Knox-East Tennessee Healthcare Coalition Radiation Emergency Surge Annex

5.09.2023 Final

Record of Revisions

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5 January 2023	Section 2.1: Graphic Replaced	Draft	Angie Bowen
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09May 2023	Radiation Emergency Surge Annex reviewed by KETHC members and approved.	**Final**	John Brinkley

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Introduction

1.1. Purpose

The purpose of The Knox-East Tennessee Healthcare Coalition is to support the development of cooperative partnerships to promote and enhance the well- being of the community's healthcare system through coordinated disaster preparedness, education, public information, response/recovery activities, and sharing of resources.

The purpose of this annex is to supplement existing Knox-East Tennessee Healthcare Coalition guidance with specific information regarding the management of those seeking care during a radiological or nuclear incident. This annex provides guidance to support a coordinated healthcare response to any incident in which the number and severity of radiologically exposed or contaminated patients challenges the capabilities of healthcare coalition member agencies and facilities.

This annex does not replace other county or local emergency operations plans or procedures but is rather designed to enhance existing plans in the event of a radiological emergency.

1.2 Scope

This annex is designed to address any radiological or nuclear incident that may affect the region encompassed by the Knox-East Tennessee Healthcare Coalition. These incidents may arise from unintentional or intentional release of radioactive materials, may include varied radioactive sources and isotopes, and may necessitate an ability to respond to both contamination and exposure-only events.

The Knox-East Tennessee Healthcare Coalition encompasses the following counties: Anderson, Blount, Campbell, Claiborne, Cocke, Grainger, Hamblen, Jefferson, Knox, Loudon, Monroe, Morgan, Roane, Scott, Sevier, and Union. The Knox-East Tennessee Healthcare Coalition participates in an active network of healthcare coalitions across Tennessee and works closely with the Regional Hospital Coordinators (RHC) and Regional Medical Communications Centers (RMCC) throughout the state. This permits planning, response, and recovery activities to also occur outside of the Knox-East Tennessee Healthcare Coalition geographic boundaries.

This annex is a supplement to, and not a replacement for, the response actions and resources described in other foundational Emergency Operations Plans of the Knox-East Tennessee Healthcare Coalition and its members (Addendum A—KETHC Membership). Membership is open to all healthcare and emergency management-related organizations within the coalition's geographic area as outlined in the coalition's bylaws. This annex does not supersede the

authorities of participating agencies and facilities. Other plans and annexes that may significantly complement this plan include those addressing pediatrics, burns, and psychological considerations.

This annex is effective from the initial date adopted by the Knox-East Tennessee Healthcare Coalition membership and shall be reviewed annually in coordination with the coalition membership. Additional reviews may be conducted after an exercise, after the occurrence of a significant incident, or as regulatory changes dictate.

1.3 Overview/Background

Current geopolitical tensions and the increased proliferation of nuclear weapons have raised concern about an impending targeted radiological or nuclear event. In addition, risks of nuclear events and injuries from radiological exposure increase with the expansion of nuclear power and industrial use of radiation. Outside of malicious attacks, radiological sources are ubiquitous in our communities, ranging from consumer products to larger radiological sources used by hospitals, university research labs, industry, and construction sites. Although abundant safeguards exist surrounding the use of these sources, inadvertent events may pose a risk to the populace.

The Knox-East Tennessee Healthcare Coalition geographic area encompasses the Department of Energy (DOE) Oak Ridge Reservation, with approximately 37,000 acres of land in Anderson and Roane Counties. About 15 percent of the Oak Ridge Reservation is contaminated by hazardous and radioactive materials, including waste sites and remediation areas. The Oak Ridge Reservation consists of three government-owned, contractor-operated sites: East Tennessee Technology Park (ETTP), Oak Ridge National Laboratory (ORNL), and the Y-12 National Security Complex (Y-12). Only two of these sites, ORNL and Y-12, have the potential to have a classified emergency that would require citizens to take protective actions.

Adjacent to the Knox-East Tennessee Healthcare Coalition geographic area, the Southeast Regional Healthcare Coalition geographic area contains two nuclear power plants. Both plants are under the supervision of the Tennessee Valley Authority (TVA). The Sequoyah Nuclear Plant (SQN), consisting of approximately 525 acres, is in Hamilton County on the western shore of the Tennessee River, approximately 15 miles north-northeast of Chattanooga. The Watts Bar Nuclear Plant (WBN), consisting of approximately 1800 acres, is in Rhea County on the western shore of the Tennessee River, approximately 50 miles north-northeast of Chattanooga and 54 miles southwest of Knoxville. The possibility of a nuclear incident involving the release of large quantities of radioactive material from either of these plants is very remote. The possibility, however, does exist. Such a release of radioactive material may constitute a health hazard for persons within specified distances of the plants, and distances may vary with the severity of the incident, meteorological conditions, wind speed, and plume direction of travel. For health and safety reasons, all persons within these specified areas may be instructed to take shelter or evacuate the area. Intake of foods from the exposed area may also be restricted.

A radiological incident has the potential to occur in any community within the Knox-East Tennessee Healthcare Coalition geographic area. These incidents may be deliberate or unintentional in nature. Relatively common radiological incidents involve the loss, theft, or mismanagement of comparatively small radioactive material sources, leading to exposure of individuals or dispersal into the environment. Generally, larger quantities of radioactive materials and facilities with nuclear capabilities, which have a greater potential for harm to human health and the environment, have more regulatory control, safeguards, and security in place. However, any facility or industrial setting, including those responsible for the transportation of materials, may be vulnerable to an act that results in the release of radioactive material.

Devices that may be used in a malicious manner include:

Radiological Dispersal Device (RDD): any device used to spread radioactive material into the environment using conventional explosives. The harm caused by an RDD is principally contamination of individuals and the environment, leading to the inability to use the contaminated area, often for many years.

Radiological Exposure Device (RED): any radiological source placed in a way to cause heightened radiological exposure to individuals. These events are exposure-only in nature and do not include contamination.

Improvised Nuclear Device (IND): an illicit nuclear weapon bought, stolen, or otherwise obtained, or a weapon fabricated from illegally obtained fissile nuclear weapons material, that can produce a nuclear explosion

Radiation related incidents bring little risk to those providing patient care and transport. Knowledge of the real radiation risk is crucial when dealing with radiation related injuries and subject matter expertise should be sought (Addendum B—SME Resources).

Exposure, or irradiation, occurs when all or part of the body is exposed to radiation from a source. Irradiated patients are not contaminated, and irradiation does not make a person radioactive. Individuals who have been radiologically exposed pose no danger to responders, healthcare providers or their environment, but these are the patients who may be at higher risk for serious medical sequelae.

Contaminated individuals are those who have transferable radiological material any place it is not desired. A person is externally contaminated if radioactive material is on the skin. A person is internally contaminated if radioactive material is inhaled, ingested, or absorbed through wounds. A person contaminated with radioactive materials will be irradiated until the radioactive material, the source of the radiation, is removed. Those who have been radiologically contaminated often do not become critically ill, but care must be taken to mitigate and contain the contamination while caring for these individuals. In these events, the key is that emergency medical care of the patient takes

precedence over decontamination. Unlike with chemical contamination, medical stabilization for patients with radiological contamination takes precedence.

In a radiological or nuclear incident, the Knox-East Tennessee Healthcare Coalition will utilize existing member resources and transfer agreements to best care for those in the community. Vulnerable populations, including the elderly, children, and those with access and functional needs will require considerations as addressed in existing Emergency Operations Plans. Medical and trauma stabilization, and decontamination efforts, should occur as standard practice. Based on patient presentation, age, and potential injuries, transfers may be made to the Region's Level I Trauma Center, the Comprehensive Regional Pediatric Center (CRPC), or other coalition hospitals and specialized treatment centers that have the capacity to care for those with burn injuries or bone marrow suppression. Appropriate triage, both pre-hospital and in-hospital, will be necessary to determine the best path of care and the extent of resources needed (Addendum C—Prehospital Radiological Triage and Addendum D—Radiation Patient Treatment)

As a member of the Knox-East Tennessee Healthcare Coalition, the Radiation Emergency Assistance Center/Training Site (REAC/TS) at the Oak Ridge Institute for Science and Education (ORISE), has the capability to provide 24/7 advice, consultation, and subject matter expertise: Radiation Emergency Assistance Center/Training Site (REAC/TS) (orau.gov). Additionally, the Radiation Injury Treatment Network (RITN), a national network of medical centers with expertise in caring for marrow toxic injuries, can aid in managing patients with acute radiation syndrome (ARS) and its health-related consequences: Radiation Injury Treatment Network (RITN).

1.4 Assumptions

Enumerated below are key assumptions for all Knox-East Tennessee Healthcare Coalition members:

- Radiation incidents may require prolonged response and extensive resource management challenges. The roles and responsibilities of agencies and facilities may change depending on the severity and scale of the incident and the respective level of activation. Federal, state, and local emergency resources will all be needed during a large-scale event. Substantial differences in response protocols and priorities exist between industrial incidents, nuclear power plant incidents, terrorist threats, and nuclear weapon detonation. Different agencies may have authority over management of power plant, transportation, and terrorist incidents, including the authority to implement shelter-in-place and evacuation orders.

- Implementation of surge protocols specific to a radiation emergency will occur quickly. Personnel must be prepared to pivot operational procedures immediately. Radiation contamination assessments and initial interventions will require rapid protocol and education implementation. Staff will need to evaluate real versus possible exposure,

internal versus external contamination, and assess overall exposure levels for at-risk patients based on serial blood testing.

While many resources are available, the Radiation Emergency Assistance Center/Training Site (REAC/TS) has just-in-time training videos that are intended for emergency medical responders and providers who need rapid information when called to care for individuals who are ill or injured during a radiological incident. This series is divided into multiple videos by subject matter, each 2-3 minutes in length. These include Radiological Triage, Exposure v. Contamination, Personal Protective Equipment, Patient Decontamination, Physical Dosimetry, Radiation Detection Devices, and Cytogenetic Biodosimetry: REAC/TS Just-in-Time Training Video Series (orau.gov)

- Contamination assessments, proper PPE utilization, and decontamination efforts will be essential in protecting responders, healthcare providers, and the public. The following addenda provide rapid information on proper PPE usage, personnel monitoring, radiological patient surveys, treatment area radiological surveys, and an overview of the use of radiological survey meters.

  Addendum E—Donning
  Addendum F—Doffing
  Addendum G—Personnel Monitoring
  Addendum H—Patient Radiological Survey
  Addendum I—Patient Radiological Survey Sheet
  Addendum J—How to use the Patient Radiological Survey Sheet
  Addendum K—Area Radiological Survey Sheet
  Addendum L—GM Detector Job Aid

- Limited understanding of radiological and nuclear health impacts will likely contribute to public anxiety. Radiation-related incidents often induce fear, including fears about long-term and delayed health effects, safety at home, and confidence in the food/water supply. There does not have to be widespread risk or harm for intense psychological effects. Fear regarding an incident will likely produce a surge of worried well to all levels of healthcare facilities and increase requests for prehospital care. Community screening sites may be required to assess low-risk patients. Community-based interventions will require significant public health effort if an evacuation or shelter in place order is necessary. Critical infrastructures may be impacted (e.g., food distribution, isolation assistance, surveillance activities).

- Healthcare personnel may also be impacted by actual or perceived radiological exposure/contamination, or the fear thereof. Personnel may also have family obligations that preclude willingness or ability to respond. For those caring for radiologically contaminated patients, good survey technique (Addendum G—Personnel

Monitoring) is essential and will provide peace of mind to the provider that they did not leave the response or patient care area with any contamination on their person. Health concerns, prolonged response requirements, difficult work environments, and stress may present behavioral health challenges among healthcare personnel.

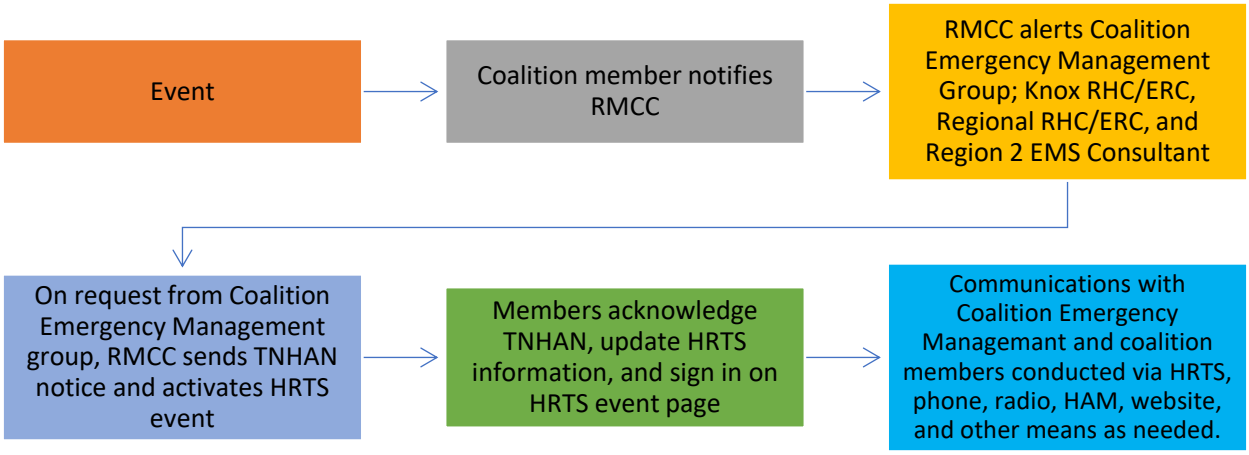
- Management of contaminated waste from decontamination efforts should be managed in consultation with subject matter experts, including the Tennessee Department of Environment and Conservation (TDEC), the Environmental Protection Agency (EPA), and local water authorities.

Concept of Operations

2.1 Activation

Activation of this annex, or any portion thereof, will be determined on a case-by-case basis. Dependent on the size and scope of a radiological or nuclear incident, activation will occur in consultation with local/state/national health authorities; radiological/nuclear subject matter experts (SMEs); and with input from local healthcare facilities, EMS leadership, and other healthcare system stakeholders.

Generally, this annex can be activated when a healthcare facility within the region has exceeded, or reasonably anticipates exceeding, its resources, capability, or capacity due to a radiological or nuclear incident. Responders or providers who recognize such an incident should contact the Regional Medical Communications Center (RMCC), which will then contact the Emergency Response Coordinator (ERC), the Regional Hospital Coordinator (RHC), and/or the Regional Emergency Medical Services (EMS) Consultant. These individuals will coordinate with health officers and the healthcare coalition to determine the level of activation required. This can vary from monitoring the situation to a fully staffed response with public health representatives deploying.



2.2 Notification

Notification to Knox-East Tennessee Healthcare Coalition members will be made via the Tennessee Health Alert Network (TNHAN), the Healthcare Resource Tracking System (HRTS), ReadyOps, or the Knox-East Tennessee Healthcare Coalition website membership management tool.

The Regional Hospital Coordinator (RHC) or the Regional Medical Communications Center (RMCC) may activate the Healthcare Resource Tracking System (HRTS), which is the Tennessee department of Health's statewide system that helps track the availability of prehospital, hospital, EMS, and long-term care resources. This system has been in use since 2007 and has been used to alert healthcare coalition members and response partners regarding multiple emergency events. Activation of a HRTS event triggers healthcare coalition members & healthcare system partners to evaluate the level of response required and enhance situational awareness.

Essential information may include:

- Bed availability (HRTS)
- Resource capabilities (HRTS)
- Organization and service capabilities (HRTS)
- Infrastructure status

2.3 Roles and Responsibilities

The following chart identifies the general organization and assignment of responsibilities in a radiological or nuclear incident response.

Agency	Primary Response Roles	Secondary Response Roles
Fire/Rescue Emergency Medical Services (EMS)	• Rescue and decontamination as appropriate • Triage, treat, transport casualties to appropriate local specialty centers in accordance with established Tennessee EMS mass casualty protocols	• Utilize Emergency Medical Dispatch (EMD) procedures to provide pre-arrival instructions for radiological or nuclear emergencies
Regional Hospital Coordinator Emergency Response Coordinator Regional Medical Communications Center EMS Consultant	• Activate coordination mechanisms and radiation-specific plans • Request/mobilize any coalition/regional caches of supplies • Triage/prioritize casualties for forward movement to specialty centers in accordance with established protocols or subject matter expertise • Assist in coordinating fatality management and behavioral health resources	• Ensure notification and coordinate information with state/federal partners • Assure that appropriate clinical information is relayed between referring and receiving facilities, as well as transporting agencies, during the transfer process • Support coordination with subject matter experts to determine appropriate destinations for patients that cannot be accommodated in the local healthcare system
Trauma Center Comprehensive Regional Pediatric Center Initial Receiving Hospitals	• Activate hospital surge capacity plans to accommodate unusual patient loads and acuities • Provide initial patient care and stabilization • Contact subject matter experts for patients suffering high levels of exposure/contamination and communicate need for specialized care if unavailable on-site	• Activate the Hospital Incident Command System (HICS) for surge patient management • Support regional coordination activities for radiologically ill or injured patients
Tennessee Department of Health (TDH)	• Ensure that patient triage, tracking, and transport needs are addressed	• Liaison between local and federal resources

Agency	Primary Response Roles	Secondary Response Roles
TDH, Division of EMS Tennessee Emergency Management Agency (TEMA)	• Support local jurisdiction with state-level coordination and requests for assistance (e.g., federal declarations) • Support detection equipment and dosimetry requests for resources for pre-hospital/hospital use • Make request for radiation assets, including countermeasures and other materials from the Strategic National Stockpile (SNS) • Engage Emergency Management Assistance Compact (EMAC) assets to provide inter-state support for transportation, staff, or other logistics	• Support bed polling and matching functions as needed in coordination with subject matter experts (e.g., REAC/TS and RITN)
Tennessee Department of Environment and Conservation (TDEC)	• Manage the environmental components of a radiological incident to include evacuation orders, contamination and decontamination efforts, environmental monitoring, investigations, and safety assessments	• Support Tennessee Department of Health in population-based screening
Tennessee National Guard and Tennessee State Guard	• Deploy Civil Support Teams as warranted	• Deploy disaster medical teams as warranted to support hospitals, alternative care sites, and community reception sites

2.4 Logistics

Resources coordination will be managed via the Regional Hospital Coordinators (RHC), Emergency Response Coordinators (ERC), Regional EMS Consultants, and local and state emergency management utilizing the Healthcare Resource Tracking System (HRTS) and WebEOC (for emergency management).

2.4.1 Space

Patients should be cared for at the facility most appropriate for their medical or trauma needs.

The University of Tennessee Medical Center (UTMC) is the designated Level I Trauma Center for the region, Tennova Turkey Creek Medical Center (TCMC) is the designated Level III Trauma Center for the region, and East Tennessee Children's Hospital (ETCH) is the designated Comprehensive Regional Pediatric Center (CRPC) for the region. Other facilities in the region may receive Level I trauma patients or pediatric patients for stabilization based on incident location and scope.

All hospitals should have the capabilities to decontaminate radiologically contaminated patients and manage initial/ongoing medical care within their scope. The geographic area encompassed by the Knox-East Tennessee Healthcare Coalition does not include a burn center and, after initial stabilization, radiological burn patients may need to be referred as per standard protocol.

Alternate Care Sites (ACS) may be considered by each hospital if they are overwhelmed with patient numbers.

2.4.2 Staff

Regional Memorandums of Understanding (MOUs) between Knox-East Tennessee Healthcare Coalition facilities and agencies allow for the sharing of staff during a disaster event. Requests for staffing needs should be escalated according to the Knox-East Tennessee Healthcare Coalition response plan. Memorandums of Understanding with neighboring coalitions provide for the sharing of staffing resources when necessary.

Limited staffing may impact facilities, healthcare providers, and overall Knox-East Tennessee Healthcare Coalition duties during a radiological or nuclear incident. Some staff may have to shelter in place or may be unable to travel. As a result of limited staffing, this situation may require patients to be transferred to adjacent regions for care.

Personnel and material resources that may be required to support the care of radiologically exposed patients include blood banks, laboratories, pharmacies, food and dietary services, and environmental services/waste and contaminated materials management. Those personnel with radiological expertise should be consulted including, but not limited to, Radiation Safety Officers (RSOs), radiologists, radiation oncologists, and medical physicists.

2.4.3 Supplies

The Regional Hospital Coordinator (RHC) may request, receive, and distribute radiological or nuclear incident-specific assets in accordance with established processes.

Resources needed may include dosimeters, hand-held/portable survey instruments and detection devices, decontamination supplies, and appropriate personal protective equipment (PPE) for the given incident. Memorandums of Understanding with

neighboring healthcare coalitions provide for the sharing of resources when necessary. Knox-East Tennessee Healthcare Coalition members should identify any specific gaps early in the response and make requests accordingly.

In a radiological or nuclear incident in which pharmaceutical radiation countermeasures are required, these may be requested via the existing processes for access to the Strategic National Stockpile (SNS).

2.5 Operations: Medical Care

Information derived from the Healthcare Resource Tracking System (HRTS) may be used to facilitate decision-making regarding implementation of any needed crisis standards of care in a radiological or nuclear incident. Coordination and communication are key to ensuring patients receive the most appropriate care at the most suitable facility in such a scenario.

Depending on the scope of the radiological or nuclear incident and bed availability, patients who need specialized care may be transferred to specialty centers outside the region. This may include transfers to burn centers or hematology/oncology centers using existing transfer agreements. Subject matter experts (Addendum B) may help with advice and consultation, and facilitate decision-making, regarding patients most impacted by radiological illness or injury.

The Radiation Emergency Assistance Center/Training Site (REAC/TS) has a Checklist for Healthcare Personnel (Addendum M) and a Checklist for Hospital-Based Radiation Professionals (Addendum N) to assist with preparation, notification, and all facets of medical management of patients involved in a radiological or nuclear incident.

2.5.1 Triage and Screening

In any radiological or nuclear incident, radiological triage must be integrated into existing medical/trauma triage systems. The standard triage system utilized across the state of Tennessee is Simple Triage and Rapid Treatment (START) for adults and JumpSTART for the pediatric population (defined as less than 8 years of age for this algorithm).

The Radiation Emergency Assistance Center/Training Site (REAC/TS) has published radiological triage guidelines for prehospital (Addendum C) and hospital (Addendum D) personnel for any radiological or nuclear incident.

In the event of a nuclear detonation, the use of the Exposure and Symptom Triage (EAST) sorting tool (Addendum O) may be useful in determining patient priority for evacuation and the administration of bone marrow cytokines based upon survivor probability.

The Radiation Injury Treatment Network (RITN) Cytokine Administration Triage Guidelines for Acute Radiation Syndrome (Addendum P) can assist healthcare providers

with myeloid cytokine triage decision-making regarding the administration of these pharmaceuticals in the immediate aftermath of a radiological disaster.

Community Reception Center(s) may be needed to receive and screen radiologically contaminated individuals who are ambulatory and who do not have combined injuries. Guidelines for Community Reception Center operations, as recommended by the Centers for Disease Control and Prevention (CDC), may be found here: https://www.cdc.gov/nceh/radiation/emergencies/populationmonitoring.htm

Some screening may be performed by Public Health, depending on services and staff availability.

Additionally, shelter in place sites, alternate care sites, supplemental triage/screening space, and treatment sites for at-risk/vulnerable populations may be needed (See Sections 2.6.1 and 2.6.2).

2.5.2 Patient Care/Management

In a radiological or nuclear incident, patient medical/trauma needs remain a priority. Symptomatic exposed patients may not have injuries. Contaminated patients may not require emergency care.

Radiological illnesses and injuries affect multiple organ systems, most notably the hematopoietic system, the gastrointestinal system, and neurovascular system, and the integumentary system. Severity will vary by the type and amount of radiation exposure or contamination. The type of radiological incident will impact the likelihood of associated traumatic injuries, particularly those associated with blast events.

Every hospital should be prepared to provide stabilization for radiologically ill or injured patients including management of immediate life threats, pain management, decontamination, and psychosocial support.

2.5.3 Treatment

Supportive medical care and management of presenting symptoms is often all that is needed for many patients who have been involved in a radiological or nuclear incident. For those with severe radiological illnesses or injuries, consultation with subject matter experts (Addendum B) is recommended.

Radiation countermeasures exist for a limited number of isotopes and are a treatment consideration depending upon the incident type. The Regional Medical Communications Center (RMCC) serves as the point of contact for the Knox-East Tennessee Healthcare Coalition membership to request countermeasures. *Expert consultation is highly recommended prior to administration of any countermeasure.*

Examples of countermeasures that may be used to minimize internal contamination include:

- **Prussian Blue (Radiogardase®)** may be used for internal contamination with cesium or thallium. Prussian Blue is taken orally and helps remove these elements from the body.
- **Diethylenetriaminepentaacetic acid (Diethylene triamine penta-acetate, DTPA)** is FDA-approved for internal contamination with plutonium, americium, or curium. It may be used off-label for other transuranics. DTPA is a chelating agent used to minimize the incorporation of these elements into the body. Diethylenetriaminepentaacetic acid may be given intravenously, intramuscularly, via inhalation, or used to irrigate contaminated wounds. It comes in two forms: Calcium-DTPA and Zinc-DTPA, with Calcium-DTPA having greater chelation ability but also a greater likelihood of depleting essential minerals from the body. Calcium DTPA is usually preferred as the first dose if given soon after internalization. The Strategic National Stockpile (SNS) contains Zinc-DTPA.
- **Sodium Bicarbonate** may be used to alkalinize the urine of patients contaminated with uranium to reduce the risk of renal damage.
- **Calcium or Aluminum Phosphate** may be used to mitigate the absorption of strontium or radium through competitive inhibition.
- **Potassium Iodide (KI)** may be used to block thyroid deposition of radioactive iodine. Potassium iodide is most effective when administered soon after an incident involving radioactive iodine. For this reason, it may be stockpiled near sites at heightened risk (e.g., within a 10-mile radius of nuclear power plants). Treatment with potassium iodide is prioritized by age with FDA recommended dosage below:

Risk Group	KI Dose (mg)	Number of 130mg tablets	Oral Solution (ml)
Over 40 Years	130	1	2
18-40 years	130	1	2
12-18 years*	65	0.5	1
3-12 years	65	0.5	1
1 month-3 years	32	Use oral solution	0.5
Birth-1 month	16	Use oral solution	0.25

* Adolescents approaching adult size (>150 lbs) should receive the full adult dose. Over 40 years, only give if >5 Gy to the thyroid.

Tennessee has additional resources available for potassium iodide if it is determined by the Tennessee Department of Health, in coordination with the Tennessee Department of Environment and Conservation (TDEC) Division of Radiological Health, that radioactive iodine has been released and detected. If an event were to occur at a nuclear power plant, the Tennessee Valley Authority (TVA) has purchased sufficient quantities of potassium iodide to provide doses to the population in the emergency planning zone who might be exposed to ionizing radiation from a plume cloud or its deposition; to emergency workers who may be required to remain in the open during the passage of a plume or subjected to inhalation of suspended particles in a contaminated area; and institutionalized or home-bound persons who, because of their immobility, would be safer to shelter in place rather than attempt a relocation. Depending on the severity of the incident and direction of plume travel, the decision may be made to shelter other residents in place rather than attempting an evacuation. Points of Dispensing (POD) may be activated using existing dispensing plans.

2.5.4 Safety and Control Measures

Protection from radiation exposure is primarily accomplished through time, distance, and shielding. For all patients with radiation exposure and/or contamination, minimizing time in the presence of the source and maximizing distance from the source, including evacuation from the incident site, are of prime importance. For contaminated patients, reduction of time of exposure should be further addressed by decontamination or decorporation measures to reduce external and internal contamination.

Shielding of alpha and beta sources can be accomplished with standard protective clothing and eye protection. Incidents involving high energy gamma radiation may require shielding with physical barriers made of dense material (e.g., concrete or water). Lead shielding is often considered protective in these events, but the amount of lead needed is impractical when providing patient care. Therefore, conducting patient care in a manner that minimizes time in the immediate area, and maximizes distance from the source, is a much more effective strategy.

When managing a contaminated patient, medical personnel can usually achieve adequate levels of protection by utilizing modified universal precautions. This may consist of coveralls or disposable gowns of the type used for standard surgical procedures or infection control, shoe covers, a head covering to prevent contamination in the hair, surgical or N-95 masks, a face shield and/or eye protection, and double gloves (Addendum E and Addendum F).

2.5.5 Fatality Management

In the case of decedents who are radiologically contaminated, special handling may be necessary. The Tennessee Department of Health (TDH), in collaboration with the Tennessee Department of Environment and Conservation (TDEC), can provide guidance on the handling of these casualties. The Knox-East Tennessee Healthcare Coalition will assist in disseminating this guidance to healthcare agencies and relevant partners.

Additional guidance documents can be obtained from U.S. Department of Health and Human Services: https://remm.hhs.gov/deceased.htm

2.5.6 Transport

All ambulances and licensed EMS personnel operating within Tennessee must meet standards set by the state Board of EMS. Specialized EMS transport resources, such as an AMBUS, may be accessed through the Regional Medical Communications Center (RMCC) in conjunction with the Region II EMS Consultant and, if necessary, the Regional Hospital Coordinator (RHC). The Regional Medical Communications Center and the Regional EMS Consultant will collaboratively coordinate the transport of potentially contaminated casualties and the mass movement of persons with significant radiation exposure who require specialized care.

2.5.7 Surveillance, Tracking, and Situational Awareness

Tennessee has a patient tracking system that is used to provide situational awareness, family reunification, and repatriation for emergency evacuees. The system provides for patient registration and documentation of patient assessments, triage, and treatment. The system is scalable and can be deployed for mass casualties, healthcare facility evacuations, and medical assistance in shelter operations.

In the event of a radiological or nuclear incident, the Tennessee Department of Health, in collaboration with the Knox-East Tennessee Healthcare Coalition, may establish a special registry for tracking all patients who have been screened and/or treated. This may include outpatient follow-up services such as serial lab work, cytogenetic biodosimetry, coordination of follow-up care, and repatriation of any patients transferred out of the area.

2.5.8 Rehabilitation and Outpatient Follow-up Services

Rehabilitation and monitoring are an essential part of treatment after any radiological injury or illness. Follow-up planning should start at the time of admission and may continue for years after a radiological or nuclear incident. Rehabilitation may require the inclusion of many subspecialists, including those with expertise in hematology/oncology, gastroenterology, dermatology, plastic surgery, and mental health. Follow-up care, outpatient services, and rehabilitation planning should occur before treatment facility discharge.

2.5.9 Deactivation and Recovery

When it is determined that the situation is contained and additional resources are no longer needed, the Regional Medical Communications Center (RMCC) will communicate with all involved healthcare entities via the Healthcare Resources Tracking System (HRTS) and/or ReadyOps that the region has returned to a normal state of operation. Additionally, other means of communication may also be employed, to include phone, radio, or website. Recovery activities will be managed as part of the overall recovery

from the disaster and include the creation of an After-Action Report to document lessons learned and the replenishment of stockpiles or caches.

2.6 Special Considerations

2.6.1 Behavioral Health

Radiological or nuclear incidents will likely require access to a continuum of mental health services for patients, caregivers, and providers with an emphasis on radiation survivor support and radiation counseling. The Knox-East Tennessee Healthcare Coalition will take into consideration the long-term mental health implications in those with real or perceived radiological contamination or exposure.

For more immediate mental health concerns, Tennessee uses the PsySTART (Psychological Simple Triage and Rapid Treatment) system to triage mental health needs and assess/manage behavioral impacts.
PsySTART Tennessee can be found at:
https://www.tn.gov/health/cedep/cedep-emergency-preparedness/temarr.html

Additionally, the Tennessee Department of Health, in collaboration with the Tennessee Department of Mental Health and Substance Abuse Services, has an established Tennessee Disaster Mental Health Strike Team through the Tennessee Federation of Fire Chaplains (TFFC) that may be deployed during a disaster. The Tennessee Federation of Fire Chaplains provides training and management of the strike team, which includes a statewide deployment-capable cadre of trained chaplain, mental health, and emergency service peer professionals. The strike team provides initial referral to licensed mental healthcare professionals, including immediate emergency referrals when appropriate.

2.6.2 Pediatric and At-Risk Populations

Radiological and nuclear incidents present special concerns for the pediatric population, including greater sensitivity to radiation due to rapidly dividing cells and smaller body size. Pediatric patients should be transported to East Tennessee Children's Hospital for medical concerns, particularly those in need of pediatric hematology/oncology services. For pediatric patients with significant traumatic injuries, transport should be to the region's Level I Trauma Center, University of Tennessee Medical Center.

Other at-risk populations will be considered in all planning and exercises. These include: the elderly, those with access and functional needs, individuals with behavioral health conditions, persons experiencing access to care issues, individuals with language barriers, individuals experiencing homelessness, and incarcerated individuals.

2.6.3 Communications

The Knox-East Tennessee Healthcare Coalition will assist in disseminating timely, accurate, and consistent information to healthcare partners. This includes providing real-time information through coordinated healthcare coalition and jurisdictional public

health information sharing systems and working to ensure streamlined and consistent communication efforts throughout the community to prevent the public from overwhelming healthcare systems.

Appendices

3.1 Training and Exercises

The Knox-East Tennessee Healthcare Coalition Radiation Emergency Exercise includes a functional surge event, a tabletop exercise, and an after-action evaluation to improve response capabilities in a radiological or nuclear incident scenario. The exercise focus includes understanding of appropriate PPE usage, radiological detection devices, and personal dosimetry; screening and triage, including differentiation between contamination and exposure-only events; decontamination protocols; implementation of acute radiation syndrome resources; and population monitoring.

3.2 Additional Resources and References

Addendum A
Healthcare Coalition Membership List
The Knox-East Tennessee Healthcare Coalition membership list is available on the coalition website: KET (Knoxville / East Tennessee) Healthcare Coalition (ketcoalition.org)

Addendum B
Subject Matter Expertise
In addition to state, regional, and local resources, the following entities can provide subject matter expertise or needed information in a radiological or nuclear incident:

- The **Radiation Emergency Assistance Center/Training Site (REAC/TS)** at the Oak Ridge Institute for Science and Education provides expertise 24/7 regarding the medical aspects of a radiological or nuclear incident. Specialized response teams consist of physicians, nurse/paramedics, and health physicists.

  REAC/TS also has a Cytogenetic Biodosimetry Laboratory that can perform dicentric assay (DCA), a technique that can be used to help calculate the absorbed radiation dose in exposed individuals.

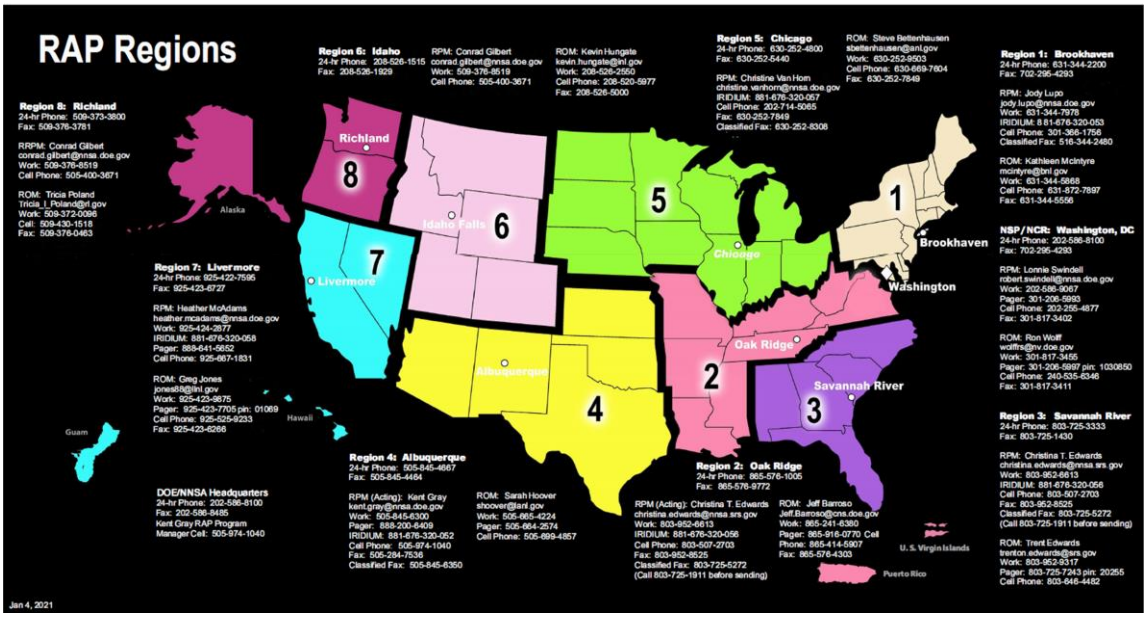
  Contact Numbers:
  865-576-3131 (General Information)
  865-576-1005 (After-Hours)
  Website: https://orise.orau.gov/reacts/index.html

- The **Radiation Injury Treatment Network (RITN)** is a national network of medical centers with expertise in the management of bone marrow failure and works to assist with managing acute radiation syndrome (ARS) and its health-related consequences. RITN provides information about available Hematology and Oncology Centers throughout the United States.

  Contact Number: 612-884-8276
  Website: https://ritn.net/

- The **Radiological Assistance Program (RAP)** provides first-responder radiological assistance to detect radiological material and thereby protect the health and safety of the general public and the environment. RAP teams may be contacted through the U.S. Department of Energy Watch Office (24/7).

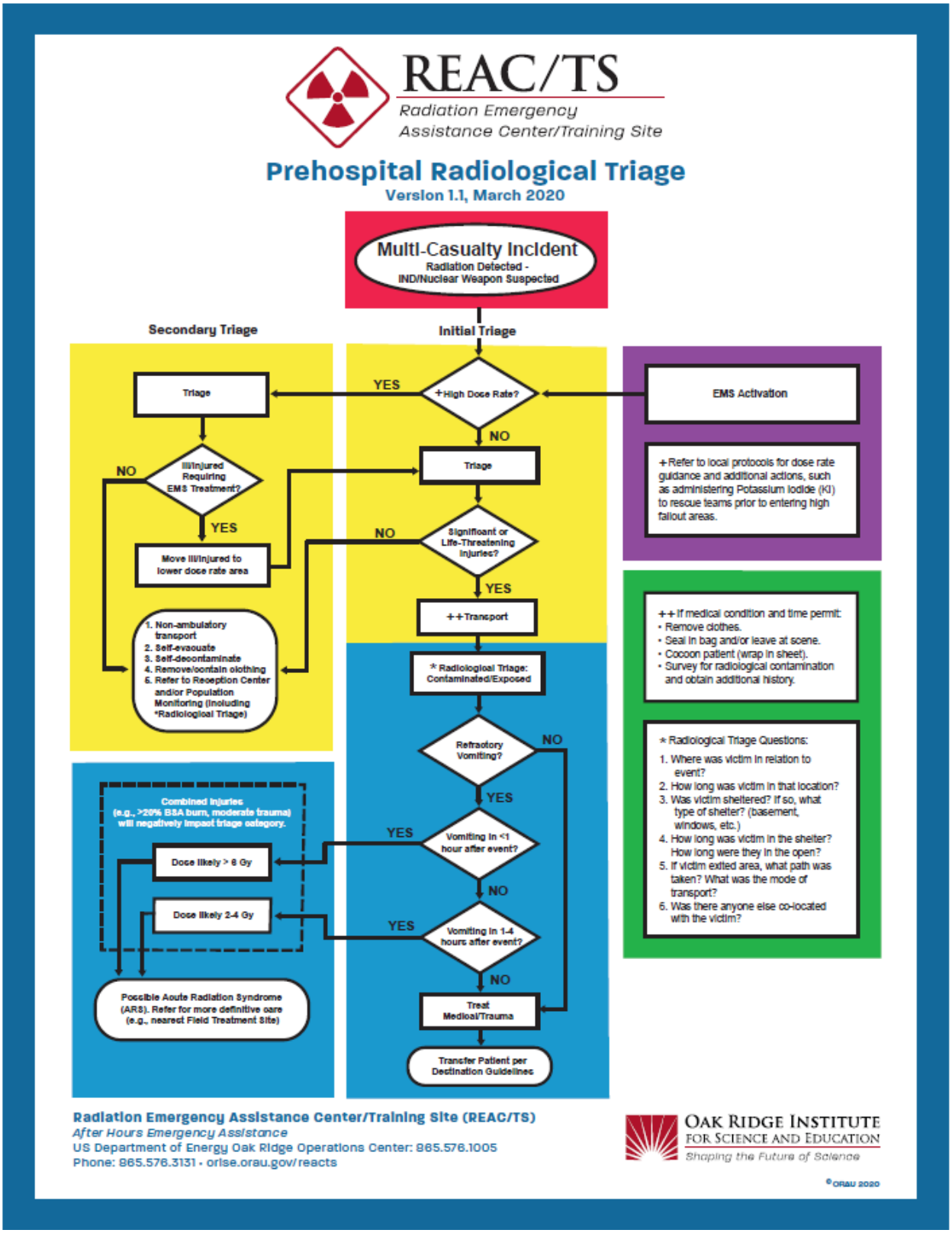
  Contact Number: 202-586-8100



- American Burn Association: https://ameriburn.org/

- Environmental Protection Agency (EPA): https://www.epa.gov/radiation/radiation-protection-document-library

Addendum C


REAC/TS
Radiation Emergency
Assistance Center/Training Site
Prehospital Radiological Triage
Version 1.1, March 2020
Multi-Casualty Incident
Radiation Detected -
IND/Nuclear Weapon Suspected
Secondary Triage
Initial Triage
Triage
YES
+High Dose Rate?
EMS Activation
NO
Triage
NO
Ill/Injured Requiring EMS Treatment?
YES
Move Ill/Injured to lower dose rate area
NO
Significant or Life-Threatening Injuries?
YES
++Transport
1. Non-ambulatory transport
2. Self-evacuate
3. Self-decontaminate
4. Remove/contain clothing
5. Refer to Reception Center and/or Population Monitoring (including *Radiological Triage)
* Radiological Triage: Contaminated/Exposed
Refractory Vomiting?
NO
YES
Combined Injuries (e.g., >20% BSA burn, moderate trauma) will negatively impact triage category.
YES
Vomiting in <1 hour after event?
Dose likely > 8 Gy
Dose likely 2-4 Gy
NO
YES
Vomiting in 1-4 hours after event?
NO
Possible Acute Radiation Syndrome (ARS). Refer for more definitive care (e.g., nearest Field Treatment Site)
Treat Medical/Trauma
Transfer Patient per Destination Guidelines
+Refer to local protocols for dose rate guidance and additional actions, such as administering Potassium Iodide (KI) to rescue teams prior to entering high fallout areas.
++If medical condition and time permit:
• Remove clothes.
• Seal in bag and/or leave at scene.
• Cocoon patient (wrap in sheet).
• Survey for radiological contamination and obtain additional history.
* Radiological Triage Questions:
1. Where was victim in relation to event?
2. How long was victim in that location?
3. Was victim sheltered? If so, what type of shelter? (basement, windows, etc.)
4. How long was victim in the shelter? How long were they in the open?
5. If victim exited area, what path was taken? What was the mode of transport?
6. Was there anyone else co-located with the victim?
Radiation Emergency Assistance Center/Training Site (REAC/TS)
After Hours Emergency Assistance
US Department of Energy Oak Ridge Operations Center: 865.576.1005
Phone: 865.576.3131 - orise.orau.gov/reacts
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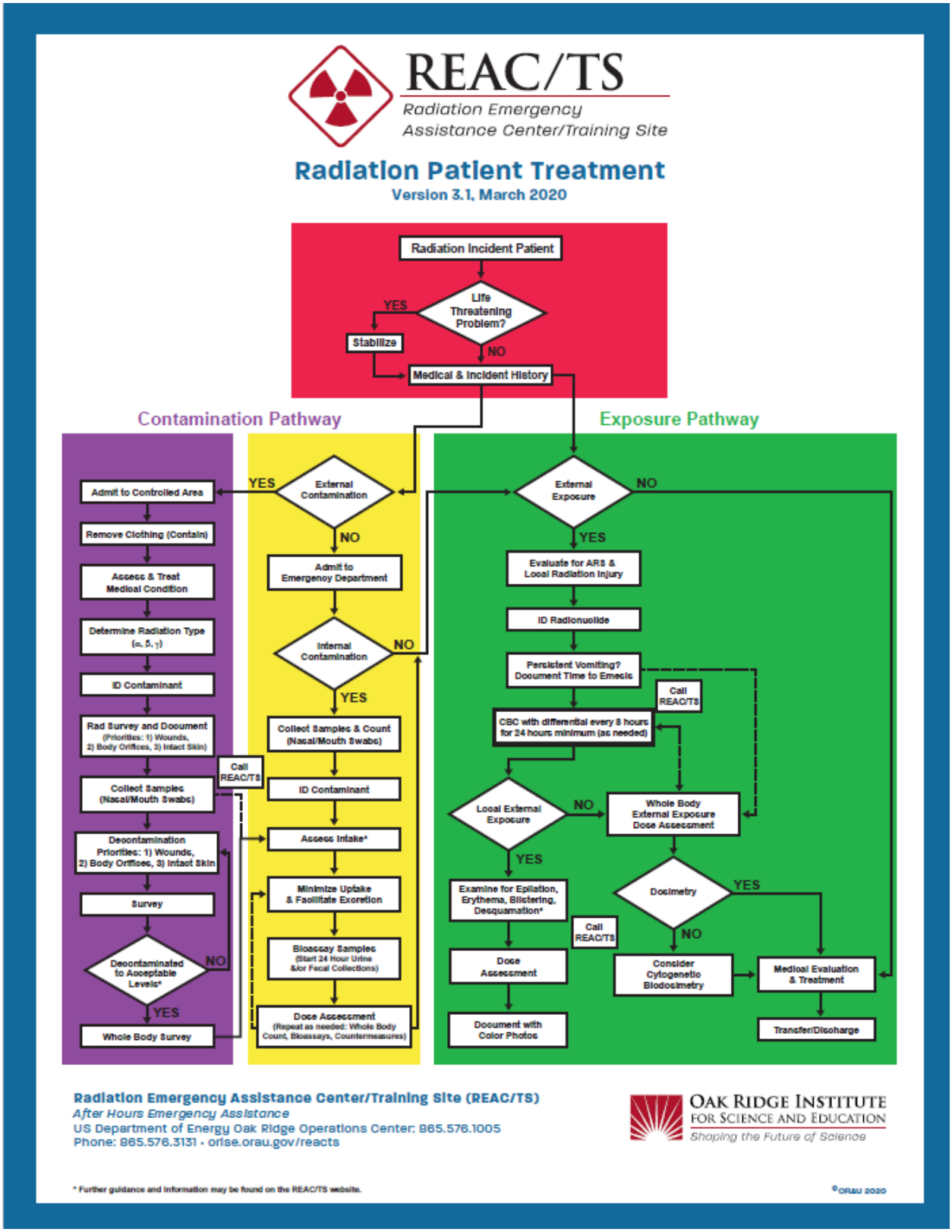
Addendum D


REAC/TS
Radiation Emergency
Assistance Center/Training Site
Radiation Patient Treatment
Version 3.1, March 2020
Radiation Incident Patient
Life Threatening Problem?
YES
Stabilize
NO
Medical & Incident History
Contamination Pathway
Exposure Pathway
External Contamination
YES
Admit to Controlled Area
Remove Clothing (Contain)
Assess & Treat Medical Condition
Determine Radiation Type (α, β, γ)
ID Contaminant
Rad Survey and Document (Priorities: 1) Wounds, 2) Body Orifices, 3) Intact Skin)
Call REAC/TS
Collect Samples (Nasal/Mouth Swabs)
Decontamination Priorities: 1) Wounds, 2) Body Orifices, 3) Intact Skin
Survey
Decontaminated to Acceptable Levels*
NO
YES
Whole Body Survey
NO
Admit to Emergency Department
Internal Contamination
NO
YES
Collect Samples & Count (Nasal/Mouth Swabs)
ID Contaminant
Assess Intake*
Minimize Uptake & Facilitate Excretion
Bioassay Samples (Start 24 Hour Urine &/or Fecal Collections)
Dose Assessment (Repeat as needed: Whole Body Count, Bioassays, Countermeasures)
External Exposure
NO
YES
Evaluate for ARS & Local Radiation Injury
ID Radionuclide
Persistent Vomiting? Document Time to Emesis
Call REAC/TS
CBC with differential every 8 hours for 24 hours minimum (as needed)
Local External Exposure
NO
Whole Body External Exposure Dose Assessment
YES
Examine for Epilation, Erythema, Blistering, Desquamation*
Call REAC/TS
Dose Assessment
Document with Color Photos
Dosimetry
YES
NO
Consider Cytogenetic Biodosimetry
Medical Evaluation & Treatment
Transfer/Discharge
Radiation Emergency Assistance Center/Training Site (REAC/TS)
After Hours Emergency Assistance
US Department of Energy Oak Ridge Operations Center: 865.576.1005
Phone: 865.576.3131 • orise.orau.gov/reacts
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* Further guidance and information may be found on the REAC/TS website.
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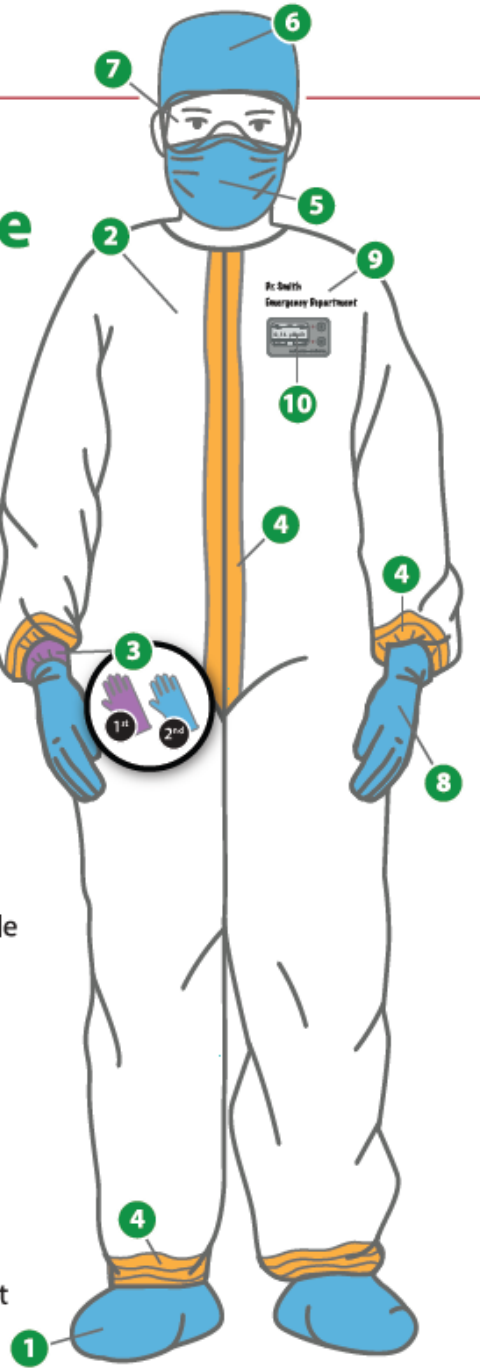
Addendum E

REAC/TS

Radiation Emergency Assistance Center/Training Site

Putting on Protective Clothing (Donning)

1. Shoe Covers.
2. Coveralls or Isolation Gown: At minimum, fully cover torso from neck to knees, arms to ends of wrists. Fasten or secure appropriately.
3. First set of gloves underneath cuff of coveralls or gown.
4. Tape sleeves and trouser cuffs (as applicable). Tape any other potential areas of contaminant entry, such as an uncovered zipper.
5. Face Mask: Secure ties or elastic band. Fit flexible band to bridge of nose and secure below chin.
6. Head Covering.
7. Face Shield or Goggles.
8. Second set of gloves. Extend to cover wrist of coveralls or isolation gown.
9. Identifying Information: Name and role on front and back of protective wear.
10. Dosimeter (if available).



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Addendum F

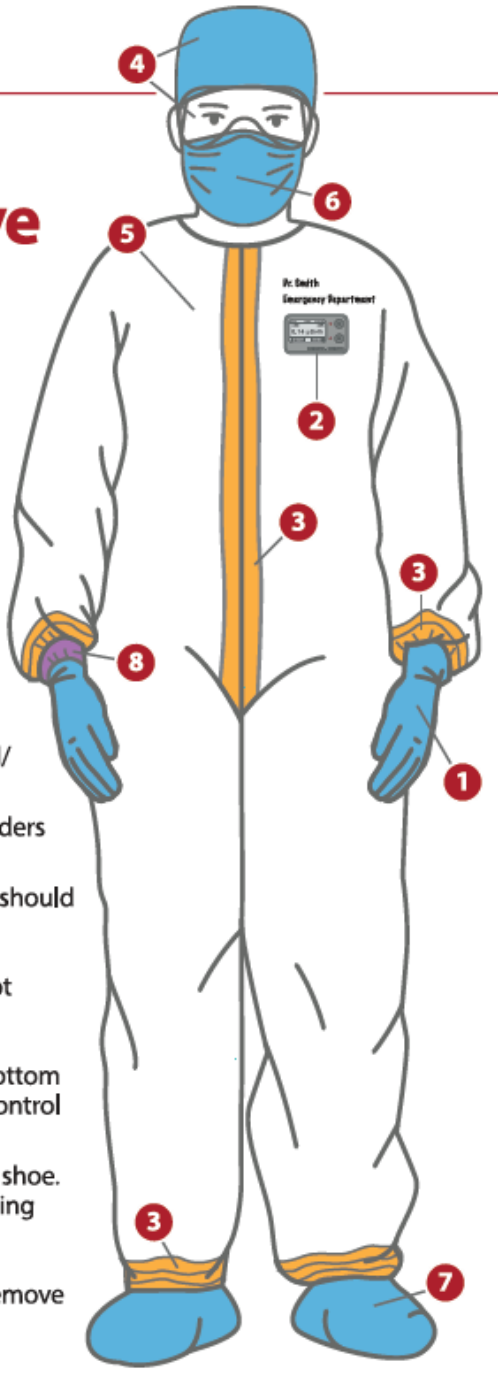
REAC/TS

Radiation Emergency Assistance Center/Training Site

Removing Protective Clothing (Doffing)

The outside of all protective clothing should be considered contaminated.

1. Remove outer gloves, turning them inside out as they are pulled off.
2. Give dosimeter to the control line person.
3. Remove all tape at sleeves, trouser cuffs, and zipper (as applicable).
4. Remove head cover and face shield/goggles, pulling them back and away from the face.
5.
   - Coveralls: Unzip and remove by folding outward/ downward, leaving shoe covers in place
   - Protective Gown: Pull away from the neck/shoulders and remove by turning inside out
   - Only the inside of protective coveralls or gowns should be touched.
6. Remove mask by grasping earpieces or ties. Do not touch the front of the mask.
7.
   - Remove shoe cover from one foot and survey bottom of shoe. If not contaminated, place foot across control line onto step-off area.
   - Remove other shoe cover and survey bottom of shoe. If not contaminated, stand in step-off area, keeping hands inside the control line.
8. While keeping hands inside the controlled area, remove inner gloves and place them in the contaminated trash receptacle.
9. Perform a head-to-toe radiological survey before leaving the step-off area.



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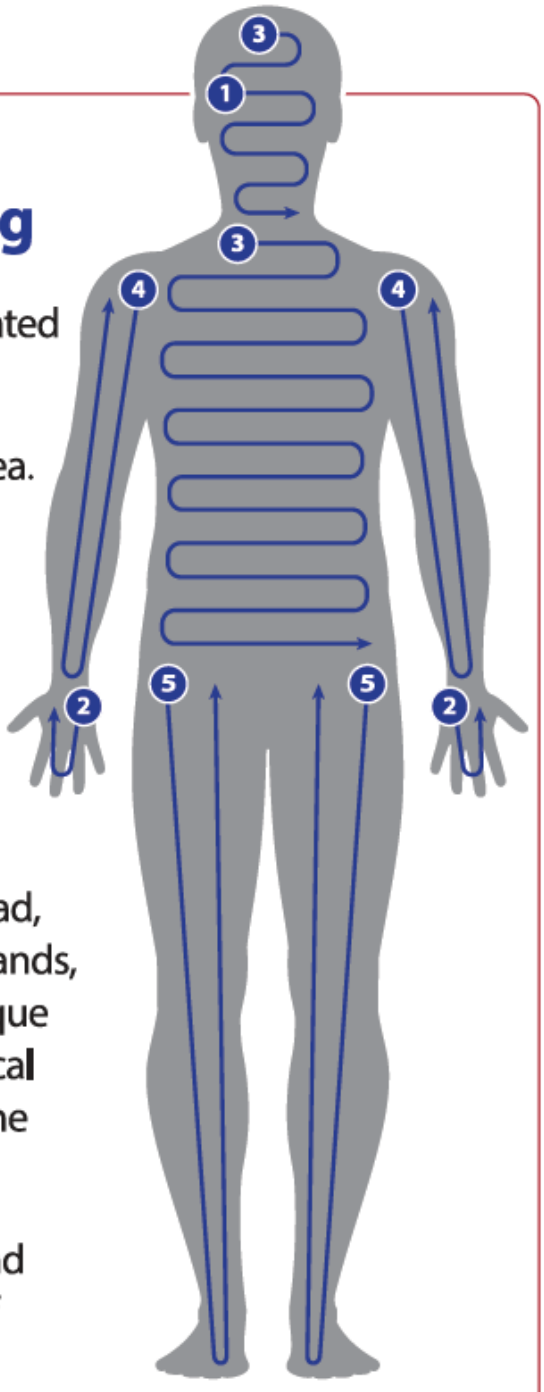
Addendum G

REAC/TS
Radiation Emergency Assistance Center/Training Site

Personnel Monitoring

- Before stepping from contaminated area, survey soles of feet.
- Have person stand in step off area.
- Instruct the person to stand straight, feet spread slightly, arms extended with palms up and fingers straight out.
- Survey 1 face and 2 hands.
- Survey from the 3 top of the head, covering the torso, 4/2 arms/hands, and 5 legs. Good survey technique is essential. Use a slow, methodical technique to monitor 100% of the body surface area.
- Have the person turn around, and repeat the survey on the back of the body.



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Addendum H


REAC/TS
Radiation Emergency Assistance Center/Training Site
Patient Radiological Surveys
1 Radiological Triage Survey
Do not delay medical triage!
Initial rapid survey to assess the hazard:
• Magnitude of contamination
• Areas of contamination
• Remove clothing and place in a plastic bag
2 Assessment Survey
Survey when/where medical status and care allow
1 Wounds
2 Body Orifices
3 Intact Skin
• Document contamination readings
α, β, γ determination
• After decontamination procedures, repeat survey and document
• Thorough whole body survey
3 Final Release Survey
Thorough survey prior to releasing patient from controlled area
• Good Survey Technique
Slow and methodical, monitor 100% body surface area
• Head to toe
5 Survey back of body (stand or log roll)
Prior to discharge, medical and health physics staff should consult on::
• Further evaluation & treatment
• Discharge Instructions & follow-up
Suspected contaminated patient who presents for treatment
Survey priorities once patient is disrobed and initial life threats have been addressed
Final survey once stabilization and decontamination have been completed
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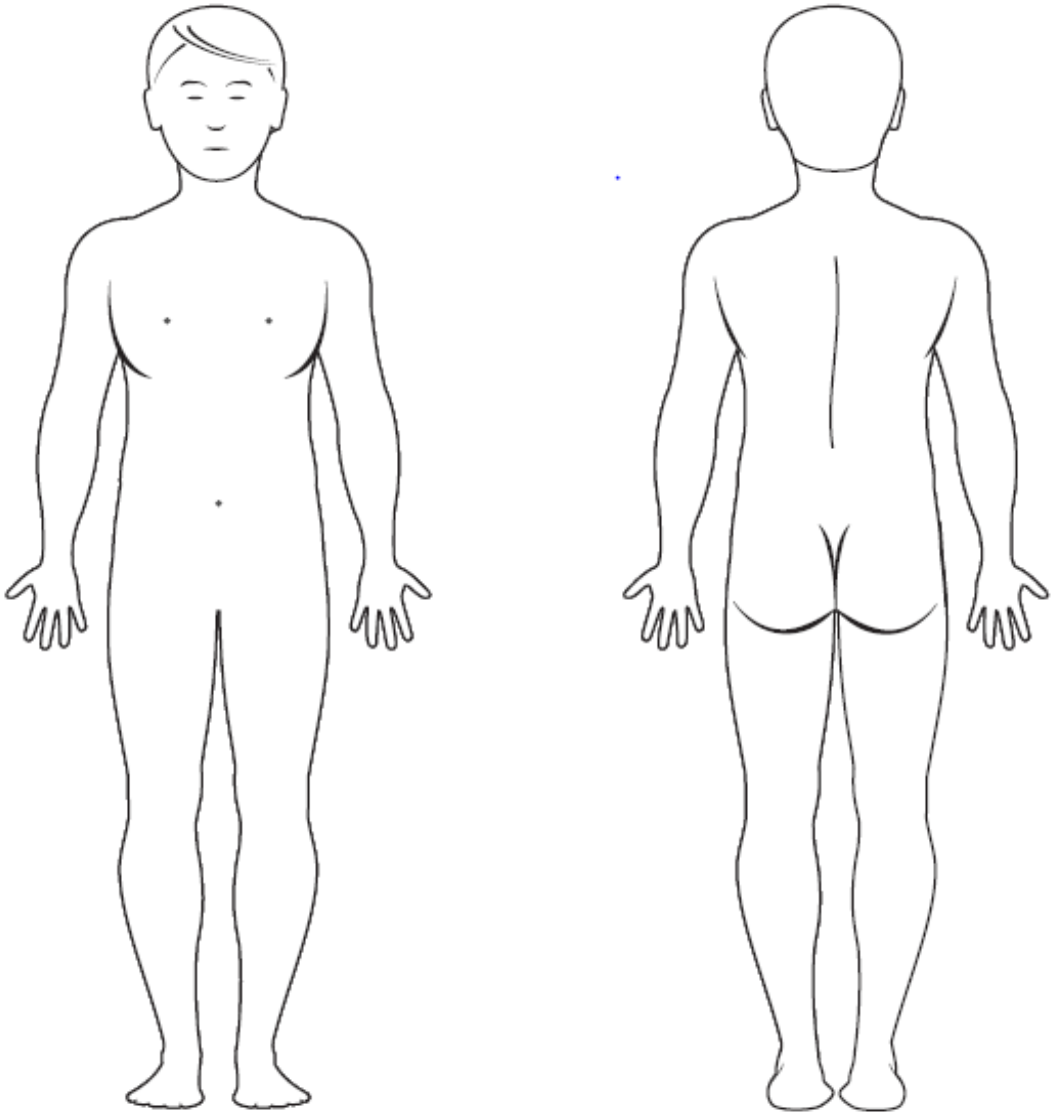
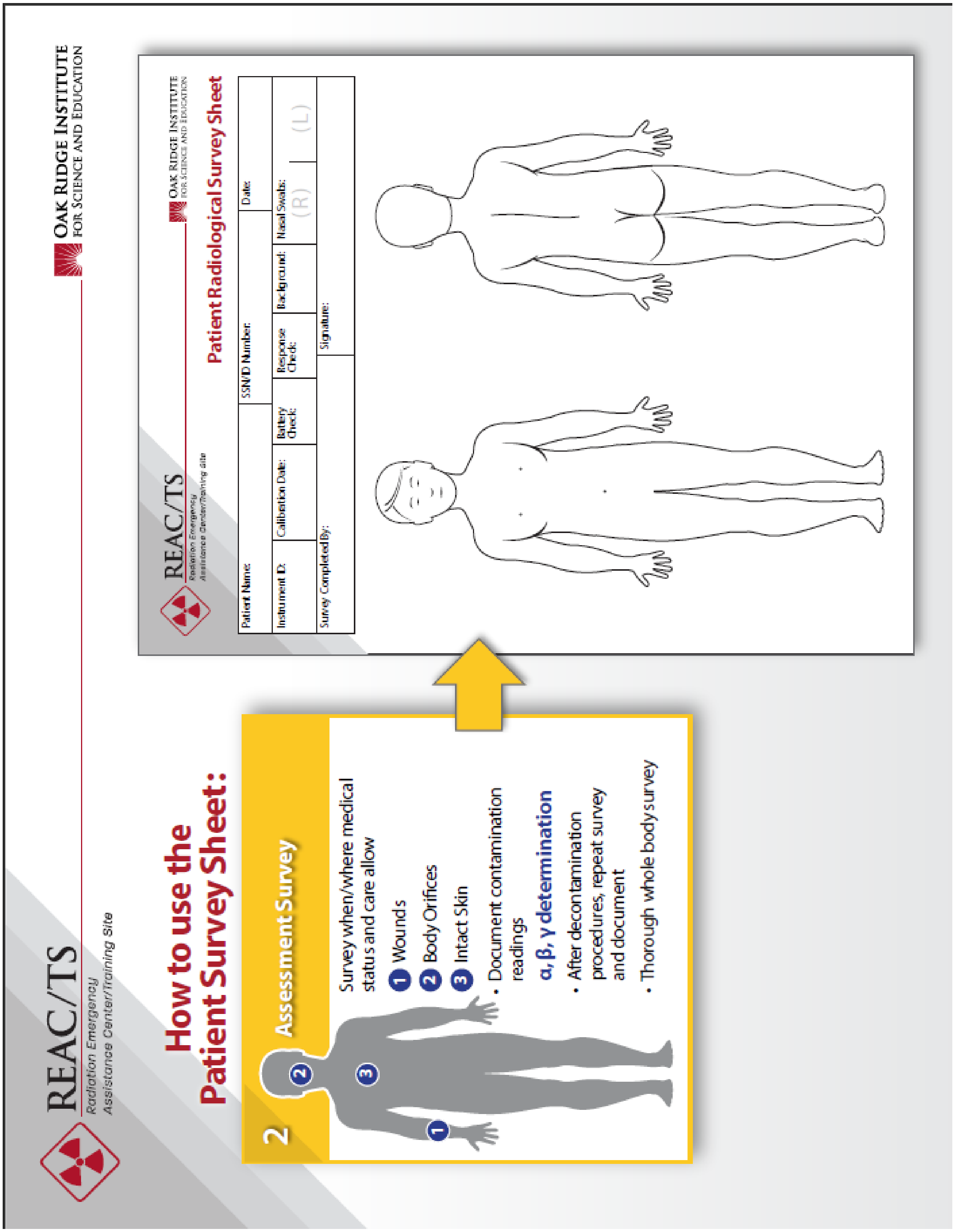
Addendum I

Patient Radiological Survey Sheet

Patient Name:		SSN/ID Number:			Date:
Instrument ID:	Calibration Date:	Battery Check:	Response Check:	Background:	Nasal Swabs: (R) (L)
Survey Completed By:		Signature:			



Addendum J

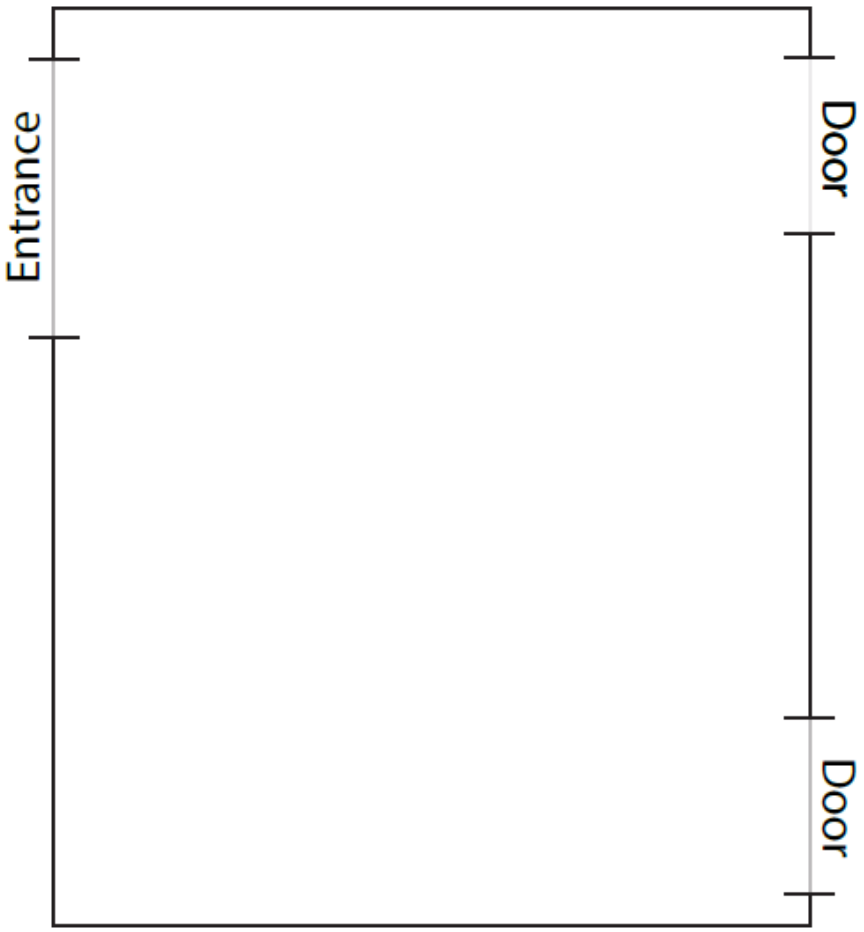

REAC/TS
Radiation Emergency Assistance Center/Training Site
Oak Ridge Institute
for Science and Education
How to use the Patient Survey Sheet:
2 Assessment Survey
Survey when/where medical status and care allow
1 Wounds
2 Body Orifices
3 Intact Skin
Document contamination readings
α, β, γ determination
After decontamination procedures, repeat survey and document
Thorough whole body survey
Patient Radiological Survey Sheet
Patient Name:
SSN/ID Number:
Date:
Instrument ID:
Calibration Date:
Battery Check:
Response Check:
Background:
Nasal Swabs:
(R)
(L)
Survey Completed By:
Signature:

Addendum K

Area Radiological Survey Sheet

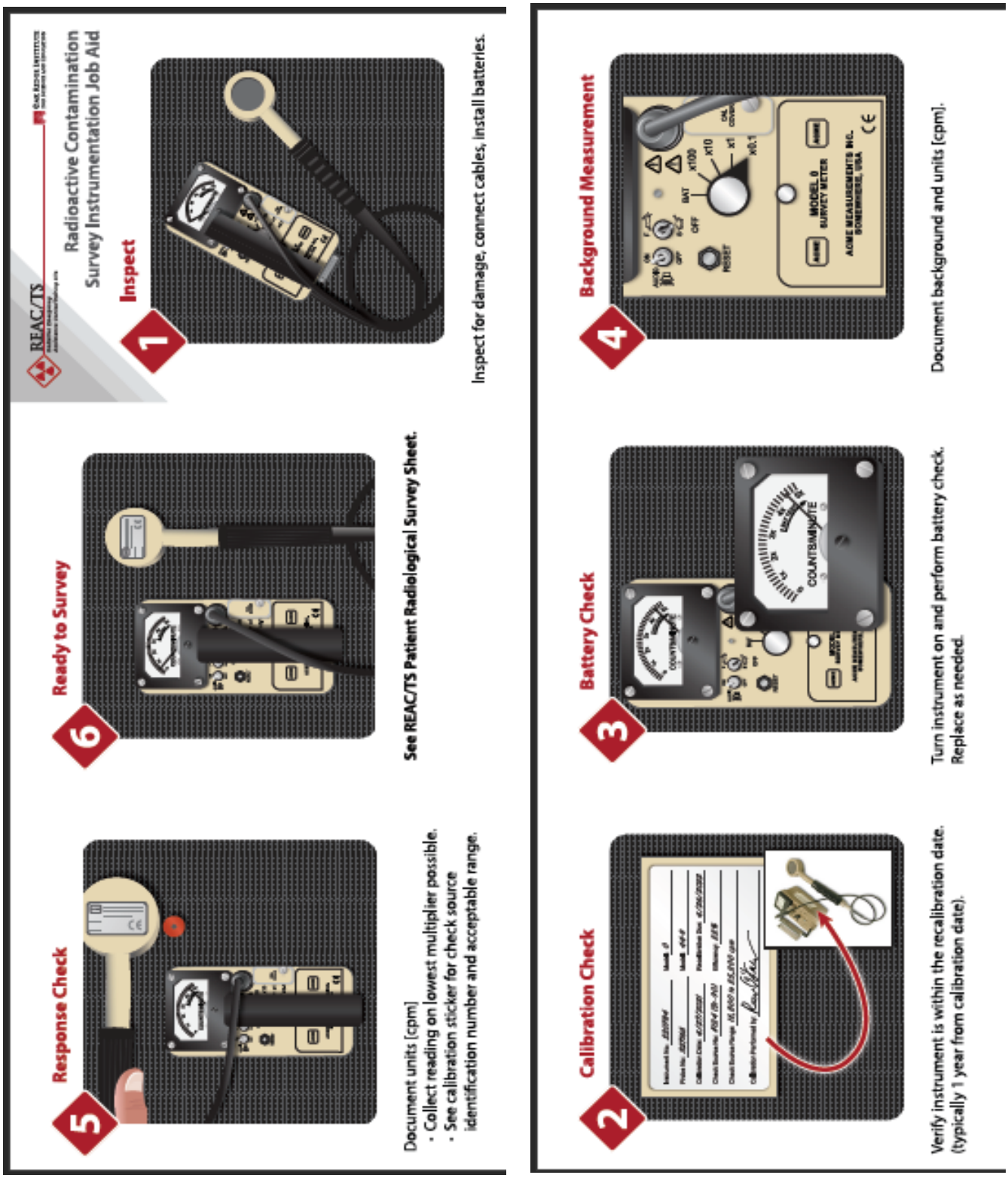
Area(s):				Date:
Instrument ID:	Calibration Date:	Battery Check:	Response Check:	Background:
Survey Completed By:			Signature:	

Perform survey instrument checkout process
Be systematic
Focus on high-touch areas
Document on survey sheet



Comments:

Addendum L


REAC/TS
Radioactive Contamination Survey Instrumentation Job Aid
1
Inspect
Inspect for damage, connect cables, install batteries.
6
Ready to Survey
See REAC/TS Patient Radiological Survey Sheet.
5
Response Check
Document units [cpm]
• Collect reading on lowest multiplier possible.
• See calibration sticker for check source identification number and acceptable range.
4
Background Measurement
Document background and units [cpm].
3
Battery Check
Turn instrument on and perform battery check. Replace as needed.
2
Calibration Check
Verify instrument is within the recalibration date. (typically 1 year from calibration date).

Addendum M

Checklist for Healthcare Personnel

REAC/TS Radiation Emergency Assistance Center/Training Site

24 Hour Number: +1 865-576-1005

CONSIDERATIONS	COMPLETE	REMARKS
See Hospital-Based Radiation Professionals Checklist for data regarding incident history		
Notifications and Assistance: • Activation of hospital emergency incident plan/request for additional personnel and resources • Request for assistance from RSO/Radiation Professionals		
Patient Information: • Number of Patients? • Life-Threatening Injuries (prior stabilization/interventions?) • Exposure v. Contamination (prior decontamination?) • Time to Emesis? • Other Pertinent Patient and Event History?		
EXPOSURE ONLY • PPE and patient placement as any potentially immunocompromised patient • Obtain CBC with differential and review for acute lymphocyte depletion (if s/s persist, repeat every 6-8 hours for 24-48 hours) • Consider Dicentric Chromosome Assay (contact REAC/TS) • Contact REAC/TS for expert consultation: 24-Hour Number: +1 865-576-1005		
CUTANEOUS INJURIES • Evaluate for cutaneous radiation injury (unlikely in short term) May be delayed (contact REAC/TS) Evaluate for conventional burns/wounds		
CONTAMINATION • Admit to controlled radiation area (can be a trauma room/tent or area as needed) • Stabilize life-threatening medical/trauma needs • Remove Clothing ▪ Mitigate spread of contamination by gentle process of removal ▪ Contain and secure clothing ▪ Consider sending contaminated clothing for radioisotope identification • Assess and treat other medical/trauma conditions ▪ Obtain vital signs ▪ IV access/fluid & medications, as needed • Determine radiation type (alpha, beta, gamma/x-ray, neutron) and identify contaminant (if available) ▪ Ask patient, responders, or other authorities		

• Radiation Survey and Documentation ▪ Document in CPM (Counts per Minute) ▪ Survey Order: Wounds, Orifices, Intact Skin • Collect Samples ▪ Nasal and mouth swabs ▪ Retain pertinent negatives and ensure chain of custody (as needed) • Assess internal intake and consider available countermeasures ▪ Survey meter readings, consult with radiation dosimetrist/health physicist ▪ Spot urine sample survey ▪ Begin 24-hour urine and/or fecal bioassay, as needed ▪ Consider whole body scanner		
DECONTAMINATION • Wounds: Standard wound cleaning/irrigation. Assess for foreign objects as appropriate. Consider surgical consult, as appropriate. • Body Orifices: Nose blows, eye irrigation. NO aggressive lavage. • Intact Skin: Do not shave, scrub, or abrade • Hair: shampoo only, NO conditioner • Tent shower decontamination if patient medically stable and mass casualty incident • Criteria to stop decontamination: ▪ Change in medical or trauma status, needing intervention ▪ CPM at two times background or below ▪ Creating further tissue damage ▪ Counts not dropping after appropriate cleaning ▪ Based on health physics/expert consultation		
DISPOSITION OF PATIENT • Admit to hospital ▪ Radiological report to be included in medical hand-off • Discharge to Home ▪ Follow-up instructions for patient/family • Transport to Morgue Consider psychological fears & concerns, monitor & refer as needed		

Expert Consultation: REAC/TS available 24/7: +1 865-576-1005

Addendum N

Checklist for Hospital-Based Radiation Professionals Dealing with a Radiological Incident

REAC/TS Radiation Emergency Assistance Center/Training Site

24 Hour Number: +1 865-576-1005

CONSIDERATIONS	COMPLETE	REMARKS
INCIDENT HISTORY ○ Type of incident: RED, RDD, Dispersal device-no explosion, IND, NPP release, Nuclear Weapon, etc. ○ Radionuclide ○ Activity ○ Exposure only or with Contamination ○ Number of people affected ○ Other hazards-chemicals, etc… ○ ETA for victims ○ How many coming to your hospital		
NOTIFICATIONS REQUIRED ○ Hospital administrators and staff (on and off-shift, regulators, outside agencies requesting assistance) ○ Information available to provide public information officer information about radionuclide from a medical perspective – important for a small scale incident; coordination with joint information center for larger scale incident-notification to public on who should/and should not come to hospital		
Request for additional radiological resources (from where?, how many?, etc.)		
Radiation expertise in the Hospital Emergency Operations Center to aid in communications and decision making		
RADIOLOGICAL INSTRUMENTATION ○ Contamination Survey Instrument (calibration, batteries, operability, background, etc.; ○ Dose Rate meter; ○ Identify where a gamma spectroscopy analysis is available.		
TREATMENT AREA AND PATIENT RECEIVING SETUP ○ Room access controls and control line, ○ Postings/signage, ○ Radiological monitoring supplies ○ Control line		
DECONTAMINATION SUPPLIES AND SETUP ○ Decontamination supplies, ○ Outside triage area, decontamination tents, etc. ○ Alternative clothing for patients after decontamination ○ Additional PPE – especially if incident duration is extended		

Dosimetry (monitoring capability in the treatment areas and/or on staff to measure accumulated dose) so there is adequate follow-up documentation on worker/hospital personnel doses.		
Trained/qualified radiological survey person to assist in treatment areas (posters that cover instrument readings/documentation, surveying patient and personnel, and the job aid above to check out an instrument)		
Just-in-Time briefings for staff to reinforce contamination control techniques and processes being used to limit dose and potential contamination		
Assist with contamination control techniques (good techniques, contain contamination, segregate radiological material- get out of the room and store)		
Documentation of readings		
Rapid Dose Assessment capability to aid in medical management (evaluate external exposure and intake potential to estimate dose); provide advice to health care providers about radionuclide hazard, dose estimations, and potential consequences at the estimated dose		
Follow-up instructions and plan for dealing with whole body counting, bioassay, cytogenetic biodosimetry, etc…		
Radiological Waste management: isolation, storage and disposal		
Not necessarily responsibility of hospital RSO, but someone has to be prepared to deal with potential contamination (survey, decontamination, etc.) of personal vehicles, ambulance, family		
Cleanup, survey, and recovery		

Expert Consultation: REAC/TS available 24/7: +1 865-576-1005

Addendum O

Exposure and Symptom Triage (EAST) Tool to Assess Radiation Exposure after a Nuclear Detonation

Nuclear Detonation Survivor Prioritization for Evacuation / Bone Marrow Cytokines

Source: Hick JL, Bader JL, Coleman CN et al., Dis Med Public Health Prep, 2018;12:386-395.

Clothing/contamination control performed

Acute medical/trauma complaints? (1) — Yes → Refer to medical care area/facility

No

Were located in/transit through damage or fallout zone? — No → Send to support services

Yes

Assess symptoms/data – major predictors listed first (e.g. ALC is best predictor, skin changes unlikely) - base cytokine and evacuation priority on column with ***majority or strongest predictive variables*** (2)

ARS Severity Prediction	**Severe ARS Predicted (>6 Gy)**	**Moderate ARS Predicted**	**Mild ARS Predicted (<2 Gy)**
ALC/lymphocyte single value estimate ($x10^9$) (3)	< 0.7 at 24h < 0.4 at 48h	0.7 – 1.1 at 24h 0.4 – 0.9 at 48h	> 1.1 at 24h > 0.9 at 48h
Vomiting onset (4)	Rapid (within 1h) after exposure	Intermediate (1-4h)	Delayed > 4h
Vomiting (per day) (5)	>6 or worsening with time	Moderate 3-6	1-2 or resolved
IMAAC /official 12-24h estimated dose map (6)	>6 Gy (modify to 2-6 Gy if good shelter for 24h)	2-6 Gy (modify to < 2 Gy if good shelter for 24h)	<2 Gy
Location in damage or fallout zone (non-IMAAC map) first 12-24h	In damage or fallout zone with minimal / no sheltering	In damage/fallout zone with good sheltering (e.g. concrete)	Not in damage/fallout zone according to map
Diarrhea (stools / day)	Severe (>6)	Mild / moderate (<6)	None
Headache (7)	Severe, interferes with activities	Mild/moderate	None/minimal
Fever (unexplained)	High/sustained	Low (< 101F) or resolved	None
Skin (beta) burns (8)	Burns / blisters > 3% BSA	Burns/blisters < 3% BSA	None
Match dominant signs/symptoms in column above to suggested triage category in same column below			
GCSF/myeloid cytokine **priority** (9)	**2** – Possible benefit	**1** – Most benefit	**3** – Unlikely benefit
Evacuation **group** (10)	**2** – Second evacuated	**1** – First evacuated	**3** - Third evacuated

Complicating Medical Conditions / Vulnerability (see note 10)

Adjust evacuation priority to a *higher* color (e.g. yellow up to red) if patient has a condition for which local care is not available and that could deteriorate within 48h putting the patient at risk including but not limited to:

- Diabetes
- Dialysis / End Stage Renal Disease
- CHF (Congestive Heart Failure)
- Pregnancy
- Immunosuppression (e.g. AIDS, taking steroids/transplant meds, recent chemo)
- Severe Respiratory Disease (e.g. Asthma, COPD with disability, requiring oxygen, or daily symptoms)
- Vulnerable / at risk in current environment (e.g. pediatric, disability)

Myeloid cytokine (GCSF/other) administration (record dose/time) according to priority/availability (11)

Support – referral to resources for evacuation and basic needs coordination (12)

End notes – turn over

Goal: Initial rapid triage of persons with radiation exposure (no/limited injury) to prioritize them for evacuation/ myeloid cytokine administration as not enough capacity in system to provide for all survivors
Setting: Assembly center or screening location in **resource-poor** environment after a nuclear detonation.
Process: Screen patients from highest to lowest precision predictors of ARS and assign priority. This tool is an imprecise guide and should not substitute for expert clinical and radiologic opinion when available. Use of serial ALC values for screening is optimal and should be instituted as soon as blood counts can be performed.
Outcome: One or combination of:

- Triage to acute medical care (depending on situation/severity of condition may have on-site resources to provide care or have to refer to another facility/location)
- Refer to myeloid cytokine administration/other medical support (may be co-located or separate)
- Assign priority for evacuation to area with adequate medical resources
- Refer to shelter/basic needs support

Endnotes:

1. Medical/trauma symptoms that preclude completion of assessment process. Consider oral anti-nausea/anti-diarrhea medications as needed without medical care (MC) referral during and post-assessment. Persons referred to MC may be treated and referred back for assessment or assessed in medical care area/hospital. Combined trauma/radiation injuries should be assessed by physician as worse prognosis when significant combined injury.
2. This tool is ONLY for use in severely resource-constrained environments. In areas with appropriate resources standard assessment tools (BAT, etc.) should be used. (see https://remm.hhs.gov/newptinteract.htm#skip)
3. Single values of ALC to predict dose are not precise. Obtain serial values as soon as possible. Use formulas and nomograms even for single values as accuracy is best when the time is precise (see link). Time is start of exposure began (e.g. fallout) NOT detonation (https://remm.hhs.gov/ars_wbd.htm#ldk_section)
4. Vomiting may be due to psychogenic or traumatic effects and time to onset may depend on fallout variables and NOT detonation time. Thus, caution is required when interpreting time to onset.
5. Vomiting can cause irritation of the stomach and other factors that can make the vomiting continue despite a relatively low radiation exposure. Thus, vomiting should be assessed in light of other signs and response to any medical treatment already provided.
6. In damage or dangerous fallout zone during first 12-24 h per IMAAC or other official mapping. Exposure likely significantly less than IMAAC predicted values if good quality (concrete / steel) sheltering for 24h
7. Headaches (HA) can be due to many things including lack of sleep, stress, trauma, and other factors. However, a severe HA in conjunction with other symptoms is likely radiation-related.
8. Radiation related burns occur from direct contact with highly radioactive fallout particles or flash burns from t he initial explosion. Absence of skin changes does *not* have predictive value but the presence of skin burns, sloughing, or blistering that is **not** due to thermal burns is a poor prognostic indicator. Estimate 1% body area as the size of the patient's palm.
9. Myeloid cytokines (e.g. GCSF) may not be available in a quantity sufficient for treating all candidates. Priori ty reflects degree of benefit based on prognosis. Refer to scarce resource triage tool for further information (see https://remm.hhs.gov/triagetool_intro.htm)
10. Evacuation priority is based on prognosis as well as resource demands and assumes that medical care in the area is inadequate. Higher priority for evacuation (e.g. yellow patient moves up to red group) may be assigned if underlying medical conditions could be potentially life-threatening if untreated for > 2d. Vulner able adults, pregnant women, or children at risk in current environment may also receive higher priori ty for evacuation. In some cases, experienced providers may *lower* the evacuation priority based on low ch ance of survival in which case palliative care and scheduled re-evaluation and re-triage should be provided
11. Myeloid cytokine administration may be co-located with other assembly center functions or located at another site. Administration should be tracked – both on a card that remains with the victim and in a retainable/sharable database.
12. Support functions should include re-unification/communication support, shelter and basic needs facilitation, facilitation of evacuation, and provision/referral for mental health and medical services. Some of these may be co-located at the assembly center and others at separate sites.

Addendum P

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

IMPORTANT CONSIDERATIONS

- Co-morbidities may alter survival and may be considered if resources are limited.
- If cytokines are not available, consider antimicrobials.
- Time zero is time exposure BEGAN and second time is time when blood is drawn.
- If patient has >2Gy estimated rad. dose with combined injuries (>20% Total Body Surface Area) see Figure 2 in Trauma & Combined Injury by Coleman, C. N., et. al. in link below.
- Patients with >6 Gy exposure should receive cytokines if there are supplies available.
- Dose reconstruction has many complicating factors; in particular when to start counting exposure time, calculation of handling gaps in exposure (i.e. due to sheltering in place), patient location at time of detonation and the dose rate along the patients path through contaminated areas (for more information see https://www.remm.nlm.gov/dosereconstruction.htm).
- 24, 96, 192 hours radiation dose estimates from Medical Management of ARS by Waselenko, J. K. et. al. see Comments.

COMMENTS

- Trauma & Combined Injury (radiation + burn/trauma) considerations: Coleman, C. N., et. al. (2011). Triage and treatment tools for use in a scarce resources-crisis standards of care setting after a nuclear detonation. DMPHP, 5(S1), S111-S121. https://ritn.net/workarea/downloadasset.aspx?id=2147484335
- **FDA Inserts** for additional details related to pediatrics, pregnancy, storage, and adverse event information (dosing for H-ARS determined based on the Animal Rule):
  - **Filgrastim:** https://www.accessdata.fda.gov/drugsatfda_docs/label/2016/103353s5188.pdf
  - **Pegfilgrastim:** https://www.accessdata.fda.gov/drugsatfda_docs/label/2015/125031s180lbl.pdf
  - **Sargramostim:** https://www.accessdata.fda.gov/drugsatfda_docs/label/2018/103362s5240lbl.pdf
- REMM dose estimator from absolute lymphocyte count or time to vomiting. https://www.remm.nlm.gov/ars_wbd.htm
- For alternative triage system: Hick JL, et. al.. Proposed "Exposure And Symptom Triage" (EAST) Tool to Assess Radiation Exposure After a Nuclear Detonation. DMPHP. 2018 Jun;12(3):386-395. https://www.remm.nlm.gov/EAST-tool-notes.htm
- Radiation dose estimates. Waselenko, J. K., et. al.. (2004). Medical management of the acute radiation syndrome: recommendations of the Strategic National Stockpile Radiation Working Group. Annals of internal medicine, 140(12), 1037-1051. https://ritn.net/workarea/downloadasset.aspx?id=2147483832

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