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Radiation Injury Treatment Network (RITN): Healthcare professionals preparing for a mass casualty radiological or nuclear incident

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Abstract

Purpose: To describe the history, composition, and activities of the Radiation Injury Treatment Network (RITN). The Radiation Injury Treatment Network® is a cooperative effort of the National Marrow Donor Program and the American Society for Blood and Marrow Transplantation. The goals of RITN are to educate hematologists, oncologists, and stem cell transplant practitioners about their potential involvement in the response to a radiation incident and provide treatment expertise. Injuries to the marrow system readily occur when a victim is exposed to ionising radiation. This focus therefore leverages the expertise of these specialists who are accustomed to providing the intensive supportive care required by patients with a suppressed marrow function. Following a radiological incident, RITN centres may be asked to: Accept patient transfers to their institutions; provide treatment expertise to practitioners caring for victims at other centres; travel to other centres to provide medical expertise; or provide data on victims treated at their centres. Moving forward, it is crucial that we develop a coordinated interdisciplinary approach in planning for and responding to radiological and nuclear incidents. The ongoing efforts of radiation biologists, radiation oncologists, and health physicists can and should complement the efforts of RITN and government agencies.

Conclusion: RITN serves as a vital partner in preparedness and response efforts for potential radiological and nuclear incidents.

Keywords: *radiation accidents, cell therapy, haematology – radiation, radiation injury, emergency response, emergency preparedness*

Introduction

Less than 10 kg of plutonium (Pu) is required to create a 10 kiloton Improvised Nuclear Device (IND) (Department of Energy [DOE] 2001). If such as device was detonated in a major city, there could be hundreds of thousands of casualties, including more than 30,000 potential patients with the most significant injury being a marrow toxic injury (Department of Homeland Security [DHS] 2008). Between 1995 and 2006, over 725 radiological devices were stolen or lost around the world. 67% of these devices have yet to be recovered (International Atomic Energy Agency [IAEA] 2007). According to this report, about 45% of these incidents involved radioactive sources, and 55% involved nuclear materials. There were 18 incidents involving highly enriched uranium (HEU) or Pu. While some seizures of HEU and Pu involved large amounts (kilogram quantities) of weapons-grade material, most have involved smaller quantities, possibly being used as samples of larger stockpiles being trafficked (IAEA 2007). While many of these missing sources are of lower activity and may have decayed to non-threatening levels, the higher activity

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sources would still pose a significant threat. Regardless of the potential for harmful medical effects, the psychological impact of an attack deploying a radiological dispersal device (RDD) would be just as great even in the case of a low activity source.

Aside from intentional exposure due to IND or RDD, there are many examples of industrial accidents such as the Chernobyl disaster or unintentional contamination events as occurred in Goiana, Brazil, that have impacted large numbers of patients who needed specialised medical treatment. These incidents are instructive both in their own right and as a model of problems that would be faced following a terrorist event (Steinhausler 2005, Flynn and Goans 2006).

In response to these threats, many organisations recognised that a networked response by medical professionals would be a necessary component in the response to radiological or nuclear event. These include the National Marrow Donor Program (NMDP), the Office of Naval Research (ONR) and the Department of Health and Human Services – Office of the Assistant Secretary for Preparedness and Response (DHHS-ASPR). NMDP has had a long-standing relationship with ONR including ONR-sponsored research. As part of this ongoing relationship, the ONR has prepared for the possibility of an ionising radiation incident that results in mass casualties with marrow toxic injuries.

The attacks on the World Trade Center towers highlighted the need for a network of specialists to participate in preparedness efforts. With the support and leadership of the American Society for Bone Marrow Transplantation (ASBMT), specifically the president of the association at that time, a group of leading hematologists and oncologists began to discuss the potential of forming a contingency network. Quickly a core group of leaders within the hematology/oncology community was formed. These leaders and their respective institutions saw the need and were willing to commit to support the development of a response network. The group solicited others within the stem cell transplant community to see if they were interested. The NMDP developed a participation agreement and secured funding to establish a small grant to offset the costs incurred by participating institutions. In 2006 the initial 13 founding centres were formed officially as the Radiation Injury Treatment Network®. As part of this initial formalisation some materials were developed including treatment guidelines, data collection protocols, informed consent documents, basic training materials and later more advanced Grand Rounds medical staff education materials. RITN now has partnerships with the federal government which have been formalised through a memorandum of understanding with DHHS-ASPR, and RITN is

Table I. Radiation Injury Treatment Network (RITN) member institutions.

Transplant centres	
AL – University of Alabama at Birmingham	P/A
AZ – Banner Blood and Marrow Transplant Program	
AZ – University Medical Center	P/A
**AZ – Mayo Clinic Phoenix*	P/A
CA – UCSF Medical Center	P/A
CA – City of Hope National Medical Center	P/A
CA – Stanford Hospital and Clinics	P/A
CO – Presbyterian/St. Luke's Medical Center	
FL – H. Lee Moffitt Cancer Center	P/A
FL – Shands Hospital at the University of Florida	P/A
GA – Northside Hospital	
IA – University of Iowa Hospitals and Clinics	P/A
**IL – Rush University Medical Center*	
IN – St. Francis Hospital and Health Centers	
KS – University of Kansas Medical Center	
MA – Dana Farber/Partners Cancer Care	P/A
MI – Barbara Ann Karmanos Cancer Center	
MN – Mayo Clinic Rochester	P/A
MN – University of Minnesota BMT Program	P/A
MO – Barnes-Jewish Hospital at Washington	
MS – University of Mississippi Medical Center	P/A
NC – UNC Hospitals	P/A
NC – Wake Forest Univ Baptist Medical Center	
NC – Duke University Medical Center	P/A
NH – Dartmouth-Hitchcock Medical Center	
NY – Strong Memorial Hospital	P/A
NY– Memorial Sloan-Kettering Cancer Center	P/A
OH – University Hospitals of Cleveland	
OH – Cincinnati Children's Hospital Medical Center	Ped
OK – Oklahoma Univ. Medical Center & Children's Hospital	P/A
OR – Oregon Health & Science University	P/A
PA – Western Pennsylvania Cancer Institute	
PA – University of Pennsylvania Medical Center	
SD – Avera McKennan Transplant Institute	
TN – St. Jude Children's Research Hospital	Ped
**TN – Vanderbilt University Medical Center*	
TX – M.D. Anderson Cancer Center	P/A
TX – Texas Children's Hospital	Ped
UT – LDS Hospital	P/A
UT – University of Utah	
WA – Seattle Cancer Care Alliance	P/A
WI – Children's Hosp of WI & Midwest Children's CC	Ped
WI – Froedtert Memorial Lutheran Hospital	
Donor centres	
CA – City of Hope National Medical Center	
CO – Colorado Marrow Donor Program	
MD – C.W. Bill Young Marrow Donor Center	
MI – NMDP operated center	
WA – Puget Sound Blood Center	
TN – Blood Assurance	
IA – Iowa Marrow Donor Program	
Cord blood banks	
CA – Stem Cyte International Cord Blood Center	
IL – ITxM Cord Blood Services	
MO – St. Louis Cord Blood Bank	
NC – Carolinas Cord Blood Bank	
WA – Puget Sound Blood Center	
CO – University of Colorado	
TX – MD Anderson	

Ped, Pediatric patient only facility; P/A, Pediatric and adult capable facility, If no capability is annotated the facility is adult only; **Invited to participate*.

Figure 1. Geographical distribution of RITN centres. (● = Transplant Centre, ▲ = Donor Centre, □ = Cord Blood Bank).

listed as a tertiary care provider in the federal plan for responding to a nuclear detonation (DHS 2010). Through training events and outreach activities, additional like-minded physicians and institutions have joined RITN bringing it to its current size.

Current composition and activities of RITN

RITN members are primarily bone marrow and stem cell transplant units within institutions that have contracts with the NMDP for marrow transplants. Over the past five years some physicians who moved to new institutions have brought RITN with them by championing the new transplant unit join RITN. This has greatly assisted in the growth of RITN whose membership currently includes 43 transplant centres, seven donor centres, and seven cord blood banks spread across 45 cities in 29 states (Table I and Figure 1). RITN centres have planned for a response to a wide range of incidents with variable impacts in terms of geographical area involved and number of casualties expected. These include at the upper end a military grade nuclear weapon (megatons yield) to an IND (kiloton yield), to radiological exposure devices (open sources), or possibly a RDD (commonly referred to as dirty bombs). In addition to scenarios involving radiological devices, IND, and RDD, the potential use of mustard gas is a serious threat. Under the some circumstances the dispersal of this chemical could result in many victims with marrow toxic injuries. Whatever the causative agent may be, many of these victims would need an unrelated marrow or cord blood match from the NMDP Registry. As of November 2010, the NMDP Registry contained over 8.8 million potential stem cell donors and more than 140,000 cord blood units, the largest source of blood stem cell donors in the

Table II. Radiation Injury Treatment Network (RITN) program activities and functions.

Preparedness efforts
Standard operating procedures
Standardized admission and treatment orders
Standardized data collection protocol
Training
Basic Radiation Training (over 2000 trained since 2006)
Fact Sheets and additional training resources on www.RITN.net
Coordination with international organizations
European Group for Blood and Marrow Transplantation
World Health Organization Radiation Emergency Medical Preparedness and Assistance Network
Conduct readiness exercises
Annual RITN tabletop exercise
Participate in national exercises (Top Officials, National Level Exercise, Pinnacle)
Participate in international exercises (IAEA Convention Exercise 2008)
Emergency communications equipment
Government Emergency Telecommunication Service calling cards
Satellite telephones
Contracted Human Leucocyte Antigen typing laboratories 6–10,000 per week during an emergency
Internet based cord blood unit searching
Data collection protocol
Response to an event
Provide expert knowledge based on significant practical experience in treating patients with compromised immune-systems
Treatment facilities for victims
Regional dispersion other transplant physicians can talk to a peer in RITN
Available through RITN Website: www.RITN.net
RITN Acute Radiation Syndrome treatment guidelines
RITN center standard operating procedure templates
Donor selection criteria
NMDP data collection protocol
Training resources
Pertinent publications

world, and represents a national resource, a ''genetic safety net'' in a time of a radiological/chemical crisis.

RITN has two primary preparedness goals (Table II). The first is to provide facilities and staff with intensive supportive care and treatment expertise in the aftermath of a marrow toxic incident resulting in mass casualties. The second is to educate hematologists, oncologists, and stem cell transplant practitioners about their potential involvement in the response to such an incident. The core membership of RITN is comprised of stem cell transplant centres and clinicians with the experience and expertise to diagnose and treat victims of marrow toxic incidents. It is important to note that RITN centres are not first responders nor are they decontamination facilities. Initial decontamination and the treatment of life-threatening injuries would have to be completed prior to RITN involvement (Figure 2). RITN would complement the planned emergency response by first responders. RITN centres are prepared to provide ready facilities with practicing specialists for intensive supportive care and treatment of victims. RITN centres, being part of the NMDP network of transplant centres, have existing infrastructure and processes for performing stem cell transplants if needed. In an emergency response situation, RITN centres may be asked to participate in such activities as: Accepting patient transfers to their institutions, providing treatment expertise to practitioners caring for victims at other treatment facilities, travelling to other centres to provide medical expertise, and provide data on victims treated at their centres to state and federal agencies.

Each RITN centre develops their emergency response plan based on their local specific needs. Each is expected to coordinate with the appropriate local or regional emergency preparedness experts as well as peer institutions to be able to respond to a surge in acute radiation syndrome (ARS) patients. The RITN central office will be notified by DHHS when there is a situation that requires the network to respond. The central office will then notify the entire network to prepare to receive patients or complete other needed activities. Once activated by DHHS-ASPR, RITN centres will submit a capabilities report for their centre. This information assists in determining the best placement of patients. RITN centres are receiving entities that coordinate with local officials and through the NMDP to DHHS-ASPR. DHHS-ASPR will coordinate patient triage and transport, most likely through the National Disaster Medical System (NDMS). Once delivered to the receiving city, local officials will already be involved for patient distribution to the appropriate care facility.

RITN drills and educational activities are designed to increase transplant community awareness about the potential need of their services in time of crisis. In addition to raising awareness by involving the

Figure 2. RITN concept of operations. RITN centres will alleviate the local hospital surge resulting from mass casualty incidents with marrow toxic injuries.

Table III. Related resources for further information on preparedness and response to radiation emergencies.

Incidents:
IAEA nuclear incidents list: http://www-news.iaea.org/news/
Database of Radiological Incidents and Related Incidents: www.johnstonsarchive.net/nuclear/radevents/index.html
Treatment:
Radiation Injury Treatment Network (RITN): www.RITN.net
Radiation Event Medical Management (REMM): www.remm.nlm.gov
Radiation Emergency Assistance Center/Training Site (REAC/TS): www.orau.gov/reacts
Radiation Countermeasures Center of Research Excellence (RadCCORE): www.radccore.org
Bio-dosimetry and treatment:
Armed Forces Radiobiology Research Institute (AFRRI): www.afrri.usuhs.mil
Other:
IAEA Library: http://www.iaea.org/DataCenter/Library/catresources.html
Radiation Emergency Medical Preparedness and Assistance Network (REMPAN): www.who.int/ionizing_radiation/a_e/rempan/

transplant community in emergency preparedness, RITN is developing resources for the general medical community. Recognising that most victims of a marrow toxic mass casualty incident will require intensive supportive care to recover without a transplant, RITN is producing standard operating procedures and treatment guidelines that can be used by medical professionals outside the RITN network that are participating in the response to a disaster. These guidelines have been developed based both on the medical expertise of RITN leadership and the abundant literature available in this field (Gusev et al. 2001, Ricks et al. 2002, Dainiak et al. 2003, Waselenko et al. 2004, National Council on Radiation Protection and Measurements [NCRP] 2006, 2009, Bader et al. 2008, Weinstock et al. 2008, Coleman et al. 2009, Gourmelon et al. 2010).

Concerns and future plans

Moving from an operational concept to actual on-the-ground activities is not a simple matter. Many areas of concern have been identified through drills and ongoing planning activities. Clearly, a catastrophic event such as the one described above would overwhelm the capacity of the health system even at a national level. A relatively small 10 kiloton IND could translate into tens of thousands of victims in need of treatment (DHS 2008). The need for international cooperation in the face of such an event is clear. While there are clearly-defined processes for emergency use authorisation for drugs in the national stockpile, funding to cover cost of treatment is an unresolved issue. There is an urgent need for new approaches to rapid dosimetry in a mass casualty setting. This is an area of very active research (Meadows et al. 2008, Brengues et al. 2010, Garty et al. 2010, Patterson et al. 2010, Pinto et al. 2010, Roch-Lefevre et al. 2010, Sharma et al. 2010), and has been a focal point for many governmental and international agencies (Straume et al. 2008, Blakely et al. 2009, Health and Human Services [HHS] 2010). The ongoing efforts of radiation biologists, radiation oncologists, and health physicists can and should complement the efforts of RITN and government agencies. Finally, the biggest area of concern is a sense of complacency in the absence of an actual event. While distressing to contemplate, the outcome of an intentional or accidental radiological/nuclear event demands our continued attention. RITN and other related organisations have assembled readily accessible resources for both professionals and the public (Table III).

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