

## ASPR TRACIE Technical Assistance

On July 11, 2018, ASPR TRACIE held a webinar discussing the impact of radiological incidents on health and healthcare, and planning strategies related to different incidents. The speakers also shared guidance and lessons learned from recent exercises and research in assessing, triaging, treating, and following-up on casualties of radiological and nuclear emergencies. The [presentation and recording](#) from this webinar are now available. The link to the recording is on the title page of the presentation; you will need to enter your email address prior to viewing.

Due to time constraints, speakers were not able to respond to all of the questions received during the Question and Answer (Q&A) portion of the webinar. ASPR TRACIE sent remaining questions to panelists and their answers are provided below.

### Q&A

#### Communications

##### **Q1: Would the Electromagnetic Pulse (EMP) affect the radio communications with shelter in place?**

**A:** A nuclear explosion also generates a phenomenon known as Electromagnetic Pulse (EMP) that can negatively impact electronic equipment. However, this issue is primarily a concern for a high-altitude, thermonuclear (high-yield) detonation. For a low-yield, 10-kT, ground-level detonation, the most damaging consequences associated with the pulse are not expected to travel beyond about 1 mile (<2 km), with some longer-range disruptions of some sensitive equipment occurring out a few miles more (2-4 km). An excellent reference for EMP effects is the [2008 report of the Electromagnetic Pulse Commission](#). The [federal planning guidance \(EOP, 2010\)](#) states that “the most severe consequence of the pulse would not travel beyond about 2 miles (3.2 km) to 5 miles (8 km) from a ground level 10 KT explosion.”

EMP effects are expected to be minimal during a ground level detonation of a nuclear device. An air burst could create more disruption, however the effects of EMP are highly controversial and theoretical. What is not theoretical is that tremendous infrastructure damage will occur in many areas that will limit public alerting and communication. Pre-event 'get inside, stay inside, stay tuned' education is very important.

The key consideration for EMP is that AM/FM radio transmitters 25 miles or more away will likely be unaffected and able to transmit protective actions into the affected area. Most hand crank and battery operated radios (including car radios) should operate in the area outside of the MDZ and should still function and be able to receive messages.

EMP is primarily an issue to those in the blast zones (who are dealing with a whole host of other issues, all windows broken for example). Even hospitals outside of the blast zones (> 3 miles away) may experience electrical, internet, and phone outages from failure of “the grid”; but their equipment on emergency power should function as normal (as should their emergency power / back-up generators as long as they have fuel). If you are *just* outside the blast zone (say 3-6 miles away), there is a *chance* that a *few* pieces of electronics may “latch up,” meaning they will need to be power cycled to start working again.

**Q2: Do you have communication templates for the different Rad scenarios?**

A: The [EPA Radiation Protection Public Communication Resources](#) includes useful communication templates. A few of particular to note:

- [Communicating about a Nuclear Detonation](#)
- [Radiation: Communicating with the Public](#)
- [Nuclear Detonation Preparedness- Communicating in the Immediate Aftermath](#)
- [Public Information Officers Resources](#)

Contamination/ Exposure

**Q3: Why is the group that has exposure between 4-6 Gy a higher priority than those with exposure over 6 Gy?**

A: The mortality rate jumps quite rapidly for exposures over 6 Gy. The order of triage depends on scarcity of resources and likelihood of success. Above 6 Gy (especially above 8) survival is low and even if there is survival from acute radiation syndrome (ARS), there is high risk of pulmonary death later on. Thus outcome benefit and resource utilization is to have 4-6 Gy ahead of >6 Gy.

See [Dr. Coleman's paper from Disaster Medicine and Public Health Preparedness](#) for additional information and clarification. This work stays consistent with prior work in the field so as not to create confusion with previously recommended triage strata.

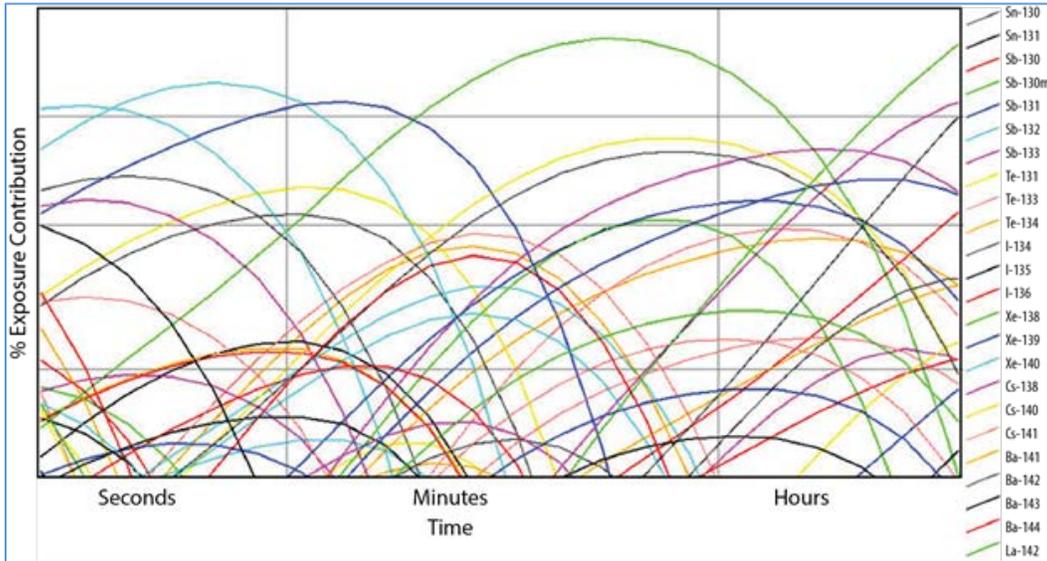
**Q4: How much of an issue is fallout contamination of water supply both short and long-term?**

A: Systems based on wells or aquifers safe to drink as the amount of time required for any contaminants to enter the system would be months and natural filtration would remove most of the material. Rain catch systems would be of the most concern, open reservoirs are less of a concern as system dilution and filtration would likely remove fallout contamination of concern. Bottled / stored water is fine to drink, including water that may be stored in systems (like water heaters and water towers/tanks). For decontamination, any water system (even rain catch) would be fine. With more time and resources, water monitoring systems can help ensure public confidence with municipal water supplies.

**Q5: Can you give an idea of the typical isotopes that might be seen with IND fallout?**

A: Although only a small physical quantity of radioactive material is produced in a nuclear detonation by the nuclear fission process, about 20 ounces (1¼ lb) for a 10-kt device, this material is *highly* radioactive. One minute after the explosion, there are almost 300 billion Curies present ([Glasstone, 1977](#)). This is more than 1,000 times the activity of material released from the Fukushima or Chernobyl accidents. However, unlike nuclear power plant accidents, the majority of fission products released from a nuclear detonation tend to be short lived. **Figure 1** and **Table 1** provides an example of just a *few* of the hundreds of radionuclides produced in the explosion and

how their relative exposure contribution changes over time.<sup>[1]</sup> Radionuclides with short half-lives will dominate the exposure in the first few seconds, but then decay away.



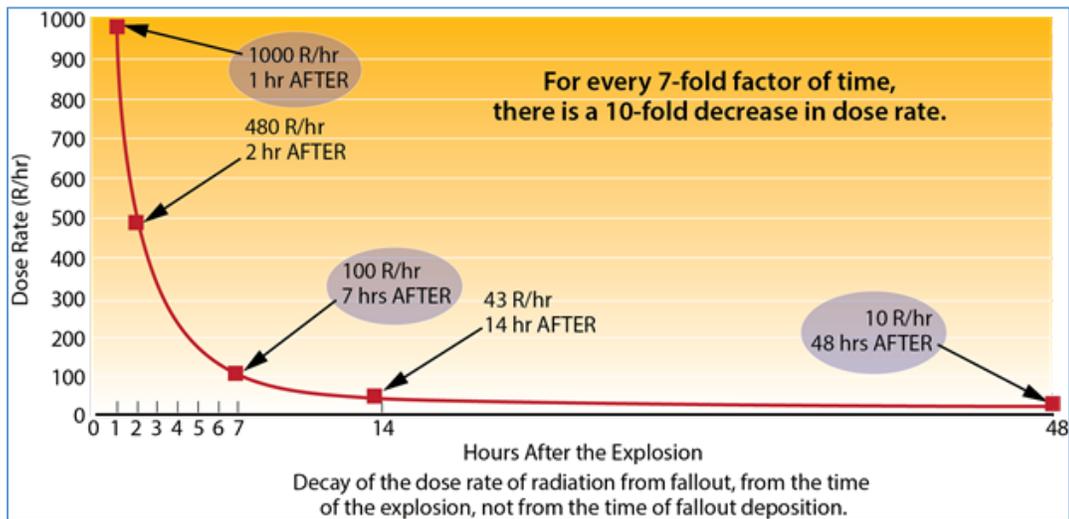
**Figure 1. Examples of how nuclear fission product radionuclides change over time. Each line represents the growth and decay of a different radionuclide, a few of which are displayed in the legend.**

Table 1 provides some examples at specific times of the primary fallout activity contributors. Radionuclides that contribute less than 1% were not included.

**Table 1: Primary Fallout Activity Contribution at 3 Different Times**

Isotope	Half Life	Activity % @ 100 days	Activity % @ 1 year	Activity % @ 10 years
Sr-89	50 d	11%	3%	
Sr-90	29 y	0.2%	3%	<b>36%</b>
Y-91	59 d	<b>22%</b>	7%	
Zr-95	66 d	<b>19%</b>	2%	
Ru-103	40 d	<b>19%</b>	2%	
Ru-106	369 d	3%	<b>24%</b>	0.5%
Cs-137	30 y	0.3%	3%	<b>46%</b>
Ce-141	33 d	14%	0.7%	
Ce-144	284 d	8%	<b>34%</b>	0.2%
Pm-147	2.6 y	1.4%	13%	14%

<sup>[1]</sup> Produced by Livermore's Weapon Activation Code (LWAC).



**Figure 2. Decay of the dose rate of radiation from fallout (from the time of the explosion, not from the time of fallout deposition).**

Because of the large amount of short-lived fission products, the activity (and the radiation) levels decrease rapidly with time. Fallout gives off more than 50% of its energy in the first hour and continues to decay rapidly even after that initial hour. **Figure 2** shows how radiation levels from fallout continue to decrease with time. For this example, an arbitrary 1-hour starting value of 1,000 R/hr was used.

Although the dangerous radiation levels will subside rapidly over the first few days, residual radiation from the long half-life fission products (such as  $^{90}\text{Sr}$ ,  $^{106}\text{Ru}$ ,  $^{137}\text{Cs}$ ,  $^{147}\text{Pm}$ , and  $^{155}\text{Eu}$ ) will become the main contribution to exposure (after about 10 years).

## Decontamination

**Q6: If a person is being transported aboard an aircraft to a facility for treatment & they get sick while on board, would the plane then need to be decontaminated?**

**A:** No. The patients transported by aircraft would be decontaminated prior to transport. Irradiation, rather than contamination causes the primary radiation injury after a nuclear event. The patients do not stay 'radioactive'. Any ingested radiologic dusts would have passed out of the stomach by the time of evacuation. airsickness bags are always available and good to use however for the general enjoyment of fellow fliers.

**Q7: How would this scenario affect decontamination at the hospital level?**

**A:** The ability to perform technical decontamination depends on where the hospital is in relation to the blast. The closer the facility, the larger the number of victims, the more that the facility should focus on radiation containment (clothing control and bagging, etc.) rather than decontamination. Remember that the priority with radiation victim care is care for the trauma

FIRST, and worry about the radiation after. For facilities with intact resources and limited numbers of patients usual radiation decontamination can occur (see [REAC/TS](#) and [REMM](#)) - patients without injury or current symptoms do NOT need hospital evaluation and should be referred to Assembly Centers or CRCs depending on what is set up. **See Attachment 1 of this document for more information.**

**Q8: For responders, if there is not decontamination at the reception or evacuation sites, how is the external contamination contained as to not contaminate the responders and transportation assets (planes, etc.)?**

**A:** Self / home decontamination should be stressed first and foremost. As resources allow, decontamination should be provided at assembly centers and is a key component of community reception centers. Evacuation centers must have the ability to screen and decontamination prior to transport. **See Attachment 1 of this document for more information.**

### Healthcare Facilities/ RITN

**Q9: If hospital is in the fallout zone, could the ED stay open to receive patients during the fallout time?**

**A:** Yes - a priority would be to shelter as many people as possible internally in the building. But hospital construction usually provides robust shielding against fallout and would be a likely destination for many persons in the area both injured and uninjured.

**Q10: Any ideas how long the period might be for health care facilities to be on their own before federal resources can be brought in/available?**

**A:** Resources will be moved forward as rapidly as possible, but this process usually takes days. Given the degree of infrastructure damage close to the scene, a priority may need to be placed on federal support for hospitals on the periphery that are still able to provide a majority of services but are overwhelmed. This will be a decision made in conjunction with local healthcare coalition and emergency management experts as well as Federal partners. But due to the difficulty with resource delivery (don't forget the glass breakage zone extends for miles - dramatically limiting vehicle access to this area until mitigated) even resources available in the area may have difficulty getting to where they are needed.

**Q11: If our state doesn't currently have a RITN, is there a process to get one established?**

**A:** Yes, each year the RITN adds a handful of new hospitals to its network. The number is limited due to funding so priority is given to locations where there is a need for additional RITN hospitals. New RITN centers must be within 75 miles of an NDMS FCC to ensure patient movement, the hospital must have a bone marrow transplant unit, it is preferred that the hospital is part of the NMDP Network of transplant centers as well as part of NDMS. To find out more about annual requirements to participate in RTIN please send an email to [RITN@nmdp.org](mailto:RITN@nmdp.org).

**Q12: With such large numbers of expectant category patients, what setting do you envision those being cared for palliatively --special needs shelters?**

**A:** Most of these patients will need aggressive symptom-based care including pain medications and medications for nausea and other symptoms. Because the availability of hospital beds is

doubtful, alternate care sites may be a relevant option. When resources allow, these persons should be re-triaged as many of them may not have as severe radiation injuries as expected. Obtaining staff and supplies for palliative care, particularly medications may be extremely challenging, but palliation should be an accepted goal and priority for the medical response.

## Medical Personnel/ Responders

**Q13: What are the assumptions being made about the availability and willingness of medical personnel to enter into radiation areas to assist patients in the initial hours to days after the incident?**

**A:** Unfortunately, provider surveys indicate that radiation incidents generate the most reluctance to respond. Pre-event education is tremendously important to emphasize the very limited risk to providers (similar to the first receiver concept for hospital response to hazmat incidents) as well as assure that processes are in place for contamination containment / decontamination as well as dosimeter monitoring to illustrate the exposure rates. EMS providers that do not have dosimeters may have to shelter after a nuclear event until it is clear that they are not in a dangerous fallout zone. Responders should follow the 'as low as reasonably achievable' exposure standards and follow response guidelines that generally limit exposure for life-saving activities to 25 rad (though exceptions certainly can be made depending on the situation and the responder - the responders must clearly understand the relative risk of higher levels of exposure). In most cases, the areas of highest radiation from the actual blast will not contain many surviving victims. Below is a summary of two studies that may be helpful.

Commitment to help staff non-hospital, field medical facilities by incident and Type of Practice		
	Physician (559)	Nurse (2775)
Natural Disaster	83%	90%
Explosion Incident	67%	70%
Chemical Incident	59%	59%
Biological Incident	56%	53%
Contagious Epidemic	56%	49%
<b>Radiological Incident</b>	<b>52%</b>	<b>45%</b>

Lanzilotte, S., "Hawaii Medical Professionals Assessment", Hawaii Medical Journal, Vo1 61. August 2002

*Health Care Workers' Ability and Willingness to Report to Duty During Catastrophic Disasters (n=6,428, 47 facilities)*

	Willing	Able
Snow Storm	80%	49%
Bioterrorism (smallpox)	61%	69%
Chemical Terrorism	68%	71%
Explosion Incident (MCI)	86%	83%
Environmental Disaster	84%	81%
<b>Radiological Terrorism</b>	<b>57%</b>	<b>64%</b>
SARs outbreak	48%	64%

**Able**  
Transportation, & dependant care

**Willing**  
Fear and concern for family and self

Qureshi, K, Gershon,R., Gebbie, E., Straub, T, and Morse, S. (2005). Healthcare workers ability and willingness to report to duty during a catastrophic disaster. *Journal of Urban Health*. 82(3):378-88.

**Q14: What does the initial T1 triage location look like in terms of physical aspects of the facility and the number of staff required and their credentials/training?**

**A:** The T1 locations are spontaneous locations - so they may be relatively small or involve a significant commitment of resources. An example might be a T1 location at a mall where people are gathering that could require multiple ambulances, EMTs, and significant wound and contamination control supplies. Fire stations are likely to become impromptu T1 locations due to the neighborhood going there for assistance. Ideally, security and medical (paramedic or higher) level staff would be present but given the dramatic impact on the area first responder and other levels of training may be all that is available.

[Resources/ Supplies](#)

**Q15: There was a reference to "scarce resources" that will have to be dealt with in this scenario. From a medical treatment standpoint, what are some of the key classes of specialty medical products and medications distinct to this event (i.e., beyond just bandages, oxygen, gloves, etc.)? What is the level of concern about gaining sufficient access to these types of products immediately and over time?**

**A:** For miles around a nuclear blast, hospitals will be both overwhelmed with casualties and likely sustain physical damage. Further, road access and the capacity to deliver medical materials is likely to be compromised severely for days or longer. Hospitals will have tremendous difficulty transferring patients out and obtaining resources. Staff may be very reluctant to report after a radiation incident, let alone a nuclear incident. Hospitals will face pervasive challenges of space, staff, and supplies, including most patient care supplies but particularly impacted will be usual symptom control medications for pain and nausea as well as personal protective equipment supplies (gloves, gowns) and wound management supplies.

Scarce resources planning should be done in advance with triggers or tripwires for determining when the setting changes and, with it, triage order; and determination of key supplies (e.g., cytokines or blood products or operating rooms). There needs to be one person declaring the status for the facility, and ideally it should not be the triage doctors.

**Q16: Since Potassium Iodide needs to be administered within four hours of exposure to radioiodine, what are your recommendations for local entities to stock KI? Should emergency responders, such as Fire/Hazmat, stock on their equipment? Should county health organizations stock it?**

**A:** Taken in advance (or within a few hours) of an exposure, potassium iodide (KI) blocks the uptake of the radioactive iodine produced by nuclear fission. Although KI can be useful to decrease the radiation exposure of the thyroid during nuclear reactor accidents (where radioiodines are preferentially released), its benefits after a nuclear detonation are negligible/ should not be a consideration.

Radioiodines are a small fraction of the of the fission products released in a nuclear explosion and KI will not protect against the other high-risk radionuclides which will dominate the exposure. According to the [Planning Guidance for Response to a Nuclear Detonation](#); “Administration of radiation blocking or decorporating agents such as potassium iodide (KI), Prussian blue, or DTPA is not useful in the early medical response.”

## Triage and Tracking

**Q17: I am interested in local health being prepared. At the community reception center how do we measure dose to better triage patients? What equipment is needed?**

**A:** Unfortunately measuring 'dose' in a nuclear scenario (IND) optimally requires serial blood counts (biodosimetry) to look at the Absolute Lymphocyte Count (ALC) although a single value can be useful (see [REMM](#) or [EAST](#))- so jurisdictions need to be able to coordinate blood draws, lab processing, and connecting results to patients. After an RDD incident, the [CDC CRC materials](#) detail the external screening and collection of urine samples to assess internal contamination. The urine bioassay results along with demographic data (age, gender, etc.) provide an estimated 'dose' for each individual. The coordination of the clinical assessment of the radiation exposure and/or contamination with the public health screening and registration efforts is one of the key issues for planners.

**Q18: The reality is some patients who may have had impactful dose hematologically may self-evacuate and present not through the NDMS to treatment facilities outside the area. Is there a mechanism to track those?**

**A:** No. Receiving communities across the nation must be prepared for many individuals to arrive and require evaluation including absolute lymphocyte counts (ALC), assessment for internal contamination and other testing. Communities within a few hundred miles of a detonation will need to set up community reception centers and include the ability to conduct ALC and other clinical testing with referral to hospitals and outpatient follow up as appropriate.

Additional helpful resources:

- [ASPR TRACIE Radiological and Nuclear Topic Collection](#)
- [U.S. Department of Health and Human Services \(HHS\) Radiation Emergency Medical Management \(REMM\)](#)
- [Centers for Disease Control and Prevention \(CDC\) Radiation Emergencies](#)
- [Radiation Emergency Assistance Center/ Training Site \(REAC/TS\)](#)

# Attachment 1. Additional Background for Decontamination

## The First Few Days

The hypothetical 10kt detonation in New York City used in the webinar, demonstrated the extent of contamination in the region. Handheld survey equipment has the ability to measure radiation at very low levels, far below any immediate health threat. Unfortunately, there is a perception that all of the radioactive material is contained within the Hot Zone, which may be the case for a small HAZMAT spill on the roadway but is not true for an event of the magnitude of a nuclear detonation.

## Nuclear Detonation Fallout Decontamination

Fallout consists of large particles that can be easily brushed off clothing and shoes. The radiation energy given off by fallout particles decays rapidly with time, for this reason early gross decontamination (brushing for example) is better than delayed thorough decontamination (such as a shower). Military operations conducted at the Nevada Test Site 30 minutes after above-ground nuclear test demonstrated that simple brushing and wiping can be effective at removing fallout particles. If additional decontamination is required, efforts should focus on removing or replacing shoes and outer clothing and washing or wiping exposed skin and hair (which is why access to quantities of clothing is an important location consideration, especially in winter).

**Self-Decontamination** instruction can be found in [FEMA's Improvised Nuclear Device Response and Recovery; Communicating in the Immediate Aftermath](#). Limited response resources should not be used on extensive population monitoring and decontamination operations in the first few days.

**Decontamination sites** can be stand-alone or co-located with reception centers or transportation hubs and should be focused on those that left (or traveled through) the DFZ. Consider placement near sources of replacement footwear and clothing.

**Population monitoring is not required**, but if it is performed then rapidly (< 30 seconds per person) scan for any immediately evident increased radiation. For very large numbers of evacuees, scan just hands and feet. Monitoring will likely occur in elevated background areas and staff should only be looking for significant contamination above background levels.

As demonstrated by the webinar, **low levels of contamination will be present throughout the region** outside of the Hot Zone. Many areas, perhaps even over a hundred miles away, will have low levels fallout contamination (< 10 mR/h, but well above nominal background radiation levels). Although initially outdoors, some small fraction of this fallout can be expected inside vehicles, hospitals, shelters, and other buildings. Although easily detectable, the fallout's rapid decay and negligible internal hazard make this small amount of regional, ubiquitous contamination relatively harmless (the total exposure over the first month after the detonation would be a fraction of typical annual exposures from natural background radiation).

Cross-contamination (i.e., minor amounts of contamination that may inadvertently rub off contaminated people or objects after they have left the hot zone) will likely be on par with the low levels of regional contamination that will occur outside the hot zone. In the early phase, the rapid decay of the fallout means that the low levels of radiation from fallout cross-contamination will be rapidly declining.

## Intermediate Phase

As the event progresses past the first week, there will be more resources and time for monitoring and decontamination. The hot zone will have been reduced to the size of the maximum extent of the dangerous fallout zone (10 - 20 miles for a 10kT).

The initial rapid decay rate of the fallout will slow, and significant contamination that is measured after the first week should be managed more carefully as it will take another week for radiation levels to drop by half.

### General Observations:

- Unlike many chemical and biological events, being contaminated with fallout is not immediately life threatening to the population or the responders who assist them.
- There will be large numbers (perhaps over a million) of people from fallout contaminated areas who may have some level of detectable contamination.
- Fallout contamination decays rapidly (giving off > 80% of its energy in the first day) so early, gross decontamination (such as removing/changing outer layer of clothing) is far more effective at reducing dose than a delayed, if more thorough, wash down.
- Fallout is likely to be salt and sand sized particles, like dirt, that can be easily removed with brushing and gentle wiping.
- Monitoring equipment and response resources will be critically limited in the initial days after a detonation, for this reason self-decontamination methods are preferred.
- Mass decontamination (i.e. fire hose wash down) techniques used in colder climates can result in more casualties from hypothermia than would have occurred from contamination.

### Key Recommendations:

- Primary population decontamination after a nuclear detonation should focus on self-decontamination. Appropriate messaging can be found in [Improvised Nuclear Device Response and Recovery Communicating in the Immediate Aftermath](#).
- Initially, monitoring equipment/personnel should be used for responder safety, hazard mapping, and search and rescue activities. Mass population monitoring stations should be considered a secondary priority.
- Medical treatment should never be delayed due to contamination concerns. Decontamination should be considered the lowest medical priority. Even if monitoring equipment is not available, brushing, wiping, and removing, bagging, and isolating potentially contaminated shoes and clothing is sufficient to ensure the safety of patients and medical staff.
- Shelter should never be denied due to contamination concerns. Even if monitoring equipment is not available, brushing, wiping, and changing of potentially contaminated shoes and clothing is sufficient to ensure the safety of staff and shelter occupants.
- Contamination concerns should not prevent the transportation of potentially contaminated evacuees or injured personnel. Simple decontamination (wiping & brushing off potential contamination) is sufficient to ensure safety of passengers and staff.
- As resources become available and delayed, deliberate evacuations are initiated; monitoring and decontamination sites can be established, preferably close to the outer boundary of the Hot Zone and at locations with replacement clothing and shoes.

- As monitoring resources become available, initial efforts should focus on rapid screening for contamination levels which represent a priority for decontamination. The references below provide a wide variety of potential screening values (from 0.1 mR/h to 10 mR/hr), but the key issue is the speed at which people can be screened. Frisking times for screening levels should be < 30 seconds to ensure adequate throughput.

## Overview of Population Monitoring Concepts

In the aftermath of a large-scale radiological release, there will be a need to assess large groups of individuals and prioritize their care from immediate medical needs to potential long-term effects resulting from the radiological incident. Population monitoring is defined by the CDC as the tasks required to “identify, screen, measure and monitor populations (people and their pets) for exposure to radiation or contamination from radioactive materials”. As always, life threatening medical issues take priority of contamination issues. With the needs of large groups to be addressed, it is recognized that self-decontamination can provide many benefits ([CRCPD](#), [NCRP 165](#), [NCRP 166](#), [CDC](#)). Regardless of the approach utilized to manage large groups, it will be important to pair it with public messaging that provides clear instructions and helps to reduce population.

## Contamination Detection Methods

- **Rapid Contamination Detection Method for nuclear detonation fallout**, if potentially contaminated with fallout from a nuclear detonation, early gross decontamination is more important than radiation screening. If trying to identify significantly contaminated individuals in a resource constrained environment, [use the IAEA Criteria for screening of groups and locations \[10 mR/hr \(100 μSv/h\) at 1 m\]](#).
- **When more resources are available for screening**, use the IAEA general monitoring criteria of 0.1 mR/hr (1 μSv/h) above background at 10 cm.