

Health Guidance:

Management in a Hospital Setting of Persons Contaminated With Radioactive Material and Exposed to Radiation Following a Dirty Bomb Explosion – 2013

October 2, 2013

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<http://health.mo.gov/emergencies/ert/alertsadvories/index.php>

The Missouri Department of Health & Senior Services (DHSS) is now using 4 types of documents to provide important information to medical and public health professionals, and to other interested persons:

Health Alerts convey information of the highest level of importance which warrants immediate action or attention from Missouri health providers, emergency responders, public health agencies, and/or the public.

Health Advisories provide important information for a specific incident or situation, including that impacting neighboring states; may not require immediate action.

Health Guidances contain comprehensive information pertaining to a particular disease or condition, and include recommendations, guidelines, etc. endorsed by DHSS.

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SUBJECT: Management in a Hospital Setting of Persons Contaminated With Radioactive Material and Exposed to Radiation Following a Dirty Bomb Explosion – 2013

In 2007, the Missouri Department of Health and Senior Services (DHSS) issued a Health Guidance document to remind hospitals and hospital staff of the need to be prepared, following a dirty bomb explosion, to triage, decontaminate, clinically evaluate, and (as necessary) treat persons exposed to significant levels of radiation and/or contaminated with radioactive material. The document also provided information and recommendations that hospitals and other medical facilities could utilize as they developed or updated their emergency response plans and trained their staff. Since that time, new information and guidance have become available. The purpose of this new Health Guidance document is to provide awareness of these new resources, as well as to again present a summary of certain key issues that medical facilities and providers must be prepared to immediately address should a dirty bomb explosion occur in their area. Note that much of the information and guidance contained here would also be relevant to the management of persons affected by other types of radiation events (e.g., industrial or transportation accidents), who could present to medical facilities with little or no warning.

Medical facilities and providers should particularly be aware of two important sources of clinical information and guidance on managing contaminated and/or exposed persons following a radiation event:

- **Radiation Emergency Medical Management (REMM)**, a comprehensive clinical tool from the U.S. Department of Health and Human Services. (<http://www.remm.nlm.gov/>)
- **Radiation Emergency Assistance Center/Training Site (REAC/TS)**, a radiation emergency medical response asset of the U.S. Department of Energy/National Nuclear Security Administration. (<http://orise.orau.gov/reacts/>.) One of the tools developed by REAC/TS is a 57-page handbook entitled "The Medical Aspects of Radiation Incidents." It provides information and guidance for the medical management of victims of radiation incidents. (<http://orise.orau.gov/files/reacts/medical-aspects-of-radiation-incidents.pdf>.)

Reference to specific sections of these materials will be made throughout the remainder of this Health Guidance.

Medical facilities and providers should also be aware that **expert medical consultation on the management of victims of radiation events is available 24/7 from REAC/TS**. Their emergency number is **865-576-1005**.

One of the weapons that could be utilized by terrorists is an explosive radiological dispersal device (RDD), also known as a dirty bomb. A dirty bomb is a mix of explosives with radioactive powder or pellets. When the explosives are set off, the blast carries radioactive material into the surrounding area, which might encompass many square miles.

The main immediate danger is from the explosion, which can result in serious injuries and deaths. The radioactive material used in a dirty bomb will probably not create enough radiation exposure to cause immediate illness (i.e., acute radiation syndrome, or ARS),

except perhaps in some persons who were very close to the blast site. However, the radioactive dust and smoke, which spread farther away, could present risks to long-term health if internal contamination occurs through inhalation or ingestion of radioactive material, or through entry of radioactive material into the body through non-intact skin, including injuries with radioactive shrapnel.

Following the explosion of a dirty bomb:

1. **All hospitals in the area of the event must be prepared to receive patients with external (and potentially internal) radioactive contamination. Some of these individuals may also have traumatic and/or burn injuries (possibly severe) related to the explosion. And some persons who were very near the explosion may have received enough external radiation exposure to cause them to develop ARS.**

In addition, many other concerned individuals who are uninjured and who did not receive significant external radiation exposure will likely be presenting for evaluation. Some of these persons may have external (and potentially internal) contamination with radioactive material.

Information and guidance on preparing a medical facility to receive patients from a radiological incident are found in a section of the REMM tool entitled “Hospital Activities,” available online at <http://www.remm.nlm.gov/hospitalprep.htm> (note the links to additional information sources).

Other medical facilities in the area of the event (e.g., urgent care centers, physicians’ offices, outpatient clinics) could have affected persons present for evaluation and care.

Hospitals and other medical facilities outside the immediate area may also be seeing victims from the event. Examples could include injured persons who are transferred to more distant hospitals because hospitals closer to the incident are full, or persons with no or minor injuries who have transported themselves out of the area of the event before seeking medical evaluation and care.

Additional points:

- a. **Very Important: If immediate action is not taken to secure those facilities to which contaminated persons will be presenting, these facilities can very quickly become contaminated (or further contaminated) with radioactive material.**

Note that if evidence of radioactive contamination is discovered inside a facility, such contamination can be effectively managed, and will not require evacuation of the facility. For further guidance, see <http://www.remm.nlm.gov/hospitalprep.htm#areas>.

- b. A **triage/decontamination area** separate from the emergency department should be immediately set up for accepting persons affected by the event (who may present in considerable numbers). Here facility staff can rapidly screen/triage victims for injury, radiation exposure, and radioactive contamination. Decontamination (removal of contaminants) can take place if evidence of external contamination is found. Information on decontamination is available in the REMM tool at http://remm.nlm.gov/ext_contamination.htm.
 - c. Caregivers should use **appropriate personal protective equipment (PPE)** when handling contaminated victims, and gloves should be changed frequently to avoid cross contamination. See the REMM tool for more information at http://www.remm.nlm.gov/radiation_ppe.htm#firstreceiver.
 - d. Hospitals must ensure that the triage process has an efficient **record-keeping system**. Contact information should be recorded for all potentially affected persons so that they can, if necessary, be reached later to arrange further evaluation.
2. The **basic management of a person with external/internal radioactive contamination and/or significant radiation exposure** is summarized in an algorithm from REAC/TS, available at <http://orise.orau.gov/files/reacts/radiation-patient-treatment-algorithm.pdf>. Note that this algorithm provides a general overview. In a specific situation, particularly if there are significant numbers of potentially affected persons presenting for evaluation and care, the availability of resources (e.g., personnel, space,

laboratory capacity, etc.) as well as other factors related to the event will have to be taken into consideration in determining precisely how patient management will take place. If large numbers of potentially affected persons are presenting, detailed evaluation of all individuals may not be possible in the immediate period following the event. Here priority should be given to those who are most likely to have significant radiation exposure and/or radioactive contamination.

3. **All seriously injured patients (and patients with other life-threatening medical conditions) should be medically stabilized before radiation exposure/contamination and decontamination are considered.**

While the patient is being stabilized, appropriate steps should be taken to prevent contamination of medical staff and the area where this initial treatment is taking place. See the REMM tool at <http://www.remm.nlm.gov/hospitalprep.htm>, and at http://www.remm.nlm.gov/radiation_ppe.htm#firstreceiver.

It is important to remember that “radiologically contaminated patients generally pose no danger to health care personnel. It is virtually impossible for a living patient to be so contaminated as to pose an acute threat to health care providers. (REAC/TS. *The Medical Aspects of Radiation Incidents*, page 34.)

“The radiation exposure hazard from a radiologically contaminated casualty will very likely be negligible, so **necessary medical or surgical treatment must not be delayed because of possible contamination. The initial management of a casualty contaminated by radioactive materials is to perform all immediate life/limbsaving actions without regard to contamination. Decontamination should never interfere with medical care and contaminated casualties should not be barred entry to a medical facility if entry is necessary for life-saving care.**” (REAC/TS. *The Medical Aspects of Radiation Incidents*, page 34.)

Information and guidance from the Centers for Disease Control and Prevention (CDC) on managing traumatic injuries caused by bombs is available at <http://emergency.cdc.gov/HAN/han00346.asp>.

4. **Comprehensive information and guidance on the clinical management of victims of radiation events (including a tool to calculate the estimated radiation dose an individual has received) are available in the REMM tool at <http://www.remm.nlm.gov/newptinteract.htm#skip>.**

Additional clinical guidance for medical professionals and facilities in managing victims of radiation emergencies is available in the REAC/TS handbook (*The Medical Aspects of Radiation Incidents*), available at <http://orise.orau.gov/files/reacts/medical-aspects-of-radiation-incidents.pdf>. More information is found on REAC/TS’ website at <http://orise.orau.gov/reacts/guide/care.htm>.

The REMM tool contains an example of medical orders for adult and pediatric patients at <http://www.remm.nlm.gov/adultorderform.htm>. Note that such orders will need to be modified based on the specific situation, including the nature of the event, the number of persons affected, and the amount of resources available.

Radiation experts at REAC/TS can provide medical consultation on the management of victims of radiation events. Their 24/7 emergency number is 865-576-1005.

5. In most cases, **external contamination** with radioactive material can be readily detected with radiation survey instruments and readily removed. Decontamination can be accomplished by removal of the victim’s clothing and thorough, careful washing with warm water and soap, followed by a radiation survey to determine if the washing procedure was sufficiently effective.

Except for victims with serious injuries (or other life-threatening medical conditions) who require immediate emergency care, decontamination should be accomplished prior to admission to the emergency department. As mentioned above, information on decontamination is available in the REMM tool at http://remm.nlm.gov/ext_contamination.htm. An additional reference is “Section 6 – Decontamination Techniques” in *The Medical Aspects of Radiation Incidents* (REAC/TS), available at <http://orise.orau.gov/files/reacts/medical-aspects-of-radiation-incidents.pdf>.

In situations where very large numbers of persons are presenting to a medical facility for evaluation, and resources for mass decontamination are not available or are being overwhelmed, it may become necessary, after discussing the situation with local emergency response officials, to instruct those who are uninjured and asymptomatic, but potentially contaminated, to go home, remove and bag their clothes, and carefully shower with warm water and soap. (Instructions for these individuals are available in the REMM tool at http://www.remm.nlm.gov/followup_1.pdf.) These persons can then listen to local TV or radio stations for recommendations from public health officials on any further steps that may be necessary. For example, they may be instructed to go to a Community Reception Center (see below) for further evaluation.

6. **Internal contamination** can occur when persons inhale or ingest radioactive material, or when radioactive material is able to enter the body through non-intact skin, including injuries with radioactive shrapnel. Externally contaminated casualties who did not have respiratory protection should be evaluated for possible internal contamination. Internal contamination is more likely if significant external contamination is found on the face, in/around the nostrils or mouth, or in/around open wounds. Guidance for assessing and managing internal contamination is available in the REMM tool, and particularly in the patient management algorithms for contaminated patients; see <http://www.remm.nlm.gov/patientmanagement.htm>. See also “Section 5 – Medical Management of Internally Deposited Radionuclides” in *The Medical Aspects of Radiation Incidents (REAC/TS)* at <http://orise.orau.gov/files/reacts/medical-aspects-of-radiation-incident.pdf>. Note that if a patient is suspected of having significant levels of internal contamination, early intervention may be required to prevent radionuclides from being incorporated into critical organs, since this may subsequently lead to serious health effects.

The nature and extent of the evaluation that can be performed initially on a given individual will depend on several factors, including the availability of resources and the number of other persons requiring evaluation and care. In a situation with large numbers of potentially affected persons, detailed evaluation of all individuals may not be possible in the immediate period following the event. Here priority should be given to those who are most likely to have significant internal contamination.

Supplies of medical countermeasures (e.g., Ca-DTPA, Zn-DTPA, Prussian blue) which can be used to treat persons with significant internal contamination with certain radionuclides are available in the Strategic National Stockpile (SNS). In addition, the SNS contains certain cytokines/growth factors that can be used in the treatment of persons experiencing the hematological effects of significant acute radiation exposure. These medications will, if necessary, be made available to medical providers by public health officials.

Following a dirty bomb explosion, large numbers of persons could potentially be contaminated (externally, and possibly internally) with radioactive material. In this situation, medical facilities in the area will probably not have the ability to evaluate all of these individuals for radioactive contamination. Instead, for many of these persons, this evaluation will likely be performed at one or more **Community Reception Centers (CRCs)**, which will be set up by public health officials and others groups within one to two days of the initial event at an appropriate location(s) within the community.

CRCs are population monitoring and decontamination sites which can assess people for:

- a) External contamination (using hand-held radiation survey instruments, and possibly beta/gamma portal monitors). Decontamination will be provided to those found to be externally contaminated.
- b) Radiation exposure and the need for bioassay. Depending on the CRC’s capabilities, clinical specimens (i.e., blood) may be collected from persons with evidence of possibly significant acute radiation exposure and risk for ARS.
- c) Internal contamination and the need for bioassay. For certain radioactive isotopes (i.e., gamma emitters), internal contamination may be detectable with hand-held radiation monitoring devices used by CRC staff. Also, depending on the CRC’s capabilities, clinical specimens (i.e., urine) may be collected from persons with evidence of possibly significant internal contamination.
- d) Need for additional evaluation and treatment/medical care, psychosocial services, and/or long-term follow-up. Referrals will be made as necessary.

CRC staff will be able to answer questions, and provide information and instructions, to all persons who present. More information on CRCs is available at <http://www.ora.gov/rsb/vcrc/>.

7. As mentioned previously, the radioactive material in a dirty bomb will probably not create enough radiation exposure to cause **acute radiation-induced illness (i.e., ARS)**, except possibly in some persons who were very close to the site of the explosion. A basic approach to immediate medical management of a patient who may have received a significant acute radiation exposure is summarized in the REAC/TS algorithm at <http://orise.ora.gov/files/reacts/radiation-patient-treatment-algorithm.pdf>. More information on clinical management is available in the REMM tool (see especially the patient management algorithms for patients with exposure) at <http://www.remm.nlm.gov/patientmanagement.htm>. Additional references are “Section 3 – Acute Radiation Syndrome” and “Section 7 – Biodosimetry” in *The Medical Aspects of Radiation Incidents (REAC/TS)*, available at <http://orise.ora.gov/files/reacts/medical-aspects-of-radiation-incidents.pdf>. See also “Acute Radiation Syndrome: A Fact Sheet for Clinicians” from CDC at <http://www.bt.cdc.gov/radiation/arsphysicianfactsheet.asp>.
8. **Psychological counseling** should be available. Addressing the psychological effects of the event on victims (including concerns about exposure to radiation) must be an integral part of patient management. In addition, responders and health care providers may experience adverse psychological reactions, and these must also be appropriately addressed. See “Section 9 – Psychological Support and Risk” in *The Medical Aspects of Radiation Incidents (REAC/TS)* at <http://orise.ora.gov/files/reacts/medical-aspects-of-radiation-incidents.pdf>. In addition, CDC has developed a web-based training entitled “Psychological First Aid in Radiation Disasters,” available at http://www2a.cdc.gov/TCEOnline/registration/detailpage.asp?res_id=2490.
9. Anticipate the need to **provide transport or shelter** to persons who do not require immediate medical care following triage/decontamination.

Additional Points

- In planning for, and responding to, radiological events, hospitals should always make full use of their own staff members who have radiation expertise (i.e., those who work in radiology and radiation oncology).
- Some hospitals establish an arrangement with the local fire department to have the latter provide assistance with radiation detection and/or decontamination. If such an arrangement is in place, the hospital should have a back-up plan in case (particularly in a large event) all fire department resources are tied up at/near the scene of the incident, and thus are unable to assist the facility.
- It should be remembered that it will be hours before any state assets arrive, and probably at least 12 hours and possibly longer before initial federal assets begin to appear. During this period, facilities must use local resources in their response.
- It is important to emphasize that people tend to be frightened of radiation, and this is as true of healthcare workers and other hospital employees as it is of the general public. If hospital staff members (both clinical and non-clinical) do not have a proper understanding of radiation, and the fact that the hospital’s response to a radiological event can proceed without placing them personally at risk, many of these individuals may not report to work because of concerns about their own safety or that of their families. Consequently, when a facility conducts trainings and exercises on radiation events, it is crucial to involve not only clinical staff but also non-clinical personnel (e.g., maintenance, janitorial, food service, security, logistics/supply, and other workers) whose presence during a major event would be essential for the hospital to function.

Useful resources providing information and guidance for medical providers and facilities include:

1. **Radiation Emergency Medical Management (REMM)** is a tool from the U.S. Department of Health and Human Services (HHS) which was developed to provide comprehensive guidance for medical care providers on the clinical diagnosis and treatment of radiation injury during radiological and nuclear emergencies. It can be

accessed online at <http://www.remm.nlm.gov/index.html>. In addition, it can be downloaded onto a computer hard drive or portable storage device (e.g., a flash drive), and an abbreviated mobile version is available for devices such as cell phones.

It is highly recommended that all medical facilities have downloaded copies of REMM on computer hard drives (or portable storage devices) in the emergency department and other appropriate locations within the facility in case access to the Internet is lost and the tool cannot be viewed online.

2. ***The Medical Aspects of Radiation Incidents*** is a 56-page handbook from the Radiation Emergency Assistance Center/Training Site (REAC/TS), a response asset of the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA). This handbook provides clinically-oriented information and guidance for the medical management of victims of radiation incidents. It is available in PDF format at <http://orise.orau.gov/files/reacts/medical-aspects-of-radiation-incident.pdf>. Note that the first section summarizes basic radiation concepts.

As with the REMM tool, it is highly recommended that all facilities have downloaded copies of this handbook on computer hard drives (or portable storage devices) in the emergency department and other locations.

3. **REAC/TS** website (<http://orise.orau.gov/reacts/>) contains a large amount of information and guidance for clinicians and medical facilities on managing victims of a radiation event. In particular, see:
 - Managing Radiation Emergencies - Guidance for Hospital Medical Management <http://orise.orau.gov/reacts/guide/care.htm>
 - Hospital Triage in the First 24 Hours after a Nuclear or Radiological Disaster <http://orise.orau.gov/reacts/resources/hospital-triage.aspx>
 - REAC/TS Resources <http://orise.orau.gov/reacts/resources/default.aspx>
4. CDC has developed a “**Tool Kit for Emergency Services Clinicians**” on radiological terrorism, which is available at <http://www.bt.cdc.gov/radiation/clinicians.asp#toolkit>. Included here is a **Just in Time Training for Hospital Clinicians** video, available at <http://www.bt.cdc.gov/radiation/justintime.asp>.
5. A very informative review article entitled “**Medical Response to a Major Radiologic Emergency: A Primer for Medical and Public Health Practitioners**” was published in *Radiology* in 2010, and is available at <http://radiology.rsna.org/content/254/3/660.full.pdf+html>.
6. **Radiological Dispersal Device Playbook** is a document from HHS for federal decision makers. The Introduction section, at <http://www.phe.gov/Preparedness/planning/playbooks/rdd/Pages/intro.aspx>, contains a helpful overview of the general response to a dirty bomb event.
7. Links to comprehensive information and guidance for medical providers and facilities on radiological/nuclear events and the medical management of victims are available from the Missouri Department of Health and Senior Services (DHSS) at <http://health.mo.gov/emergencies/ert/nucmed.php>.

The information provided in this document has primarily been directed at medical facilities and their clinical staff. **Specific resources and guidance for pre-hospital settings/first responders** are also available, including:

1. Information for Emergency Responders (CDC) http://www.bt.cdc.gov/radiation/first_responders.asp
2. Managing Radiation Emergencies: Guidance for Prehospital Emergency Services (REAC/TS) <http://orise.orau.gov/reacts/guide/manage.htm>
3. *Handbook for Responding to a Radiological Dispersal Device: First Responder’s Guide – the First 12 Hours* Conference of Radiation Control Program Directors (CRCPD) http://www.crcpd.org/RDD_Handbook/RDD-Handbook-ForWeb.pdf

On-scene responders should not send uninjured persons with no signs/symptoms of ARS (e.g., nausea/vomiting) or other significant medical problems to hospitals. Individuals who are only externally contaminated, and not injured and with no evidence of ARS or other significant illness, should be decontaminated at a location other than a hospital to conserve hospital resources. Contact information should be recorded for all potentially affected persons so that they can, if necessary, be reached later to arrange further evaluation.

Questions, as well as requests for additional information, should be directed to DHSS' Bureau of Environmental Epidemiology at 573/751-6102.