as well as the administration of antibiotics to prevent or treat infection. Exposure to ionizing radiation affects bone marrow at very low doses. However, complete destruction of the human marrow system requires whole body exposure to significant doses. A person's immune system would be impacted at doses above 1 gray (Gy). Doses between 2-8 Gy of exposure would be survivable with prompt intensive supportive care[1], at exposures of above 8 Gy survival decreases but is still possible depending on how quickly care is provided; above 12 Gy survival is unlikely even with intensive supportive care or transplant.

It should be noted that casualties with combined injury (i.e., the combination of radiation with trauma or cutaneous burns) have a markedly worse prognosis compared to those with radiation injury alone. In a mass casualty incident, casualties with exposure to as little as 2 Gy of radiation who also have moderate or severe trauma are unlikely to survive. Thus, casualties with significant but survivable radiation injury who lack other significant injuries will be prioritized for transfer to RITN centers. However, given the chaos likely to surround an IND detonation, some patients may have co-existing traumatic injuries. RITN centers should have or be able to access expertise in burn care and trauma care should these situations arise and be able to provide consultation to those patients at trauma and burn centers with combined injuries.

The total possible number of casualties appropriate for management at RITN centers is estimated to range between 10,000–63,000; this is a small fraction of the total number of possible casualties, yet still overwhelming to the medical communities that would be called upon to help (see figure 3).

As the medical community receives the surge of casualties, the number of casualties may temporarily exceed the availability of beds, staff, and specialized equipment necessary for normal standards of care. Imbalances between need and resource availability may require the implementation of crisis standards of care (also called altered standards of care) that typically require approval at the state level. For RITN centers to manage such a large number of casualties, patients will need to be triaged into categories roughly based on radiation injuries and delineated as: mild, moderate, severe and expectant (Table 1).



[1] Coleman CN, Weinstock DM, Casagrande R; et al. Triage and treatment tools for use in a scarce resources - crisis standards of care setting after a nuclear detonation. Disaster Med Public Health Prep. 2011;5(Suppl 1):S111-S121

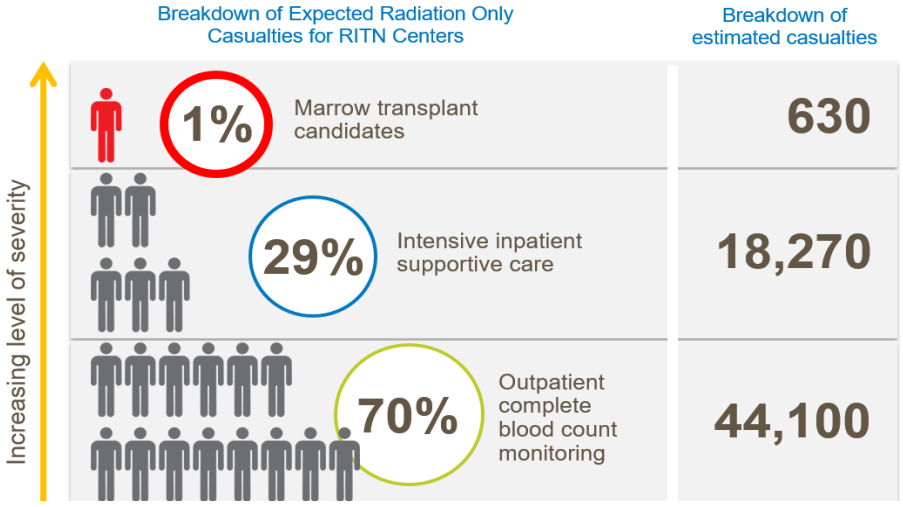
Table 1: Radiation Casualty Estimates for and Improvised Nuclear Device[2]

Radiation Dose (Gy)	Care Requirement	High Casualty Estimate (95 %tile)
Mild (0.75-1.5)	Outpatient monitoring	91,000
Moderate (1.5-5.3)	Supportive Care outpatient monitoring and possible inpatient admission	51,000
Severe (5.3-8.3)	Intensive Supportive Care (possibly including HCT)	12,000
Expectant (>8.3)	Comfort Care some casualties may benefit from intensive supportive care or HCT	47,000
Combined Injury and Radiation (>1.5)	Stabilization and monitoring, pending resource availability	44,000
Estimate of total casualties for triage to RITN (Moderate + Severe categories)		**63,000**

RITN Patient Profile

Patients distributed through the NDMS will be medically stabilized and at a minimum grossly decontaminated before transportation. Combined injury (i.e., radiation with moderate to severe trauma and/or significant burns) negatively impacts prognosis. Thus, the vast majority of casualties that receive more than 2 Gy of radiation and have significant trauma and/or burns will not be candidates for treatment by RITN centers[3]. Patients distributed to RITN centers will likely have been exposed to whole-body doses of 2-8 Gy and may be experiencing signs and symptoms of Acute Radiation Syndrome (ARS).

Figure 3: Breakdown of Expected Radiation Only Casualties



[2]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

[3]RITN Acute Radiation Syndrome Treatment Guidelines, September 2010; http://www.ritn.net/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=2147483696&libID=2147483696.

Casualty Treatment

The RITN ARS Treatment Guidelines outline the principles of ARS management, crisis standards of care, symptoms, and casualty triage. A template for hospital admission orders for radiation casualties can be found on the Radiation Emergency Medical Management website. There are established algorithms for prioritizing casualties to receive marrow growth factors (e.g., G-CSF) and other supportive care as well as consideration of the extent of injuries, availability of resources and current standards of care.

Methods for estimating the dose of radiation received by a casualty include serial blood counts and chromosome assays and may be available to help stratify casualties. Growth factors and antibiotics are widely utilized at RITN centers and additional supplies may be available through the Strategic National Stockpile (SNS).

Specific ARS treatment guidelines and information can be found below:

RITN treatment guidelines: https://ritn.net/treatment/
Radiation Emergency Medical Management (REMM): https://www.remm.nlm.gov/ars.htm

Estimated Timeline of Operations

Action	Responsible Party	Time From Notification
Alert & Notification		
RITN Control Cell notified to activate the network	ASPR	-
RITN centers notified of incident	RITN Control Cell	1 hr
RITN Exec Committee/Med Director conference call		2 hrs
Notify Partners (ONR, HRSA)		2 hrs
SEND SITREP to network		4 hrs
Capabilities Review		
Submit Capabilities Report to RITN Control Cell -review staff availability -review current & pending patient activity -review available resources	RITN centers	reported daily at 1200 CT
Submit Network Capabilities Report to ASPR SOC	RITN Control Cell	reported daily at 1430 CT

Medical Response Actions*		
RTR sites established	First responders, healthcare providers	First 48 hrs
Medical care and assembly centers	Local, state and federal responders	First 96 hrs
Evacuation centers	Local, state and federal responders	3+ days
Patient reception areas	Local, state and federal responders	4+ days
NDMS trauma hospitals	healthcare providers	4+ days
NDMS burn hospitals	healthcare providers	4+ days
RITN hospitals	healthcare providers	5+ days

**The medical response actions, responsible parties and timeframes shown are interpretations made by the RITN based of concepts and plans related to the medical response to an Improvised Nuclear Device (IND).*

Acronyms & Additional Resources

Acronym	Meaning
AC	Assembly Center
ARS	Acute Radiation Syndrome
ASPR	Assistant Secretary for Preparedness and Response
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosive
CONOPS	Concept of Operations
DASF	Disaster Aeromedical Staging Facility
EC	Evacuation Center
FCC	Federal Coordinating Center
Gy	Gray
HCT	Hematopoietic Cell Transplantation
HHS	U.S. Department of Health and Human Services
HLA	Human Leukocyte Antigen
IND	Improvised Nuclear Device
MOU	Memorandum of Understanding
NDMS	National Disaster Medical System
NMDP	National Marrow Donor Program
RDD	Radiological Dispersal Device
REAC/TS	Radiation Emergency Assessment Center / Training Site
RED	Radiological Exposure Device
REMM	Radiation Emergency Medical Management
RITN	Radiation Injury Treatment Network
RTR	Radiological TRiage TRansport and TReatment

Assistant Secretary for Preparedness and Response (ASPR): CBRNE Branch
http://www.phe.gov/about/oem/cbrne/Pages/default.aspx

Radiation Emergency Assessment Center / Training Site (REAC/TS)
http://orise.orau.gov/reacts/

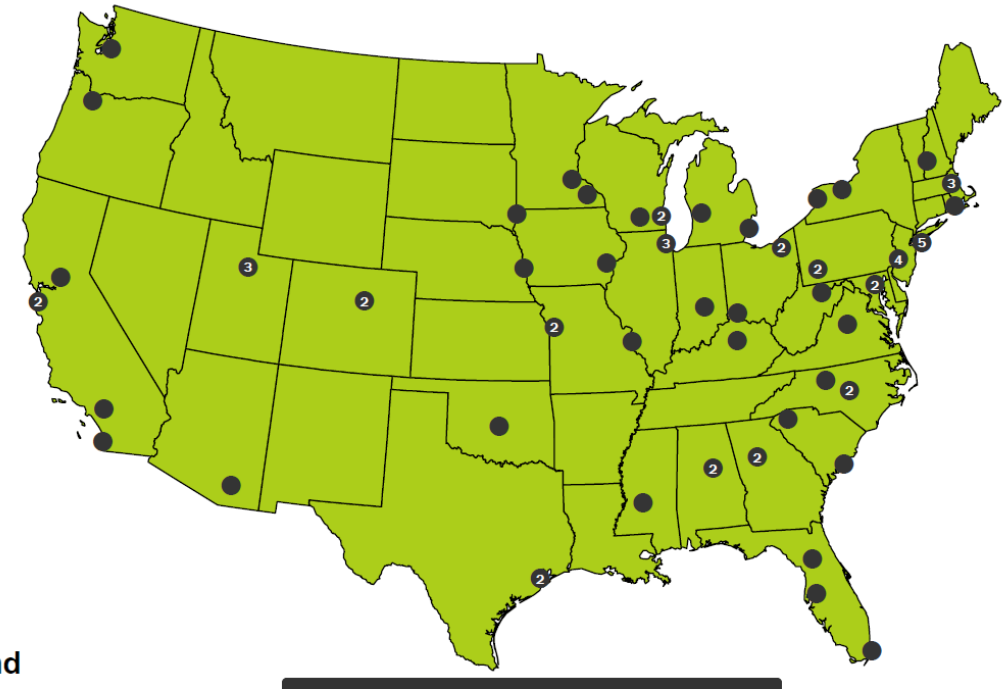
Radiation Emergency Medical Management (REMM)
https://www.remm.nlm.gov/

Radiation Injury Treatment Network (RITN)
http://ritn.net

RITN Memorandum of Understanding (MOU) with HHS/ASPR.
http://ritn.net/workarea/downloadasset.aspx?id=2147484147

RITN Map & Hospital List

Map of Participating Hospitals



-black dot = 1 RITN center
-# in black dot = number of RITN centers in a city
-For the most current map and a list of participating facilities reference www.ritn.net

	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	T1	•	•	•
GA	Emory University	A				•
GA	Northside Hospital	A				•
IA	University of Iowa Hospitals and Clinics	P/A	T1	•	•	•
IL	Northwestern University MC	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	NorthShore 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	M.D. Anderson Cancer Center	P/A				•
TX	Texas Children's Hospital	P	T1		•	•
UT	LDS Hospital	A			•	•
UT	Primary Children's Medical Center	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		•	•

*please report any corrections to this document to RITN@nmdp.org

As of Nov 2020

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

Total number of RITN centers	72	
Total Pediatric or Ped/Adult	38	53%
Total Trauma Centers	52	72%
Total Burn Centers	27	38%
Total NDMS Centers	56	78%
Total HPP Centers	65	90%