2019

RITN Tabletop Exercise (TTX) After-Action Report/Improvement Plan Medical Focus

Exercise Date: July 16, 2019
Report Date: July 26, 2019

EXERCISE OVERVIEW

Exercise Name	2019 RITN Tabletop Exercise (TTX)
Exercise Date	July 16, 2019
Scope	This exercise is a distance-based tabletop exercise planned for 1 ½ hours. Exercise play is limited to RITN facilities and their response partners' collective challenges and considerations for improved and effective response.
Mission Area(s)	Response
Capabilities	Public Health & Medical Services
Objective	**Objective 1:** Medical staff are able to describe their approaches used for hematopoietic cell transplantation (HCT) in patients who appear to have received myeloablative doses of radiation.
Hazard	Radiological
Scenario	Medical surge from a distant radiological incident
Sponsor	Radiation Injury Treatment Network® (RITN) National Marrow Donor Program (NMDP) Office of Naval Research (ONR)
Participating Organizations	Banner University Medical Center (Tucson, AZ) Barbara Ann Karmanos Cancer Institute (Detroit, MI) Duke University Hospital (Durham, NC) Emory University Hospital (Atlanta, GA) MedStar Georgetown University (Washington DC) Mount Sinai Cancer Center (New York, NY Presbyterian St. Luke's Medical Center (Denver, CO) Roger Williams Medical Center (Providence, RI) Scripps Green Hospital (LaJolla, CA) University of California San Francisco Medical Center (conducted on own) University Hospitals (Case Western) Seidman Cancer Center (Cleveland, OH) University of Kentucky University of North Carolina Hospital West Virginia University Hospital

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EXERCISE SUMMARY

On July 16, 2019, RITN centers and the RITN Control Cell participated in an online tabletop exercise to describe treatment approaches for patients with acute radiation syndrome (ARS) following patient arrival to the hospital from a distant radiological event. A facilitated series of exercise tasks were provided to participants for their consideration, response, and group discussion organized by the exercise scenario summary below.

Scenario Summary: The following illustrate the scenario events considered for participant discussion:

Exercise Scenario Ground Truth

- A 10-kiloton Improvised Nuclear Device (IND) was detonated in a major metropolitan area.
- The blast occurred at least 500 miles away from your facility and there is no concern of fallout affecting your location.
- RITN Control Cell staff begins to monitor the situation and start sending out daily Situation Reports (SitReps).
- All centers are requested to submit daily Healthcare Standard (HCS) capabilities matrix.

Day 6

- The National Disaster Medical System (NDMS) issues activation protocol for your region and the local Federal Coordinating Center (FCC) establishes a Patient Reception Area (PRA) and expects patients to start arriving in the next 24-48 hours.

Day 9

- The first NDMS aircraft evacuating patients with radiation only injuries arrives at the PRA. NDMS officials expect there will be multiple aircraft a day arriving for the next several days. Facilities able to provide specialized care for ARS patients are asked to accept as many as possible.

ANALYSIS OF CAPABILITIES

Exercise Discussion Module: Patient Treatment

Participants were asked to select one of the patients below (pediatric or adult) and respond to a series of questions regarding treatment.

Pediatric Patient

- 9 year-old male with no comorbidities who received an estimated 8 Gy dose of fallout radiation over a two hour period. No additional injuries were sustained.
- He began G-CSF treatment three days after the exposure, which has been continued daily.
- He has normal renal, liver and other organ functions and remained afebrile since day 13 when he was started on broad-spectrum antibiotics.
- He developed 2nd degree skin burns that have now resolved.
- Peripheral blood WBC count has been <0.1 since day seven and he is dependent on platelet transfusions.
- HLA typing of the patient and his 12 year-old brother confirmed that they are HLA matched. The brother accompanied the patient to your center.
- An unrelated donor search was also initiated, but by day 21 after detonation, no matching donors have been identified.
- On day 19 after detonation, bilateral bone marrow aspirates were performed and show aplastic marrow. He remains profoundly pancytopenic.

Adult Patient

- 33 year-old male with no comorbidities who received an estimated 8 Gy dose of fallout radiation over a two hour period. No additional injuries were sustained.
- He began G-CSF treatment three days after the exposure, which has been continued daily.
- He has normal renal, liver and other organ functions and remained afebrile since day 13 when he was started on broad-spectrum antibiotics.
- He developed 2nd degree skin burns that have now resolved.
- Peripheral blood WBC count has been <0.1 since day seven and he is dependent on platelet transfusions.
- HLA typing of the patient and his 37-year old brother that they are HLA matched. The brother accompanied the patient to your center and is willing to donate.
- An unrelated donor search was also initiated, but by day 21 after detonation, no matching donors have been identified.
- On day 19 after detonation, bilateral bone marrow aspirates were performed and show aplastic marrow. He remains profoundly pancytopenic.

<u>Determination for HCT (21 days post-detonation)</u>

All hospitals reported that they would proceed with Hematopoietic Cell Transplantation (HCT) 21 days post-detonation (all but one utilized the adult profile above). The availability of a matched sibling influenced the decision to transplant as well as the high estimated dose (6-8 Gy) and depleted cell counts (pancytopenic) despite G-CSF therapy.

The group was also asked what preparative regimen (if any) would be given if proceeding with HCT. The responses were as follows:

- ATG (anti-thymocyte globulin)
- Fludarabine (Flu) + ATG

- Cytoxan-ATG (aplastic anemia regimen)
- ATG-Cytoxan (Cy)
- Flu-Cy with Tacrolimus and Myocophenolate Mofitil Graft-Versus-Host Disease (MMF GVHD) prophylaxis
- Flu-Cy-ATG (RITN recommended regimen)

All participating hospitals would use bone marrow for the transplant with the exception of two that would utilize peripheral blood stem cells (PBSC) and if ATG is included in the preparative regimen this would act to deplete T cells *in vivo* so the majority of hospitals would not require any additional T cell depletion.

Hospitals were asked about the brother who is matched for one haplotype and regarding the age as to whether this would change their choice of donor, cell product, or conditioning. All hospitals would not change their donor choice unless the brother was an unsuitable donor or had co-morbidities that precluded transplant. One hospital indicated trying to identify younger donors (e.g., if the brother had children). Some would change the conditioning regimen if the haplotype brother were the donor; for example

- Flu-Cy-NO-TBI (total body irradiation)
- Less ATG as preparative regimen
- Flu-Cy-TBI plus post-transplant Cytoxan
- Post-transplant Cytoxan
- Flu-Cy-ATG with post-transplant Cy 3-4 days after the transplant. Also use Tacrolimus as GVHD prophylaxis.

One hospital would alter their plan to use PBSC instead of marrow, modify the conditioning regimen and timing (i.e., increase Flu to 40 mg/m2 x 5 (TD 200 mg/m2) and Cyclophosphamide to 50 mg/kg x 2 (TD 100 mg/kg); continue ATG but move timing to Day -9). Additionally, Alpha/Beta T-cell depletion of the graft would be utilized to avoid all pharmacologic GVHD prophylaxis. There were several key discussion points amongst participants regarding the HCT and associated regimens:

- Using PBSC (rather than bone marrow) from the haplotype donor transplant may assist with more rapid recipient grafting, but G-CSF required for this process is already in short supply and should be reserved for patients not undergoing transplant (prioritize resources based on other patients at the hospital).

- Discrepancies on the conditioning regimen, agreement on the use of ATG for a haplotype transplant but the conflicting opinions on the use of Flu-Cy; the participating hospitals went with experience/standards used routinely for similar scenarios/patients.
- Discussion as to whether 8 Gy exposure would be viable (or if organ failure is imminent) or if the patient immune function would have returned to a degree by Day 21.
- Patient profile question regarding the burn injury; unsure if this was intended to prevent going forward with transplant but need more information on that burn injury (e.g., degree, surface area, associated infection).

Strengths

The following strengths were demonstrated:

Strength 1: There was agreement across all participating hospitals to proceed with the HCT, the majority would use the same cell type (marrow) and proceed with the haplotype brother as the donor (as long as no co-morbidities) with minimal changes to the regimen.

Strength 2: Hospitals had robust representation at the exercise and demonstrated a wealth of experience in transplant treatment plans; for hospitals with newer staff the exercise served to introduce them to the RITN scenario and patient care needs.

Areas for Improvement

The following areas require improvement:

Area for Improvement 1: There was discrepancy and a good discussion amongst participating hospitals regarding the pre-conditioning treatment in this scenario (use of haplotype brother as the donor); the recommendation is that the RITN Medical Subject Matter Expert provide guidance on the approach as follow up to this exercise.

Area for Improvement 2: If using these patient profiles in future exercises, more details are needed on the burn injury in order for RITN centers to make determinations about transplant. Guidance from RITN as to proceeding with transplant under the circumstances of various traumatic injuries may also be helpful (e.g., ethical plan for treatment, use of resources).

Area for Improvement 3: Engage other disciplines and departments in the RITN exercises to build awareness and capacity to respond to a surge of ARS patients; also ensure that there is a mechanism to rapidly communicate with all key personnel that would be involved in the response and patient care.

APPENDIX A: IMPROVEMENT PLAN

This improvement plan template has been developed specifically for the RITN centers participating in the 2019 RITN Medical Focus Tabletop Exercise conducted on July 16, 2019. RITN centers can utilize this table to organize the opportunities for improvement to augment and develop their own corrective actions. The improvement plan is intended to strengthen the response of RITN hospital core capabilities identified in this report.

Core Capability	Issue/Area for Improvement	Corrective Action	Capability Element[1]	Primary Responsible Organization	Organization POC	Start Date	Completion Date
Core Capability 1: [Capability Name]	1. [Area for Improvement]	[Corrective Action 1]					
		[Corrective Action 2]					
		[Corrective Action 3]					
	2. [Area for Improvement]	[Corrective Action 1]					
		[Corrective Action 2]					

[1] Capability Elements are: Planning, Organization, Equipment, Training, or Exercise.

APPENDIX B: EXERCISE PARTICIPANTS

Participating Organizations	
Banner University Medical Center	Cody Standage
Banner University Medical Center	Wendy Andrews
Banner University Medical Center	Sue Simo
Banner University Medical Center	Valerie Marine
Banner University Medical Center	Candice Preble
Banner University Medical Center	Sandy Kurtin
Banner University Medical Center	Jacquelyne Echave
Banner University Medical Center	Laura McPheeters
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Banner University Medical Center	Lisa Partin
Banner University Medical Center	Cynthia Garcia
Banner University Medical Center	Emmanuel Kotsenis
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Barbara Ann Karmanos Cancer Institute	David Edwards
Barbara Ann Karmanos Cancer Institute	Amy Shehu
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Seidman Cancer Center (Case Western University Hospitals)	Megan Kuhlenschmidt
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Seidman Cancer Center (Case Western University Hospitals)	Kirsten Bongham
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St. Luke's Presbyterian Hospital (Denver)	Hannah McNally
St. Luke's Presbyterian Hospital (Denver)	Nicole Martinez
St. Luke's Presbyterian Hospital (Denver)	Lee McCall

Participating Organizations	
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University of Kentucky	Sharon Barry
University of Kentucky	Jessica Cox
University of Kentucky	Christopher Deering
University of Kentucky	Roger Herzig
University of Kentucky	Bryan Lemieux
University of Kentucky	Wilma Maloney
University of Kentucky	Laura Martinez Garza
University of Kentucky	Robyn McKenney
University of Kentucky	Chandra Roper
University of Kentucky	Philip Schwieterman
University of Kentucky	Heather Spears
University of Kentucky	Jon Tarr
University of Kentucky	Robert Walchack
University of Kentucky	Brittany Ware
University of Kentucky	Gayle Plank
University of Kentucky	Allison Butts
University of Kentucky	Delaney Wright
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University of North Carolina Hospital	Andrew Sharf
University of North Carolina Hospital	Martha Tye
University of North Carolina Hospital	Sam Sharf
University of North Carolina Hospital	Rebecca Davis
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University of North Carolina Hospital	Genise Nicholson
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University of North Carolina Hospital	Darryl Owens
University of North Carolina Hospital	Kevin Corbin
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University of North Carolina Hospital	Keith Pardue
University of North Carolina Hospital	Christian Lawson
University of North Carolina Hospital	Kimberly Kasow
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West Virginia University	Abraham Kanate
West Virginia University	Aaron Cumpston
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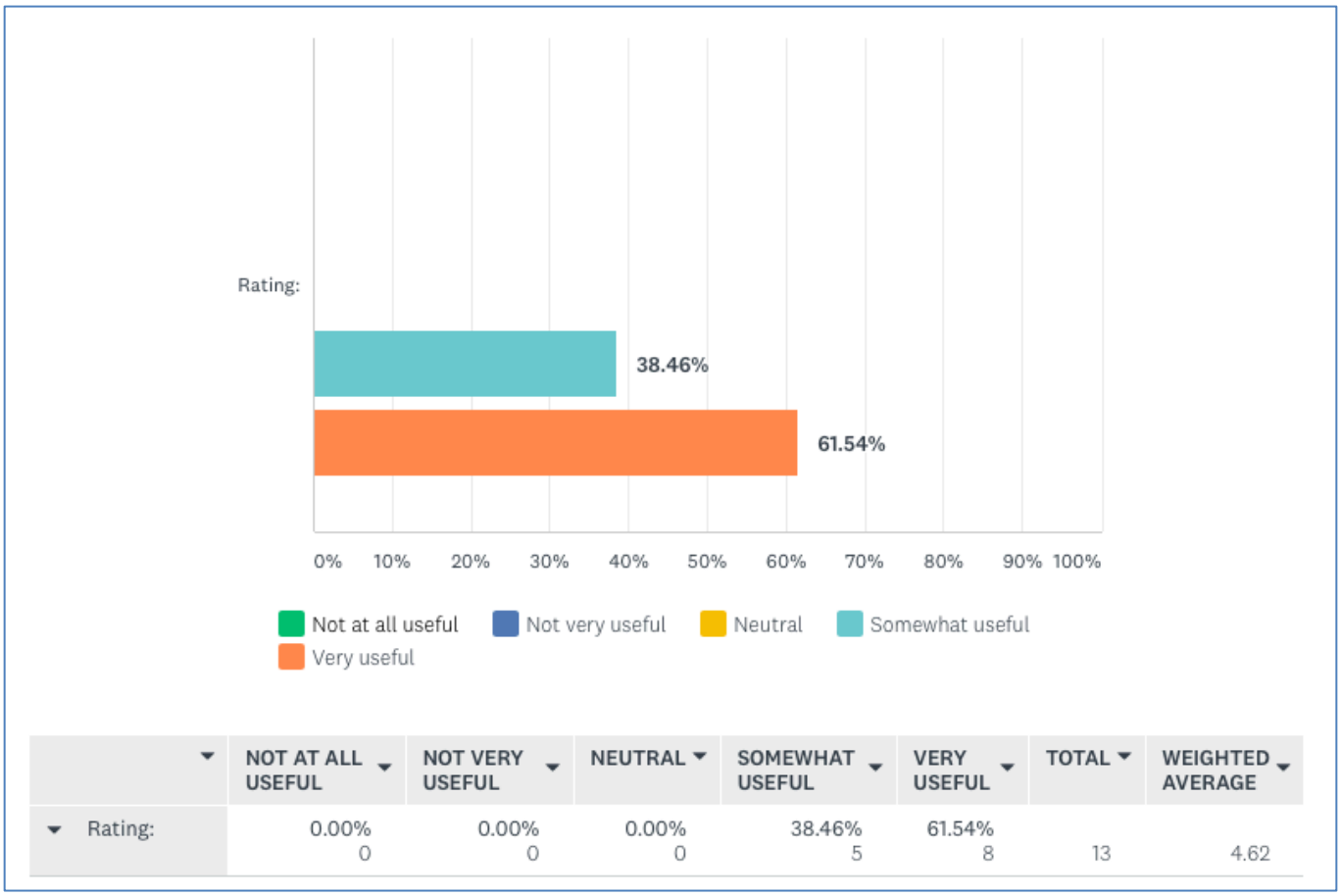
APPENDIX C: PARTICIPANT FEEDBACK

RITN Centers were asked to provide feedback via an online questionnaire following the exercise. The comments below are not in any particular order and are provided unedited to avoid intent changes.

Note: The average rating provided by the participating RITN centers regarding the usefulness of this exercise was 4.62 (out of 5.0). Number of responses = 13.



	NOT AT ALL USEFUL	NOT VERY USEFUL	NEUTRAL	SOMEWHAT USEFUL	VERY USEFUL	TOTAL	WEIGHTED AVERAGE
Rating:	0.00% 0	0.00% 0	0.00% 0	38.46% 5	61.54% 8	13	4.62

Based on discussions today, please briefly describe the 1 or 2 strengths demonstrated by your organization's ability to respond to a radiation mass casualty incident as described in this exercise scenario.	
Banner University Medical Center	*Our greatest strength is a very strong and robust HCTT program that was started in 1988 and has robust and quality processes in place for transplant patients. Our program consists of a very experienced and dedicated team of HCTT physicians, Advanced Practice Providers, nurse coordinators, social workers and HCT lab staff. Another strength was noted today as staff from many other departments such as Emergency Management, Radiation*

Based on discussions today, please briefly describe the 1 or 2 strengths demonstrated by your organization's ability to respond to a radiation mass casualty incident as described in this exercise scenario.	
	Safety, Pharmacy and Lab came to the exercise and actively participated. This sets us up for a positive, efficient and dedicated team if our RITN center is needed in a radiation mass casualty.
Barbara Ann Karmanos Cancer Institute	*No response.*
Duke University Hospital	*Good understanding among physicians and nursing staff on issues involved with deciding on an approach to developing a treatment plan. Local EMS and county health service are aware of RITN and know to contact Duke in case of a local incident.*
Emory University Hospital	*Good participation across system with good representative subject matter experts within our system. Interesting choice of patient scenario to stimulate treatment discussion.*
MedStar Georgetown University	*Dr. Rowley has extensive clinical expertise in BMT and would be able to successfully guide a treatment plan for a patient exposed to high amounts of radiation. Our team would be able to ensure that the patient receives timely and appropriate therapy in our facility.*
Mount Sinai Cancer Center)	*Experience in allogeneic and autogeneic collegiality and collaboration*
Presbyterian St. Luke's Medical Center	*Our greatest strength is in our medical management as we are accustomed to putting a large number of patients through the program at one time and managing their medical needs in both the inpatient and outpatient setting. We have approximately 25 providers on our team and a strong presence from our consulting physicians. Another strength is the size of our team. We have experienced nurses in both the inpatient and outpatient setting along with all of the specialized support staff such as transplant coordinators including search and donor coordinators, psychologists, social workers, pharmacy, cellular therapy and apheresis, laboratory, rehab services, heme and allo follow up coordinators, quality, and data staff. In addition to this, we have the support of the upper level leaders at our facility to ensure we have what we need to properly care for these patients.*
Roger Williams Medical Center	*Although we are a small program we have a seasoned staff, the approach to this TTX again shows the ability of*

Based on discussions today, please briefly describe the 1 or 2 strengths demonstrated by your organization's ability to respond to a radiation mass casualty incident as described in this exercise scenario.	
	our staff and the benefit of our institutions interdepartmental communication.
Scripps Green Hospital	*We have a long standing history as a center of excellence.*
University of California San Francisco Medical Center	*Quaternary care Children's Hospital with multiple disciplines and state of the art facilities needed to respond to a casualty incident as described.*
University Hospitals (Case Western) Seidman Cancer Center	*The organization has new people in key positions so today's exercise gave them a first taste of RITN and allowed them to see the various participants across the country. We also include most of the medical staff that would be directly involved with the patient care.*
University of Kentucky	*No response.*
University of North Carolina Hospital	*Because UNC is a large tertiary hospital with level 1 trauma center, a burn center, and highly skilled 24 bed BMT unit, this allows us to provide a full array of required medical skills for this complex irradiated patient. Being part of a ten hospital network throughout the state allows us to utilize these other hospitals to offload stable patients thus opening bed capacity to care for a mass casualty incident.*
West Virginia University Hospital	*Our physicians and pharmacists are eager to share their expertise with our staff so that our fellows, mid-levels and nursing staff are familiar with RITN and understand each staff members role.*

Based on discussions today, please briefly describe the 1 or 2 challenges demonstrated by your organization's ability to respond to a radiation mass casualty incident as described in this exercise scenario.	
Banner University Medical Center	*Our group noted today during our discussion that communication to all the various departments needs to be worked on in the case of a radiation mass casualty. We (the HCTT program) will be working with our Emergency Management Department to set up a phone distribution list (called X-Matters) which can be deployed with one call to reach all key personnel for RITN and a radiation incident.*
Barbara Ann Karmanos Cancer Institute	*No response.*

Based on discussions today, please briefly describe the 1 or 2 challenges demonstrated by your organization's ability to respond to a radiation mass casualty incident as described in this exercise scenario.	
Duke University Hospital	*Some question as to whether or not radiation burns would really have resolved that quickly and how that would influence treatment plan. Centers should have a plan for providing care based on an ethical framework. Age should not be a factor in determining who receives care if all other medical issues are equal.*
Emory University Hospital	*Context of the event. Is it a single incident or multiple incidents, which would impact treatment choices and capacities. Patient outlier with burn and donor seemed odd.*
MedStar Georgetown University	*I believe we need to integrate more team members into the tabletop, in order to ensure that everyone is prepared to receive and care for these patients-including inpatient representatives, the ER, hematology team, fellows, nurse practitioners, patient admission, apheresis, bone marrow collections department and the cath lab. It is very evident that everyone needs to be on the same page and to communicate effectively about the treatment plan.*
Mount Sinai Cancer Center)	*Representative from Operating Room and an Ethicist would be helpful T-cell depletion not done at MSH*
Presbyterian St. Luke's Medical Center	*Since we just had one patient to address, the management of this situation was pretty straight forward. What is more challenging is not knowing if we had other patients that are in house or that are coming to us and what their condition might be.*
Roger Williams Medical Center	*During the discussion we did not identify challenges regarding treating the one individual.*
Scripps Green Hospital	*This scenario was not straight forward with limiting information but great community dialogue from medical community and centers. waiting for answers.*
University of California San Francisco Medical Center	*Limited awareness amongst other specialties, currently restricted to the key disciplines*
University Hospitals (Case Western) Seidman Cancer Center	*This scenario didn't present a challenge.*

Based on discussions today, please briefly describe the 1 or 2 challenges demonstrated by your organization's ability to respond to a radiation mass casualty incident as described in this exercise scenario.	
University of Kentucky	*No response.*
University of North Carolina Hospital	*We may be overlapping with county and emergency responses because we have another RITN transplant center (Duke) within 8 miles of our center.*
West Virginia University Hospital	*Limited resources. Depending on the number of patients transported to WVUH, we would have limited supply of antibiotics and GCSF. We have a 12 bed unit but would be able to over flow to our oncology unit.*

List and briefly discuss elements to address for future RITN exercises.	
Banner University Medical Center	*We greatly enjoyed the medical focus exercise - a suggestion was more patients at once so we could practice triage and look at various patients with different exposures, injuries etc. to manage at once. Thank you !*
Barbara Ann Karmanos Cancer Institute	*No response.*
Duke University Hospital	*We recently had an incident of an industrial radioactive source being lost off a truck and found in the middle of a major road. The person who called 911 moved the container out of the roadway and left the scene without giving any contact info. In this case the level of radiation emitted from the container was within specified limits but if it had been a high dose how would we track down that individual without causing a public panic? What should area hospitals do to respond to a public panic?*
Emory University Hospital	*More medically complex patients to drive additional discussion. Patient with minor trauma, e.g. long bone fracture.*
MedStar Georgetown University	*As a first time RITN member, I think it would be helpful to understand who should attend the tabletop exercise. I also think more logistical processes should be discussed, such as who receives the first call in a mass radiation event and recommended guidelines for triaging a patient through should be reviewed. How have other centers handled events in the U.S. such as this? It would be great to*

List and briefly discuss elements to address for future RITN exercises.	
	understand how facilities have traditionally triaged and cared for these patients.
Mount Sinai Cancer Center)	*Larger set of patients Housing Family members Ethical issues*
Presbyterian St. Luke's Medical Center	*Working with the allocation of limited resources with a larger number of patients and deciding who would get what treatment based on limited supplies addressing GCSF, antibiotics, blood, inpatient bed space etc. Also a scenario with multiple patients that are on the cusp of needing more intensive treatment and deciding when to pull the trigger on them with more intensive treatment vs. hospice/ palliative care.*
Roger Williams Medical Center	*Sharing of information from other centers post TTX.*
Scripps Green Hospital	*Better format to get through with splitting it up.*
University of California San Francisco Medical Center	*Encourage involvement from others areas.*
University Hospitals (Case Western) Seidman Cancer Center	*Use of cord blood as transplant medium where a 10/10 match is not available. Resource allocation in scarce conditions where triage would be necessary.*
University of Kentucky	*No response.*
University of North Carolina Hospital	*Historically extend invitations to multi disciplinary team members, and many of the people attending today were not able to participate. We also prefer looking at a multitude of patients with a variety of problems. It would be helpful to incorporate one on a mass casualty level that would involve LARGE numbers to help the team expand the horizons beyond our traditional comfort level. Having the questions put forward does help with advance preparation BUT, perhaps there need to be a few impromptu questions to help evoke discussion on the fly.*
West Virginia University Hospital	*In all of the exercises we have only been sent 20 patients. It might be helpful to have larger patient load to better address resources.*

APPENDIX D: ACRONYMS

Acronym	Term
AAR	After Action Report
ARS	Acute Radiation Syndrome
ATG	anti-thymocyte globulin
BMT	Bone Marrow Transplantation
Cy	Cytoxan
FCC	Federal Coordinating Center
Flu	Fludarabine
G-CSF	Granulocyte-Colony Stimulating Factor
Gy	Gray
HCS	Healthcare Standard
IND	Improvised Nuclear Device
NMDP	National Marrow Donor Program
NDMS	National Disaster Medical System
ONR	Office of Naval Research
PBSC	Peripheral Blood Stem Cell
PRA	Patient Reception Area
RITN	Radiation Injury Treatment Network
SITREP	Situation Report
TTX	Tabletop Exercise