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The Management of Patients In a Radiological Incident

State Expert Panel on Radiation Incidents

**Wisconsin Division of Public Health
Hospital Disaster Preparedness Program**

October 2007

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Introduction to the Management of Patients in a Radiological Incident

These “Guidelines” are intended to assist hospital personnel, especially Emergency Department staff, in the management of patients, who have been exposed to radioactive substances. Although these “Guidelines” are written with nuclear or radiological incidents in mind, these “Guidelines” also apply to the management of any patient, who has been exposed to radiological substances. Given the proliferation of radioactive substances used in the normal course of manufacturing and other business processes, an accident, involving radiological substances, can occur anywhere and at any time.

Because these are uncommon occurrences, Emergency Department staff may not be familiar with all the protocols necessary to treat patients, exposed to radioactive substances, while protecting themselves, other staff and the facility, not to mention other patients in the Emergency Department and in the hospital.

These “Guidelines” are based, to a great extent, on materials available through the Radiation Emergency Assistance Center/Training Site (REAC/TS). Since 1976, the Oak Ridge Institute for Science and Education (ORISE) has positioned the U.S. Department of Energy (DOE) as an international leader in emergency medical response to radiation incidents through the management of the Radiation Emergency Assistance Center/Training Site (REAC/TS).

The REAC/TS mission is two-fold:

- provide 24/7 availability to deploy and provide emergency medical services at incidents involving radiation anywhere in the world
- provide advice and consultation on radiation emergency medicine from its Oak Ridge, TN., headquarters or at the scene of an incident

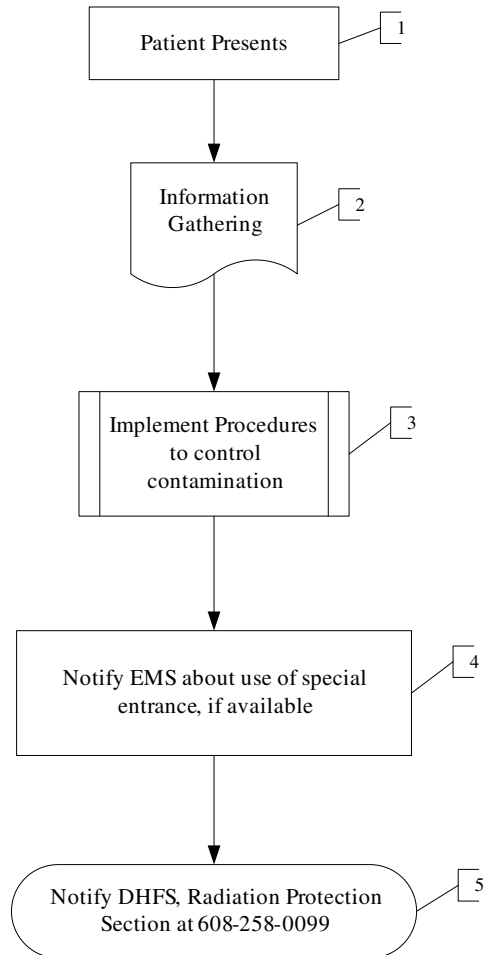
Further information about REAC/TS can be found at <http://orise.orau.gov/reacts>
The State Expert Panel on Radiation Emergencies reviewed REAC/TS materials and made minor changes and additions to provide hospitals in the State of Wisconsin with training and background materials to help them in their response to an accident, involving radioactive materials.

These “Guidelines” are to be considered as an appendix to the hospital HazMat Plan. If there is any suspicion of biological, radiological or chemical contamination, then the hospital is to follow its established procedures for decontamination.

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Part A: Template Policies for Hospitals

Policy One: Flowchart for the “Notification and Verification of a Radiation Accident”



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Policy One: Notification and Verification of a Radiation Accident

IMPORTANT: Use of universal precautions will help prevent the spread of contaminants to emergency responders. Emergency responders should not delay treatment of victims due to fear of becoming contaminated with radioactive materials. The victims should be handled in a manner that will reduce the spread of contaminants to other individuals and medical equipment.

There is minimal risk of high exposure to radioactive materials for Emergency Department Staff due to the limited time that Emergency Department Staff spend with the patient during treatment.

Pregnant healthcare workers may be excluded according to hospital policy or upon the advice of qualified personnel.

1. Notification and Verification of a Radiation Accident

IMPORTANT: Hospitals that do not have qualified personnel to manage patients from a radiation accident are to call for assistance from the Radiation Safety Network (see **Appendix One: Obtaining Assistance from the Radiation Emergency Response Network**).

2. When the hospital receives a call that a radiation accident victim is to be admitted, the following procedures are to be followed.

a. **Information Gathering:** The individual receiving the call should get as much information as possible, including the following:

- 1) Number of accident victims
- 2) Each victim's medical status and mechanism of injury
- 3) If victims have been surveyed for contamination
- 4) Radiological status of victims (exposed vs. contaminated).
- 5) Identity of contaminant, if known
- 6) Estimated time of arrival

b. Patients with life-threatening conditions must be treated first.

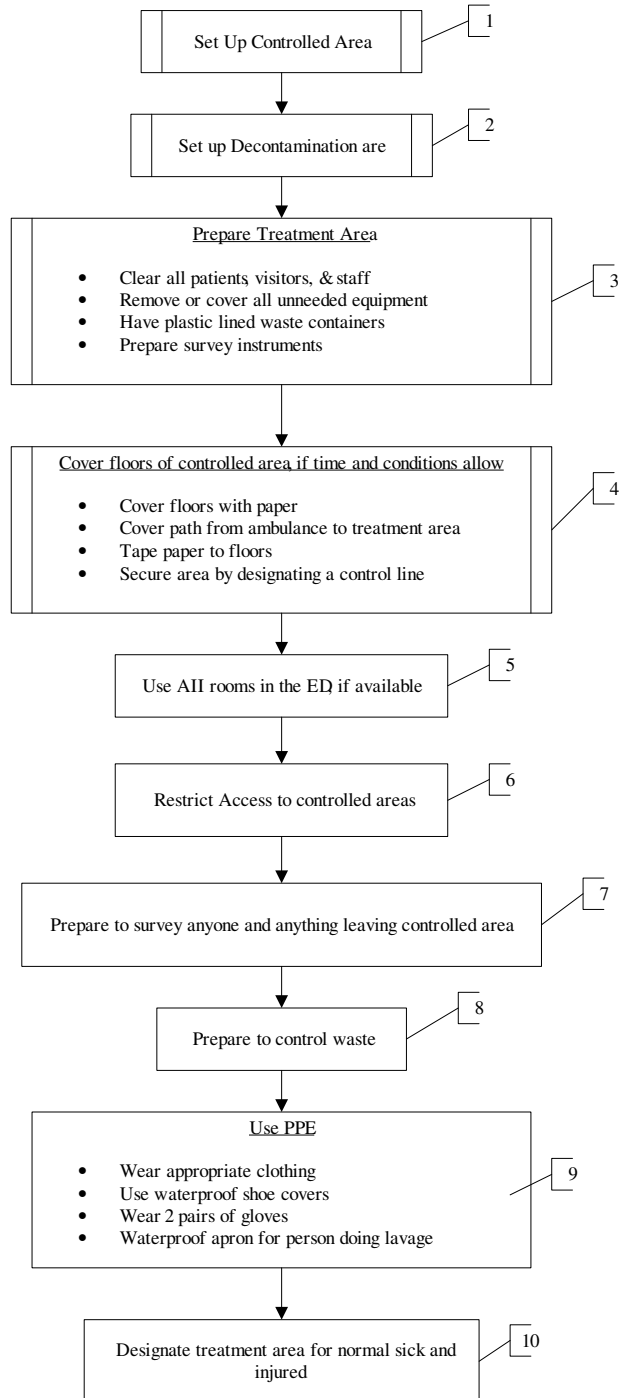
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- 1) IMPLEMENT PROCEDURES FOR CONTAMINATION CONTROL (see **Policy Two**)
 - 2) Ambulance personnel are to be instructed regarding the special entrance (if any) to the emergency department for the radiation accident victim
 - 3) Although the hospital is not required by statute to notify an authority that a patient has been exposed to a radiological agent, it is highly recommended that the hospital: **notify the Division of Public Health, 24/7 telephone number, Radiation Protection Section at 608-258-0099**
- c. If the patient has radioactive contamination, then the patient is to be decontaminated according to standard decontamination protocols.

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Part A: Template Policies for Hospitals

Policy Two: Flowchart for “Preparing for Patient Arrival”



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Policy Two: Preparing for Patient Arrival

1. The goals of contamination control are to prevent the spread of radioactive materials from:
 - a. the patient
 - b. the rescue personnel
 - c. the gurney and equipment used in patient care
 - d. the ambulance

2. This contamination can be transferred to:
 - a. care providers as they touch or move the patient
 - b. the equipment used to assess and treat the patient
 - c. the immediate area
 - d. in rare cases, where dust or powders are present, the hospital is too implement its decontamination plan, which is no different than hazardous materials decontamination with the exception that **serious medical problems always have priority over radiological concerns**

3. Prepare Area for Contamination Control
 - a. set up a controlled area large enough to hold the anticipated number of victims and implement the hospital security policy
 - b. restrict access to the controlled area
 - c. prevent tracking of contaminants by covering floor areas (see 5.b.)

Note: It is recommended that paper not be used if there is the potential for the paper to get wet due to rain, snow, etc.

 - d. consider ventilation issues
 - e. prepare to survey *anyone* or *anything* leaving the controlled area
 - f. use a buffer zone or secondary control line for added security
 - g. use strict isolation precautions, including protective clothing (see 4) and double bagging

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- h. control waste by using large, plastic-lined containers for clothing, linens, dressings, etc.
- i. change instruments, outer gloves, drapes, etc., when they become contaminated
- j. use waterproof materials to limit the spread of contaminated liquids; for example, waterproof aperture drapes.

4. Protective Clothing: The purpose of protective clothing is to keep bare skin and personal clothing free of contaminants.

- a. Give the team members a personal dosimeter, if available
- b. Responding personnel should dress in appropriate clothing (such as scrub suit, gown, surgical mask, cap, eye protection, and gloves).
- c. Waterproof shoe covers also should be used. All open seams and cuffs should be taped using masking or adhesive tape. Fold-over tabs at the end of each taped area will aid removal.
- d. Two pairs of surgical gloves should be worn. The first pair of gloves should be under the arm cuff and secured by tape. The second pair of gloves should be easily removable and replaced if they become contaminated.
- e. Qualified personnel, if available, are to monitor exposure levels in the treatment area.
- f. A waterproof apron can also be worn by any member of the team using liquids for decontamination purposes.
- g. Protective clothing is effective in stopping alpha and some beta particles but not gamma rays. Lead aprons, such as those used in the x-ray department, are not recommended since they give a false sense of security because they will not stop most gamma rays.

5. Preparing the Treatment Area for Contamination Control (if supplies are available and time allows for the set-up of the treatment area)

- a. If possible, select a treatment room near an outside entrance so that there is a shorter pathway to the treatment area.
 - i. Clear the area of visitors and patients.

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- ii. Remove or cover with plastic sheeting equipment that will not be needed during emergency care of the radiation accident victim.
 - iii. Several large plastic-lined waste containers will be needed. The treatment table should be covered with several layers of waterproof, disposable sheeting. Plastic bags in all sizes will be needed and should be readily available.
 - iv. Survey instruments should be checked and ready for use before the patient arrives. Background radiation levels should be documented. If feasible, the probe should be covered with plastic so as to prevent contamination of the probe.
 - v. The treatment team should be prepared to meet the patient at the ambulance where the patient can be transferred to the prepared treatment gurney.
- b. If supplies are available and time allows for the set-up of the treatment area, cover the floor areas.
- i. Rolls of brown wrapping paper or butcher paper three to four feet wide can be unrolled to make a path from the ambulance entrance to the decontamination room. Ordinary cloth sheets or square absorbent pads can be used if paper is unavailable.
 - ii. Whatever the floor covering, it should be taped securely to the floor.
 - iii. This route should then be roped off and marked to prevent unauthorized entry.
 - iv. A control line should be established at the doorway to the treatment room. A wide strip of tape on the floor at the entrance to the room should be marked clearly to differentiate the controlled (contaminated) from the non-controlled (uncontaminated) side.
- c. Ventilation control is to be considered. Airborne Infection Isolation (AII) rooms in the Emergency Department are preferred for treatment rooms, if available.
6. The hospital is to designate a treatment area for the “normal sick and injured” that may arrive during the treatment of contaminated patients, clearly delineated as a “clean area”. The hospital is also to designate equipment and supplies that are to be used in this “clean area”.

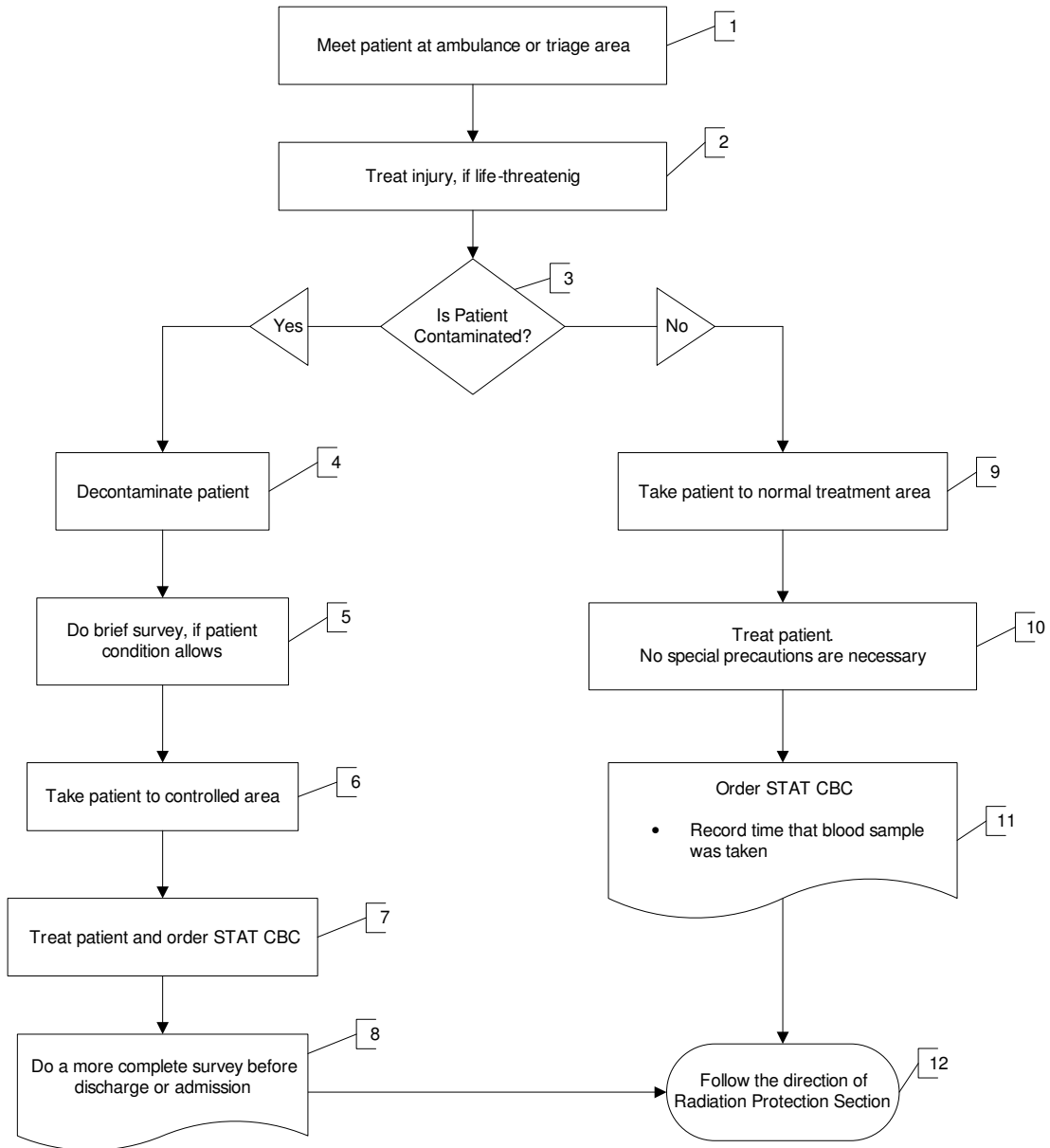
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Patients with trauma may require X-rays. Depending upon the scale of the incident, if a hospital has multiple X-rays or CT Scanners, then one should be designated for use in the controlled area.

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Part A: Template Policies for Hospitals

Policy Three: Flowchart for "Patient Arrival and Triage"



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Policy Three: Patient Arrival and Triage

Patients, including “normal” Emergency Department patients, are to be triaged as to whether they were or were not involved in the incident. Qualified personnel are to determine whether patients are

- a. contaminated or potentially contaminated
- b. known to be non-contaminated, but potentially exposed

1. **CONTAMINATED PATIENT:** If external contaminants are known to be present through a survey, decontaminate, if compatible with the patient’s condition.

- a. The patient is to be decontaminated until the survey achieves background level.
- b. Decontamination is to be repeated up to three times, if necessary. The patient is to be surveyed after the third decontamination.
- c. If the patient is still decontaminated after three decontamination attempts, then the patient is to be treated.

2. **CONTAMINATED OR POTENTIALLY CONTAMINATED PATIENTS** are to be admitted to a specially prepared area. When in doubt, a critically injured patient should be taken immediately into this prepared area.

- a. If the team members in the Emergency Department have knowledge or suspect that the incident potentially involves radiological agents, then a triage area is to be set up and all patients are to be surveyed, if qualified personnel are available for this purpose.

If the hospital does not have qualified personnel to survey the patients, then the hospital team members are to assume that all patients are contaminated.

- i. If the victim's condition allows, an initial, **brief** radiological survey can be performed to determine if the victim is contaminated.
- ii. Any radiation survey meter reading above background radiation levels indicates the possibility of contamination.
- iii. A more thorough survey will be performed once life-threatening problems are addressed and before admission or discharge.

- b. During triage, **serious medical problems always have priority over radiological concerns** and immediate attention is directed to life-threatening

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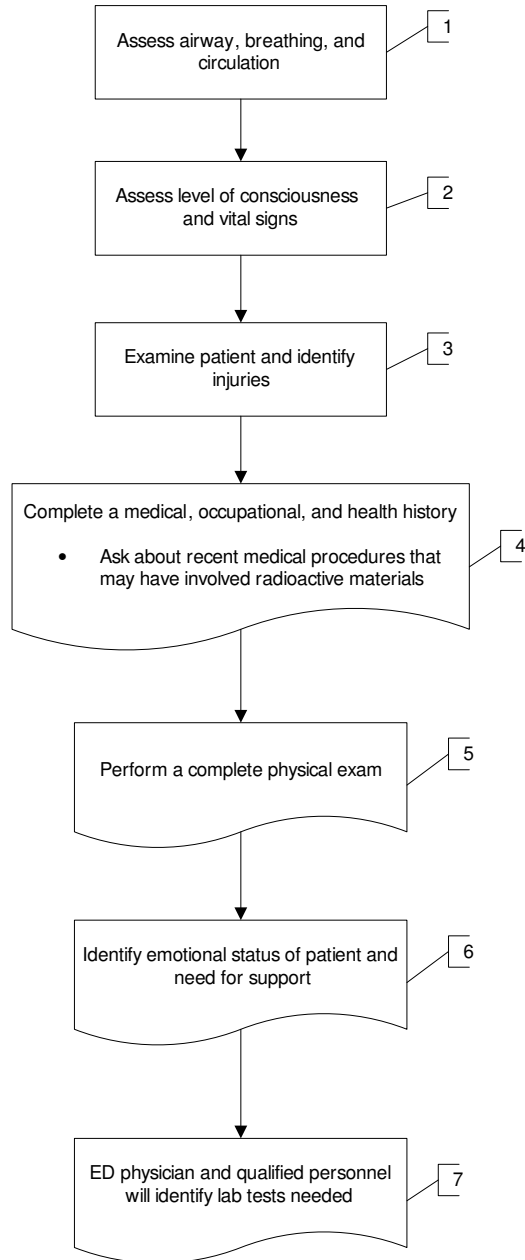
problems. Radiation injury rarely causes unconsciousness or immediate visible signs of injury and is not immediately life threatening; therefore other causes of injury or illness **must** be considered.

- c. If a potentially contaminated patient needs to be transported to an ancillary services area, then these procedures should be followed.
 - i. During the transport to and from the ancillary services area, the patient is to be wrapped in a sheet with a head cover to minimize the shedding of any contaminated particles.
 - ii. During transport and in the ancillary areas, disposable items should be used to the extent possible.
 - iii. Staff, transporting the patient, are to wear the appropriate protective clothing (see Policy Two: #4)
 - d. Instruct EMS personnel to stay in the vicinity of their vehicle until they, their vehicle, and equipment are surveyed and/or released by qualified personnel. Assume that the vehicle is contaminated, unless it is surveyed and deemed to be non-contaminated. A contaminated ambulance may be used for the transport only of other contaminated patients.
 - e. Normal decontamination procedures are to be followed for the decontamination of clothing and personal belongings except that bags for these items are to be marked "Potential Radioactive Contamination". Bags are to be dated and timed.
3. **NON-CONTAMINATED, BUT POTENTIALLY EXPOSED PATIENTS** are admitted to the usual treatment area. The following procedures are to be followed for the assessment and treatment of the non-contaminated patient:
- a. The victim of exposure without contamination poses no radiological hazard to anyone. A specially prepared treatment area is not needed.
 - b. Following attention to medical needs, question the patient to determine the possibility of radiation exposure from an external source.
 - c. If exposure is known or suspected, a stat CBC should be ordered with particular attention given to determining the absolute lymphocyte count.
 - d. Be sure to record the time the blood sample is taken. For differential diagnosis, refer to acute radiation injury.
 - e. Call the Radiation Protection Section for guidance on the follow-up care for the patient.

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Part A: Template Policies for Hospitals

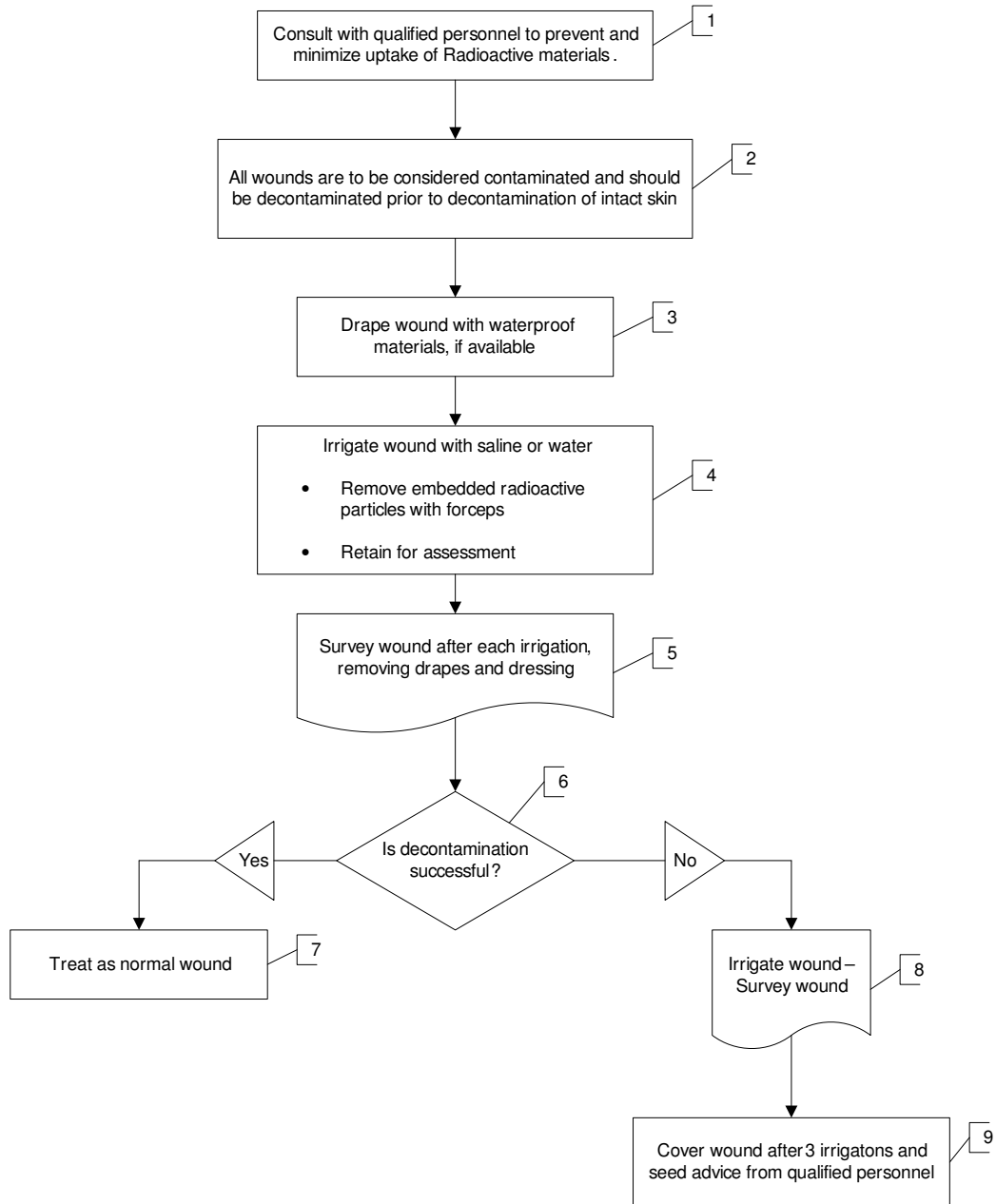
Policy Four, Section 1: Flowchart for “Medical Assessment and Treatment of Contaminated Patients”



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Part A: Template Policies for Hospitals

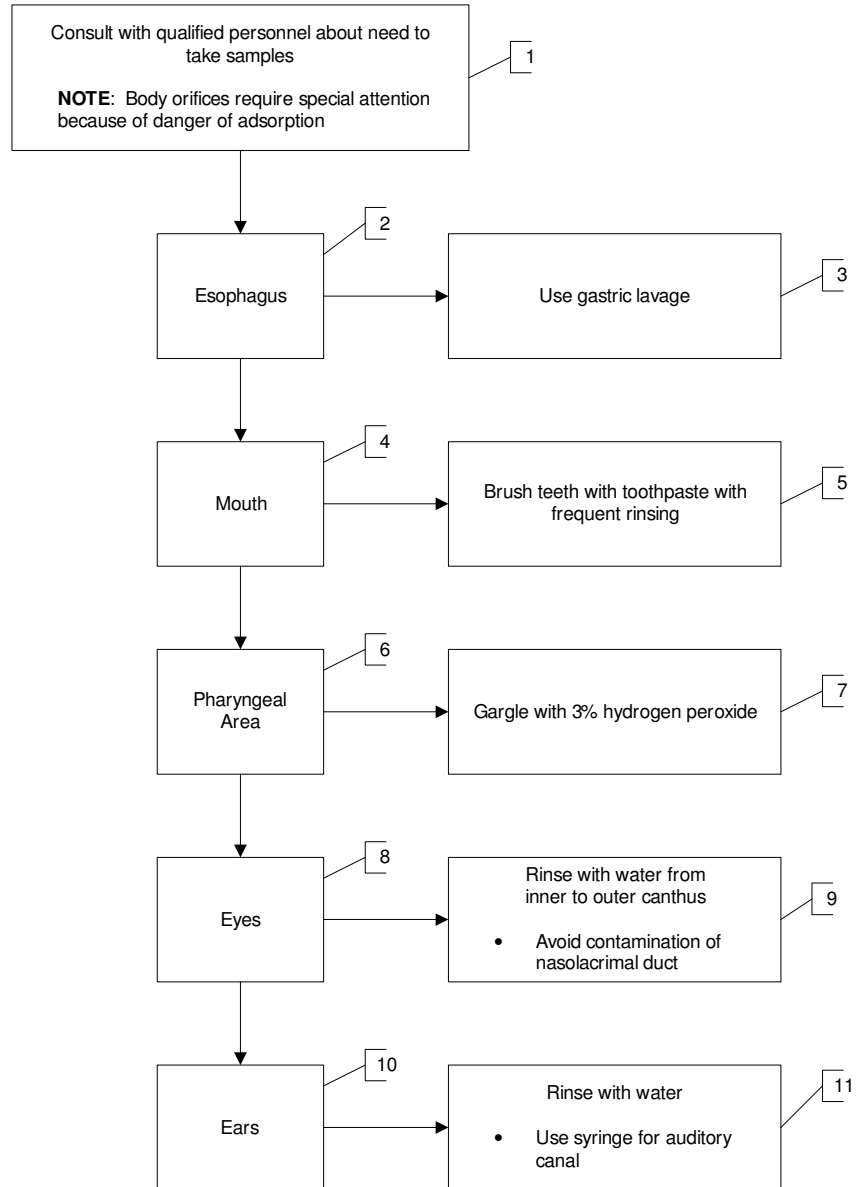
Policy Four, Section 4: Flowchart for “Treatment of Contaminated Wounds”



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Part A: Template Policies for Hospitals

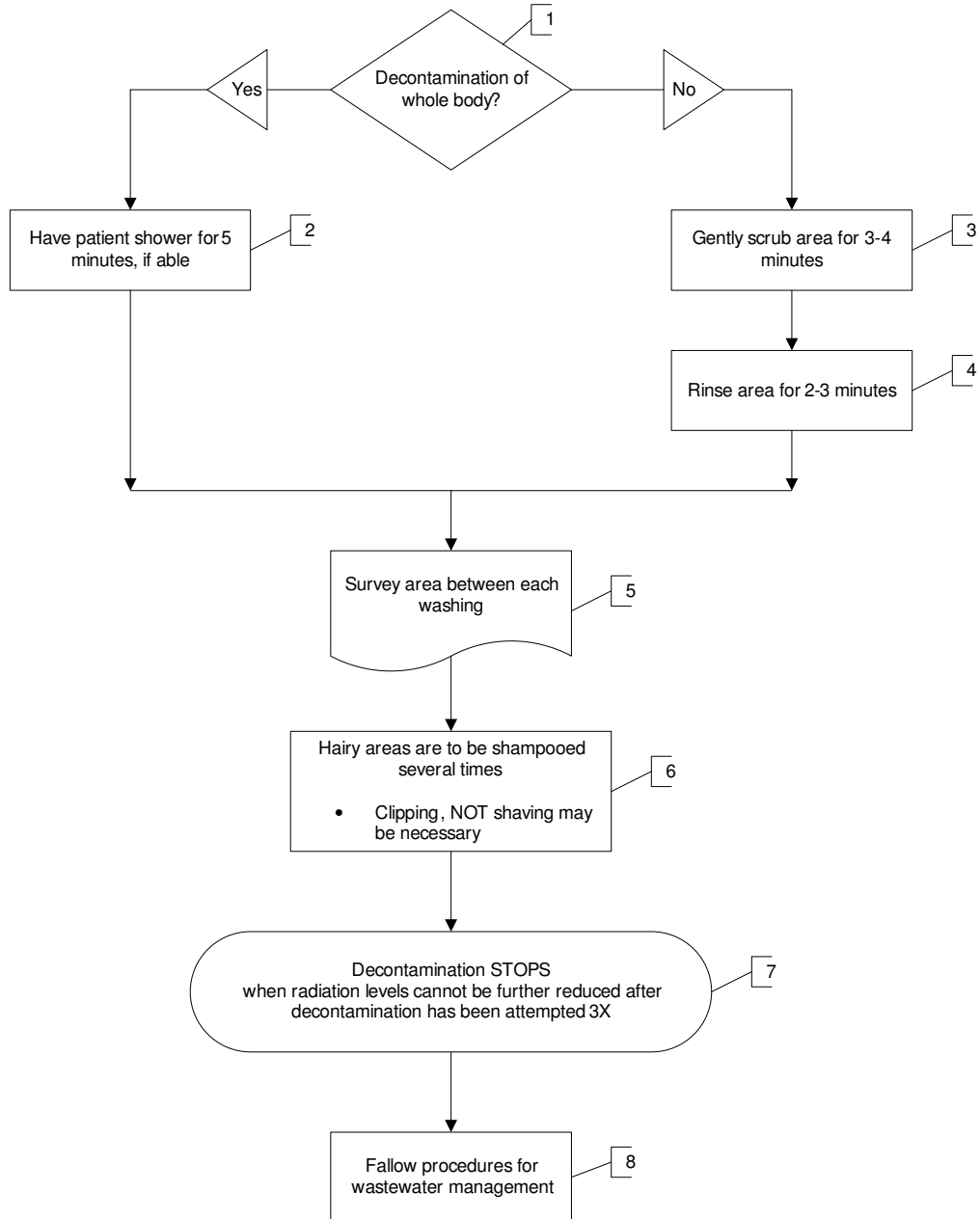
Policy Four, Section 5: Flowchart for “Decontamination of Body Orifices”



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Part A: Template Policies for Hospitals

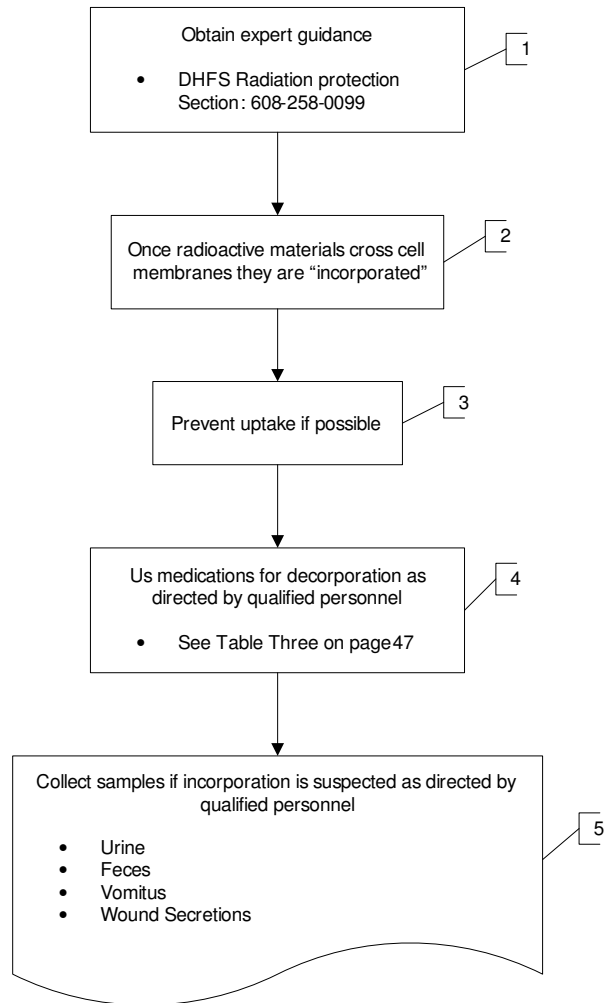
Policy Four, Section 6: Flowchart for "Intact skin"



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Part A: Template Policies for Hospitals

Policy Four, Section 7: Flowchart for "Internal Contamination"



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Policy Four: Medical Assessment and Treatment of the Contaminated Patient

Part A: Medical Assessment and Treatment Following Successful Decontamination

1. Successful decontamination is defined as a patient who has been decontaminated and the survey shows no contamination above background level.
2. These successfully decontaminated patients can be treated as normal Emergency Department patients and do not need to be treated in a controlled area.

Part B: Medical Assessment and Treatment of the Decontaminated Patient

1. The following procedures are to be followed for the medical assessment and treatment of the contaminated or potentially contaminated patient, after the patient has been decontaminated or of a contaminated patient, who has not been decontaminated because of life-threatening conditions.

Note: If a patient needs to be decontaminated in a treatment room due to life-threatening conditions, the treatment is to be considered contaminated and used only for other non-decontaminated patients. The hospital, in its planning, may consider what room is best suited for the treatment of non-decontaminated patients, who may need to be stabilized due to life-threatening conditions. (This room must be surveyed and decontaminated before being returned to normal use.)

- a. Contaminated patients can have radioactive materials deposited on skin surfaces, in wounds, or internally (ingested, inhaled, or absorbed).
- b. Reassessment of the contaminated patient's airway, breathing, and circulation is completed.
- c. Level of consciousness and vital signs are assessed promptly and the patient's condition is stabilized.
- d. After examining the entire patient and identifying all injuries, a complete radiological survey should be done.
- e. A complete and detailed medical, occupational, and accident history should be taken, and a physical examination completed.
- f. The patient's level of anxiety should be noted, and psychological support offered.

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g. The patient should be questioned about recent medical procedures, especially recent nuclear medicine tests or radioactive implants. Keep in mind that the patient may NOT know that radioactive materials were used in recent medical procedures.

h. The Emergency Department physician, with assistance from qualified personnel, will specify which laboratory tests may be necessary. It is recommended that a CBC be ordered for each patient.

2. Patient comfort and emotional support

a. A patient involved in a radiation accident needs explanations of procedures and actions being taken (isolation, use of survey meters, taking of samples, decontamination, etc.) in the treatment area.

b. A knowledgeable person should answer the patient's questions and provide reassurance. For example, explain use of protective clothing and surgical masks during treatment.

c. Following initial care and treatment, someone with knowledge of radiation effects should spend adequate time answering the patient's questions. Preferably, this person should be the attending physician who continues to treat the patient until discharge.

3. Decontamination of the contaminated patient in the treatment room

a. Good judgment is essential in determining decontamination priorities. Since some radioactive materials are corrosive or toxic because of their chemical properties, medical attention might have to be directed first to a non-radiological problem if radioactive materials are components of acids, fluorides (uranium hexafluoride-UF₆), mercury, lead, or other compounds

b. The radioactive agent may also have a chemical or biological component. You should deal with the chemical agent as necessary. Keep in mind that the treatment staff may also have been exposed to the chemical or biological agent.

c. The purpose of decontamination is to prevent or reduce incorporation of the material (internal contamination), to reduce the radiation dose from the contaminated site to the rest of the body, to contain the contamination, and to prevent its spread.

d. Incorporating the results of the radiological survey, in general, contaminated wounds and body orifices are decontaminated first, followed by areas of highest contamination levels on the intact skin.

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e. Please note that frequent glove changes will be necessary.

4. Treatment of contaminated wounds

a. It is important to consult qualified personnel as soon as possible and to initiate measures that prevent or minimize uptake of the radioactive material into body cells or tissues.

b. In a contamination accident, any wound must be considered contaminated until proven otherwise and **should be decontaminated prior to decontaminating intact skin.**

c. When wounds are contaminated, the physician must assume that uptake (internal contamination) has occurred. Appropriate action is based on half-life, radiotoxicity, and the amount of radioactive material.

d. The following procedures are to be followed for the treatment of contaminated wounds:

i. Contaminated wounds are first draped, preferably with a waterproof material, to limit the spread of radioactivity.

ii. Wound decontamination is accomplished by gently irrigating with saline or water. More than one irrigation is usually necessary.

Note: Water from the irrigation should be placed in a waste receptacle that is lined with a plastic bag.

iii. The wound should be surveyed after each irrigation by qualified personnel.

iv. For the most accurate survey results, contaminated drapes, dressings, etc., should be removed, if possible before each survey.

v. Following repeated irrigations, the wound is treated like any other wound. Debrided or excised tissue with embedded radioactive materials should be retained for health physics assessment.

vi. If the preceding decontamination procedures are not successful, excision of vital tissue should not be initiated until expert medical or qualified personnel advice is obtained.

vii. Embedded radioactive particles, if visible should be removed with forceps and saved for analysis.

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viii. After the wound has been decontaminated, it should be covered with a waterproof dressing. The area around the wound is decontaminated as thoroughly as possible before suturing or other treatment.

ix. Contaminated burns (chemical, thermal) are treated like any other burn. Contaminants will slough off with the burn eschar. However, dressings and bed linens can become contaminated and should be handled appropriately.

5. The following procedures are to be followed for the decontamination of body orifices:

a. Note: Before decontaminating bodily orifices, the treatment team should obtain advice from qualified personnel about the need to take samples.

b. Contaminated body orifices, such as the mouth, nose, eyes, and ears need special attention because absorption of radioactive material is likely to be much more rapid in these areas than through the skin.

c. If radioactive material has entered the oral cavity, encourage brushing the teeth with toothpaste and frequent rinsing of the mouth.

i. If the pharyngeal region is also contaminated, gargling with a 3-percent hydrogen peroxide solution might be helpful.

ii. Gastric lavage may also be used if radioactive materials were swallowed.

iii. Contaminated eyes should be rinsed by directing a stream of water from the inner canthus to the outer canthus of the eye while avoiding contamination of the nasolacrimal duct.

iv. Contaminated ears require external rinsing, and an ear syringe can be used to rinse the auditory canal, provided the tympanic membrane is intact.

6. The following procedures are to be followed for the decontamination of intact skin:

a. Decontamination of the intact skin is a relatively simple procedure. Complete decontamination, which returns the area to a background survey reading, is not always possible because some radioactive material can remain fixed on the skin surface. Decontamination should be only as thorough as practical.

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b. The simplest procedure is to wash the contaminated area gently with soap and water (do not splash) and scrub at the same time using a soft brush or surgical sponge. Warm, never hot, tap water is used. Cold water tends to close the pores, trapping radioactive material within them. Hot water causes vasodilation with increased area blood flow, opens the pores, and enhances the chance of absorption of the radioactive material through the skin.

Aggressive rubbing tends to cause abrasion and erythema and should be avoided.

c. A mild soap (neutral pH) or surgical scrub soap can be used. The area should be scrubbed for 3 to 4 minutes, then rinsed for 2 to 3 minutes and dried, repeating if necessary.

d. Between each scrub and rinse, check the contaminated area to see if radiation levels are decreasing. A mildly abrasive soap can be used for calloused areas.

e. Contaminated hairy areas can be shampooed several times. Contaminated hair can be clipped if shampooing is ineffective. Shaving should be avoided since small nicks or abrasions can lead to internal contamination. When shampooing the head, avoid getting any fluids into the ears, eyes, nose, or mouth.

f. Ambulatory patients with localized contamination can be decontaminated using a sink or basin.

g. If extensive body areas are contaminated, the patient can be showered under the direction or with the assistance of qualified personnel. Caution the patient to avoid splashing water into the eyes, nose, mouth, or ears. Repeated showers might be necessary, and clean towels provided for drying after each shower. Again, decontamination should be as thorough as practical.

h. Management of the wastewater should follow the “Recommendations for the Management of Waste Water During Decontamination at the Hospital Site” or the directions of qualified personnel.

i. **The decontamination procedure stops when the radioactivity level cannot be reduced to a lower level.** Qualified personnel might be needed to determine an appropriate stopping point.

7. Treatment of Internal Contamination: Once radioactive materials cross cell membranes, they are said to be incorporated.

a. Incorporation is a time-dependent, physiological phenomenon related to both the physical and chemical natures of the contaminant.

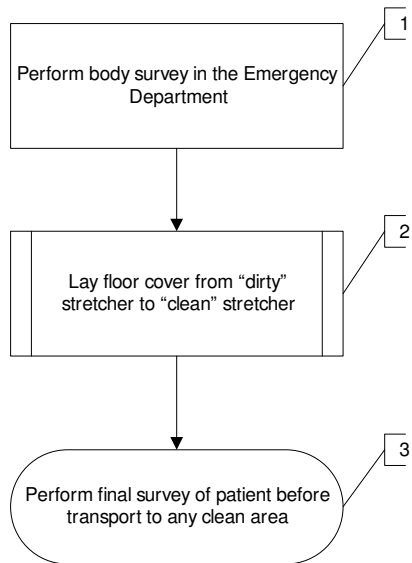
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- b. Incorporation can be quite rapid, occurring in minutes, or it can take days to months. Thus, time can be critical and prevention of uptake is urgent.
 - c. Several methods of preventing uptake (e.g., catharsis, gastric lavage) might be applicable and can be prescribed by a physician.
 - d. Some of the medications or preparations used in decorporation (see chart on page X) might not be available locally and should be stocked when a decontamination station is being planned and equipped.
 - e. Examples of specific agents used for selected radionuclides can be seen in the table below.
 - f. Expert guidance is available from:
 - i. DHFS Radiation Protection Section 24/7 telephone number:
608-258-0099
 - ii. REAC/TS 24/7 telephone number: 865-576-1005
8. If internal contamination is suspected or has occurred, the physician or qualified personnel should request samples of urine, feces, vomitus, wound secretion, etc.
9. The contaminated patient admitted with an airway or endotracheal tube must be considered to be internally contaminated.

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Part A: Template Policies for Hospitals

Policy Five: Flowchart for “Transfer of Patient from Emergency Department”



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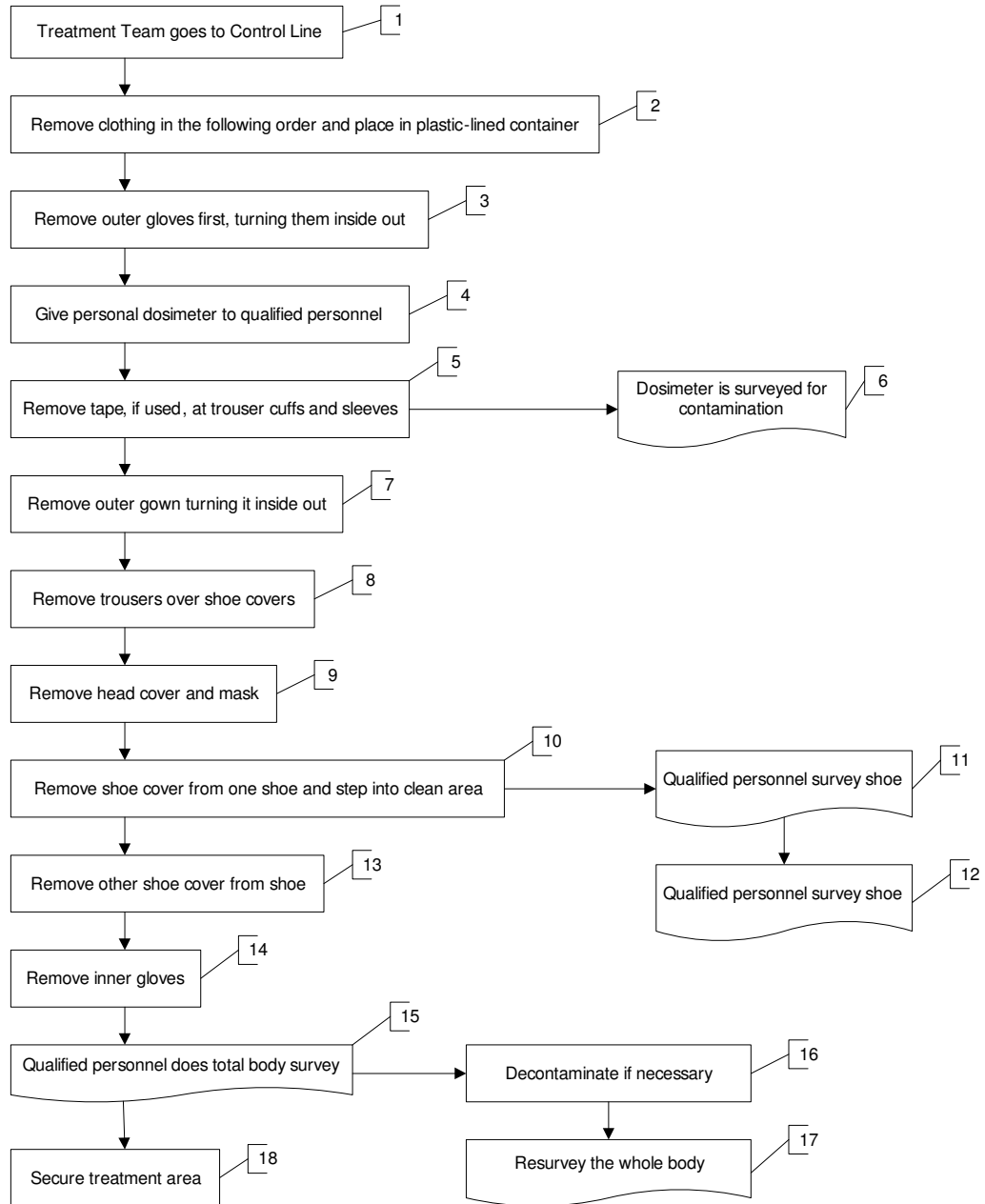
Policy Five: Transfer of the Patient from the Emergency Department, Following Decontamination Procedures

1. Before transfer of the patient, a final complete-body survey is performed.
2. A new floor covering is laid from the clean area to the patient stretcher in order to cover the potentially contaminated floor.
3. A clean stretcher is brought in, the patient is transferred to it by clean attendants (those involved in the decontamination procedure may become contaminated), and the patient is wheeled to the door.
4. After qualified personnel make a final check of the patient and the stretcher (especially the wheels), the patient is taken from the room.

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Part A: Template Policies for Hospitals

Policy Six: Flowchart for “Doffing and Terminal Cleaning”



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Policy Six: Doffing of Personal Protective Equipment

1. The following doffing procedures are to be followed by the Team after patient decontamination and treatment:
 - a. All members of the treatment team go to the control line and remove their protective clothes. All removed clothing and materials are to be placed in a free-standing, plastic-lined, waste container.
 - b. Remove outer gloves first, turning them inside-out as they are pulled off.
 - c. Give personal dosimeter, if being used, to qualified personnel.
 - d. Survey personal dosimeter for contamination.
 - e. Remove all tape, if used, at trouser cuffs and sleeves
 - f. Remove outer surgical gown, turning it inside-out -- avoid shaking.
 - g. Pull surgical trousers off over shoe covers.
 - h. Remove head cover and mask.
 - i. It is recommended to have a chair available when removing shoes.
 - j. Remove shoe cover from one foot and let qualified personnel survey shoe; if shoe is clean, step over control line, then remove other shoe cover and survey other shoe.
 - k. Remove inner gloves.
 - l. Do total-body radiological survey of each team member. If there is any evidence of contamination, the person needs to be decontaminated
2. After staff exit, the treatment room should be secured and a sign reading **"CAUTION -- CONTROLLED AREA -- DO NOT ENTER"** should be posted.
3. Unless it is needed for emergency medical reasons, the treatment room remains secured until it can be checked and decontaminated, if necessary, by qualified personnel.
4. The terminal cleaning and decontamination of the treatment room and any other contaminated areas should be directed by the Radiation Section of the Bureau of Environmental and Occupational Health, Wisconsin Division of Public Health. Any contaminated areas should remain isolated and unoccupied until cleared for use by qualified personnel in collaboration with the Radiation Section.

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Part B: Template Policy for Emergency Medical Services

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Part C: Appendices

Appendix One: Obtaining Assistance from the Radiation Response Network

1. Hospitals that have a Nuclear Medicine service may have both the survey meter and the in-house qualified personnel with which to manage patients that have been exposed to and/or contaminated with radioactive agents.

**Any hospital that does not have qualified personnel is to call the
Radiation Protection Section,
Bureau of Environmental and Occupational Health,
Wisconsin Division of Public Health
24/7 at 608-258-0099**

2. The Radiation Protection Section will assess the situation and provide to the hospital the resources necessary to manage the incident.
3. The Radiation Protection Section maintains a “Radiation Response Network” of qualified personnel who can respond to the requesting hospital within one hour.
4. Until the arrival of qualified personnel from the “Radiation Response Network”, the hospital is to follow the directive as outlined previously in Part A.

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Appendix Two: Guidelines for Physician Offices and Clinics

1. In the event if a wide-spread incident involving radiological agents, diagnostic and treatment information will be made available to physician offices and clinics through the Radiation Protection Section, Bureau of Environmental and Occupational Health of the Wisconsin Division of Public Health.
2. Information can also be obtained by calling the Radiation Protection Section at 608-258-0099.

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Appendix Three: Training and Education

The purpose of this document is to provide template policies to hospitals and EMS and First Responder services so that these template policies can be adapted for use at hospitals and EMS/ First Responder services.

These policies then should be integrated with hospital decontamination plans with the assistance of the hospital Radiation Safety Officer or qualified personnel with the help of the following staff:

- Radiation Safety Officer
- Nuclear Medicine Department staff
- Emergency Department physicians and nurses
- Safety Officer
- Person in charge of Decontamination Training
- Person in the Incident Command System who will fulfill the role of the Technical Specialist in a radiation incident

The Expert Panel has drafted these template policies to provide useful information in one document so that is easy to understand and concise in nature. However, this document references other materials that can and should be used in addition to these template policies.

To assist in the training of staff at hospitals in these recommend procedures, the Hospital Disaster Preparedness Program has suggested the following guidelines:

#1: Each hospital is to identify a “Radiation Champion” who will be responsible for the implementation of these template policies at the hospital.

#2: The “Radiation Champion” will read, understand and adapt these template policies for implementation at the hospital.

#3: All Emergency Department Team Leaders will have reviewed these policies and viewed the CDC DVD, “Radiological and Nuclear Terrorism: Medical response to Mass Casualties”.

#4: All members of the Decontamination Team will have reviewed these policies and viewed the CDC DVD, “Radiological and Nuclear Terrorism: Medical response to Mass Casualties”.

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Appendix Four: Characteristics of Nuclear Radiation

Characteristics of Nuclear Radiation					
Name	Range in Air	Range in Tissue	Shielding Required	Biological Hazard	Source
alpha particle	5 cm	cannot penetrate skin	none	none, unless inhaled or ingested	decay of uranium and plutonium
beta particle	5 meters	several layers of skin	stopped by heavy clothing ¹	<u>External</u> : possible skin injury; <u>Internal</u> : a hazard only if inhaled or ingested	fission products and neutron induced elements
gamma ray	up to 500 meters	very penetrating	dense material such as concrete, steel plate or earth	whole body injury; many casualties are possible	decay of fission products and neutron induced elements
neutron	less than gamma rays	very penetrating	hydrogenous materials such as water or damp earth	whole body injury; many casualties are possible	Fission and fission reactions; Am-Be sources

¹ An example of heavy clothing is “turn out gear” for a fireman or a heavy trench coat

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Appendix Five: Information on the Effects of Radiation Injury on the Treated Patient

1. Exposure to high levels of penetrating radiation can involve the whole body (uniformly or non-uniformly), a significant portion of the body, or a small, localized part. The exposure can be acute, protracted, or fractionated over time.
2. Local Injury: Most radiation injuries are "local" injuries, frequently involving the hands. These local injuries seldom cause the classical signs and symptoms of the acute radiation syndrome.
 - a. Consider local radiation injury in the differential diagnosis if the patient presents with a skin lesion without a history of chemical or thermal burn, insect bite, or history of skin disease or allergy.
 - b. If the patient gives a history of possible radiation exposure (such as from a radiography source, X-ray device, or accelerator) or a history of finding and handling an unknown metallic object, note the presence of any of the following: erythema, blistering, dry or wet desquamation, epilation, ulceration. Local injuries to the skin evolve very slowly over time and symptoms may not manifest for days to weeks after exposure.
 - c. Conventional wound management is usually ineffective in these cases.
 - d. Consultation with qualified personnel regarding definitive diagnosis, tissue dose, treatment, and prognosis is recommended.
3. **Acute Radiation Syndrome:** Acute radiation syndrome (ARS) is an acute illness caused by irradiation of the whole body (or a significant portion of it). It follows a somewhat predictable course and is characterized by signs and symptoms, which are manifestations of cellular deficiencies and the reactions of various cells, tissues, and organ systems to ionizing radiation.

Immediate, overt manifestations of the acute radiation syndrome require a large (i.e., hundreds of rem, usually whole-body) dose of penetrating radiation delivered over a short period of time. Penetrating radiation comes from a radioactive source or machine that emits gamma rays, X-rays, or neutrons. The signs and symptoms of this syndrome are non-specific and may be indistinguishable from those of other injuries or illness.

The ARS is characterized by four distinct phases:

- a. a prodromal period, a latent period, a period of illness, and one of recovery or death.
- b. During the prodromal period patients might experience loss of appetite, nausea, vomiting, fatigue, and diarrhea; after extremely high doses, additional

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symptoms such as fever, prostration, respiratory distress, and hyperexcitability can occur.

- c. However, all of these symptoms usually disappear in a day or two, and a symptom-free, latent period follows, varying in length depending upon the size of the radiation dose.
 - d. A period of overt illness follows, and can be characterized by infection, electrolyte imbalance, diarrhea, bleeding, cardiovascular collapse, and sometimes short periods of unconsciousness.
 - e. Death or a period of recovery follows the period of overt illness.
4. In general, the higher the dose the greater the severity of early effects and the greater the possibility of late effects. Depending on dose, the following syndromes can be manifest:
- a. Hematopoietic syndrome - characterized by deficiencies of WBC, lymphocytes and platelets, with immunodeficiency, increased infectious complications, bleeding, anemia, and impaired wound healing.
 - b. Gastrointestinal syndrome - characterized by loss of cells lining intestinal crypts and loss of mucosal barrier, with alterations in intestinal motility, fluid and electrolyte loss with vomiting and diarrhea, loss of normal intestinal bacteria, sepsis, and damage to the intestinal microcirculation, along with the hematopoietic syndrome.
 - c. Cerebrovascular/Central Nervous System syndrome - primarily associated with effects on the vasculature and resultant fluid shifts. Signs and symptoms include vomiting and diarrhea within minutes of exposure, confusion, disorientation, cerebral edema, hypotension, and hyperpyrexia. Fatal in short time.
 - d. Skin syndrome - can occur with other syndromes; characterized by loss of epidermis (and possibly dermis) with "radiation burns."
5. Diagnosis
- a. History of exposure - consider acute radiation syndrome in the differential diagnosis if there is:
 - i.a history of a known or possible radiation exposure (for example, entering an irradiation chamber when the source is unshielded)
 - ii.a history of proximity to an unknown (usually metallic) object with a history of nausea and vomiting, especially if n/v are unexplained by other causes

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- iii.a tendency to bleed (epistaxis, gingival bleeding, petechiae) and/or respiratory infection with neutropenia, lymphopenia, and thrombocytopenia, with history of nausea and vomiting two to three weeks previously
 - iv.epilation, with a history of nausea and vomiting two to three weeks previously
 - b. Symptom - type of symptom, time of onset, severity, and frequency.
 - c. Clinical Lab - STAT CBC with differential. Repeat in 4-6 hours, then every 6 to 8 hours for 24 to 48 hours. Look for a drop in the absolute lymphocyte count if the exposure was recent. If the initial WBC and platelet counts are abnormally low, consider the possibility of exposure a few days to weeks earlier.
6. Acute Radiation Syndrome: Dose Less Than 2 Gy (200 rad)
- a. Nausea and vomiting due to radiation are seldom experienced unless the exposure has been at least 0.75 to 1 Gy (75-100 rads) of penetrating gamma or X-rays and it has occurred within a matter of a few hours or less. The prospective patient who has been asymptomatic within the past 24 hours will most certainly have had less than 0.75 Gy of whole-body exposure. Hospitalization generally will be unnecessary if the dose has been less than 2 Gy (200 rads).
 - b. Management of ARS (dose <2 Gy):
 - i.Close observation and frequent CBC with differential.
 - ii.Outpatient management may be appropriate.
 - iii.Provide instructions regarding home care.
7. Acute Radiation Syndrome: Dose Greater Than 2 Gy (200 rad). Signs and symptoms become increasingly severe with dose.
- a. Hematopoietic Syndrome:
 - i.The prodromal phase - nausea, vomiting and anorexia within a few hours at the higher dose levels, or after 6 to 12 hours at the lower dose levels. Lasts 24 to 48 hours, after which time the patient is asymptomatic and may feel well. The absolute lymphocyte count will fall; a stress response of WBC may be present.

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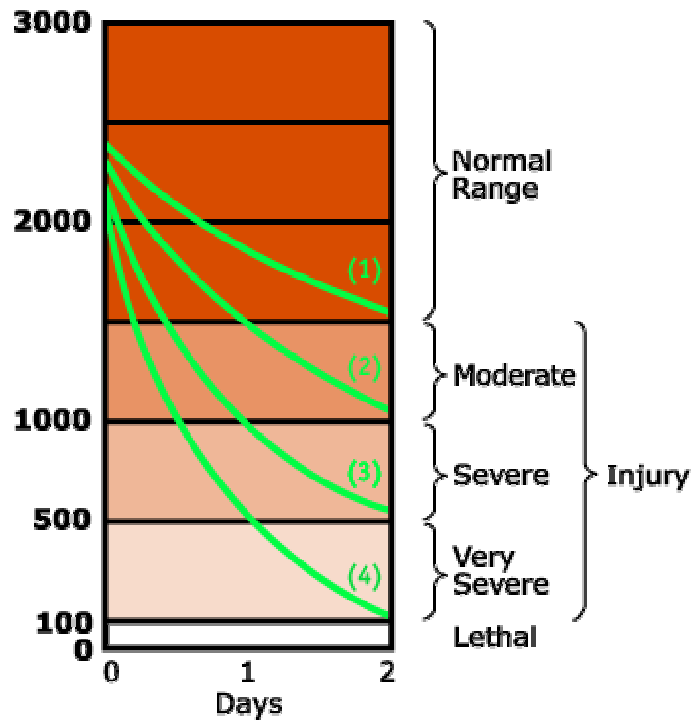
- ii. The latent phase - lasts a few days to as long as 2 to 3 weeks at the lower dose levels. The patient is asymptomatic but CBCs will show characteristic changes in the blood elements, with lymphocyte depression and gradual decrease in neutrophil and platelet counts.
 - iii. A bone marrow depression phase requires sophisticated treatment. Infection and hemorrhage could occur when white cell and platelet counts become critically low.
 - iv. The recovery phase - stem cells in the bone marrow are never completely eradicated at 2 to 10 Gy (200 to 1000 rads); some may replicate and eventually produce sufficient blood elements. Supportive therapy is required.
- b. Gastrointestinal Syndrome:
- i. Over 10 Gy (1000 rads) - this syndrome is distinguishable from the hematopoietic syndrome by the immediate, prompt and profuse onset of nausea, vomiting and diarrhea, followed by a short latent period.
 - ii. GI symptoms recur and lead to marked dehydration, and vascular effects.
 - iii. The GI mucosa becomes increasingly atrophic, and massive amounts of plasma are lost to the intestine. Massive denuding of the GI tract and accompanying septicemia and dehydration can occur.
 - iv. If the patient survives long enough, depression of the hematopoietic system occurs and complicates the clinical course.
- c. Cardiovascular Syndrome:
- i. Over 30 Gy (3000 rads), an extremely high dose, to the whole-body.
 - ii. Always fatal, there is immediate nausea, vomiting, anorexia and prostration, and irreversible hypotension; blood pressure will be markedly unstable.
 - iii. Within hours after exposure, the victim will be listless, drowsy, tremulous, convulsive, and ataxic.
 - iv. Death most likely will occur within a matter of days.
8. Management of Acute Radiation Syndrome (Dose >2 Gy)
- a. Initial management:

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- i. Vomiting - use selective blocking of serotonin 5-HT₃ receptors or use 5-HT₃ receptor antagonists.
 - ii. Consider initiating viral prophylaxis.
 - iii. Consider tissue, blood typing.
 - iv. Treat trauma.
 - v. Consider prompt consultation with hematologist and radiation experts, re: dosimetry and prognosis use of colony stimulating factors, stem cell transfusion, and other treatment options.
 - vi. Draw blood for chromosome analysis; use heparinized tube.
 - vii. Note areas of erythema and record on body chart. If possible, take photographs.
- b. Begin, as indicated:
- i. Supportive care in a clean environment (reverse isolation).
 - ii. Prevention and treatment of infections.
 - iii. Stimulation of hematopoiesis (use of growth factors, i.e., GCSF, GMCSF, interleukin 11).
 - iv. Stem cell transfusions: cord blood, peripheral blood, or bone marrow. Platelet transfusions if bleeding occurs or if platelet count too low.
 - v. Psychological support.
 - vi. Observe carefully for erythema (document locations), hair loss, skin injury, mucositis, parotitis, weight loss, and/or FEVER.
 - vii. Consultation with experts in radiation accident management is encouraged.

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Patterns of early lymphocyte response in relation to dose.



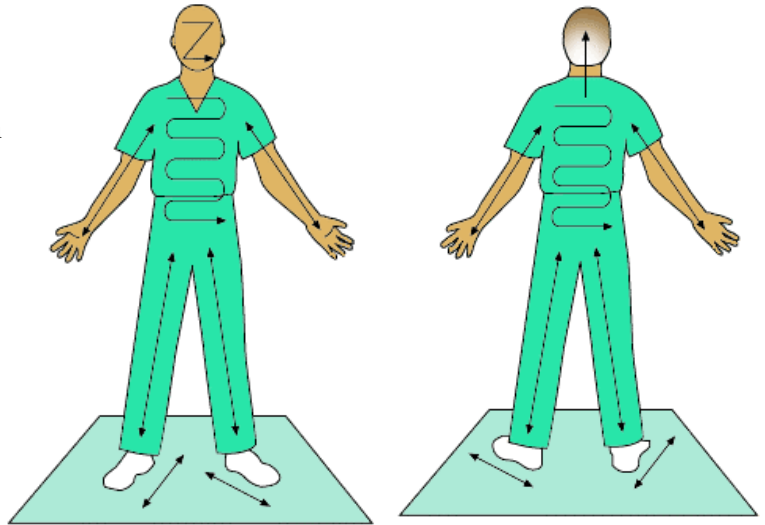
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Appendix Six: Recommended Procedures for Personnel Monitoring

1. Radiation cannot be detected by human senses. A variety of instruments are available for detecting and measuring radiation. The most common type of radiation detector is a Geiger-Mueller (GM) tube, also called a Geiger counter. The following procedures are to be followed in using the Geiger-Mueller (GM) Counter to survey.
2. Surveying the patient
 - a. Set the instrument selector switch to the most sensitive range of the instrument.
 - b. Holding the probe approximately 1/2 to 1 inch from the person's skin, systematically survey the entire body from head to toe on all sides.
 - i. Move the probe slowly (about 1 inch per second).
 - ii. Do not let the probe touch anything.
 - iii. Try to maintain a constant distance.
 - iv. Pay particular attention to hands, face and feet.
 - c. Ending the radiation survey:
 - i. Switch off the meter.
 - ii. Replace the cap on the meter probe.
 - iii. Take the batteries out.
 - iv. Put the Geiger counter back in its case.

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1. Survey is to be completed by qualified personnel.
2. Have the person stand on a clean pad.
3. Instruct the person to stand straight, feet spread slightly, arms extended with palms up and fingers straight out.
4. Monitor both hands and arms; then repeat with hands and arms turned over.
5. Starting at the top of the head, cover the entire body, monitoring carefully the forehead, nose, mouth, neckline, torso, knees, and ankles.
6. Have the subject turn around, and repeat the survey on the back of the body.
7. Monitor the soles of the feet.



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Appendix Seven: Radiological and Clinical Laboratory Assessments

1. All samples *must* be placed in separate, labeled containers that specify name, date, time of sampling, area of samples, and size of area samples.
2. It is suggested that blood, urine, feces, or other samples taken in the emergency treatment period be retained for subsequent investigation.
3. Appropriate advice (legal, radiation safety, etc.) should be obtained regarding the storage and disposition requirements of collected samples.

Table One: Clinical Samples		
Samples Needed	Why?	How?
In all cases of radiation injury		
CBC and differential STAT (follow with absolute lymphocyte counts every 6 hours for 48 hours when history indicates possibility of total-body irradiation)	To assess the radiation dose; initial counts establish a baseline, subsequent counts reflect the degree of injury	Choose a non-contaminated area for veni-puncture; cover puncture site after collection
Routine urinalysis	To determine if kidneys are functioning normally and establish a baseline of urinary constituents; especially important if internal contamination is a possibility	Avoid contaminating specimen during collection; if necessary, give the patient plastic gloves to wear for collection of specimen; label specimen "Number 1," with date and time
When external contamination is suspected		
Swabs from body orifices	To assess possibility of internal contamination	Use separate saline- or water- moistened swabs to wipe the inner aspect of each nostril, each ear, mouth, etc.
<i>Continued on next page</i>		

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Wound dressing and/or swabs from wounds	To determine if wounds are contaminated	Save dressings in a plastic bag. Use moist or dry swabs to sample secretions from each wound, or collect a few drops of secretion from each using a dropper or syringe; for wounds with visible debris, use applicator or long tweezers or forceps to transfer samples to specimen containers which are placed in lead storage containers (pigs)
When internal contamination is suspected		
Urine: 24-hour specimen x 4 days and feces x 4 days	Body excreta may contain radionuclides if internal contamination has occurred	Use 24-hour urine collection container

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Table Two: Possible Treatment for Selected Internal Contaminants			
Radionuclide	Medication	For Ingestion/Inhalation²	Principle of Action
Iodine	KI (potassium iodide) Lugols Solution	130 mg (tabl) stat, followed by 130 mg q.d. x 7 if indicated	Blocks thyroid deposition
Rare earths Plutonium Transplutronics Yttrium	Zn-DTPA Ca-DTPA	1 gm Ca-DTPA (Zn-DTPA) in 150-250 ml 5 percent D/W IV over 60 minutes	Chelation
Uranium	Bicarbonate	2 ampules sodium bicarbonate (44.3 mEq each; 7.5%) in 1000 cc normal saline @ 125 cc/hr; alternately, oral administration of two bicarbonate tablets every 4 hours until the urine reaches a pH of 8-9	Alkalinization of urine; reduces chance of acute tubular necrosis
Cesium Rubidium Thallium	Prussian Blue [Ferrihexacyano-Ferrate (II)]	1 gm with 100-200 ml water p.o. t.i.d. for several days	Blocks absorption from GI tract and prevents recycling.
Tritium	Water	Force fluids	Isotopic dilution

² These recommendations from REAC/TS and are adult dosages

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Appendix Eight: Glossary of Terms

Alpha particle: Charged particles relatively large compared to other radioactive particles. Because of their size, alpha particles cannot travel far. Alpha particles can be stopped by a thin layer of light material, such as a sheet of paper, and cannot penetrate the outer, dead layer of skin. Therefore, they do not damage living tissue when outside the body. When alpha-emitting particles are inhaled or swallowed, however, they are especially damaging because they transfer relatively large amounts of ionizing energy to living cells.

Background radiation: Ionizing radiation from natural sources to which people are routinely exposed.

Beta particles: Charged particles that are smaller than an alpha particle. Although they can be stopped by a thin sheet of aluminum, beta particles can penetrate the dead skin layer, potentially causing burns. If received in excessive amounts (see page XX) beta particles can be lethal. They also pose a serious internal radiation threat if beta-emitting particles are ingested or inhaled.

Control Line: the demarcation between the controlled area and the normal area of a hospital

Dirty bomb: a device designed to disperse radioactive materials through a conventional explosive device; also know as a “radiation dissemination device” (RDD)

Dose (radiation dose): A measure of the radiation absorbed in a person’s body (see page 25, #10).

Dose rate: The radiation dose delivered per unit of time.

Dosimeter (personal): A small portable instrument (such as a film badge, thermoluminescent dosimeter [TLD], or pocket dosimeter) for measuring and recording the total accumulated dose of ionizing radiation a person receives.

Electron: part of an atom with a negative charge.

Exposed Patient (radiation): a person in the vicinity or in contact with a source of radiation (exposure does not necessarily mean that the person has been contaminated)

External contamination: radioactive materials on the outside of the body

Gamma rays: High-energy electromagnetic radiation or rays, emitted by some radioactive materials. Gamma rays are similar to x-rays.

Incident Command: this is a nationally accepted method to manage an occurrence, either caused by human or natural phenomena, that requires a response to prevent or minimize loss of life or damage to property

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Internal contamination: radioactive contamination taken into the body by inhalation or ingestion

Ion: A charged, positive or negative, atom.

Ionizing radiation: Any radiation capable of producing ions. High doses of ionizing radiation may produce severe tissue damage such as from the radiation, received from x-ray machines or a radioactive source.

Irradiation: Exposure to radiation.

Neutron: A particle possessing no electrical charge found within an atom's nucleus, but one that still can cause damage to human tissue.

Non-ionizing radiation: radiation that has lower energy levels and longer wave lengths than ionizing radiation. It is not strong enough to affect the structure of what it contacts, but it is strong enough to heat tissue and can cause harmful biological effects. Examples include radio waves, microwaves, visible light and infra-red rays from a heat lamp.

Nucleus: The inner parts of an atom made up of protons and neutrons.

Penetrating radiation: Radiation that can penetrate the skin and reach internal organs and tissues. Gamma rays, x-rays, neutrons are penetrating radiations. However, alpha particles and all but extremely high-energy beta particles are not considered penetrating radiation.

Proton: A particle having a single positive electrical charge located in the nucleus of an atom.

Qualified personnel: A radiation safety officer or someone with knowledge and expertise to perform radiation measurements such as a radiologist, nuclear medical technician, radiation oncologist.

Radiation: Energy moving in the form of particles, rays or waves. Familiar radiations are heat, light, radio waves, and microwaves and gamma, beta and x-rays

Radiation Safety Officer: a person appointed to oversee the radiation safety program (a hospital may not have a Radiation Safety officer, qualified to manage radioactive materials, if it does not have a nuclear medicine department)

Radioactive contamination: The deposition of unwanted radioactive material on the surfaces of structures, areas, objects or people. It can be airborne, external or internal.

Radioactive material: Material that contains unstable (radioactive) atoms that give off radiation.

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Radioactivity: The process of radioactive material giving off ionizing radiation or gamma rays.

Survey: the process of measuring radiation or contamination by using appropriate instrumentation

Survey Meter: an instrument used to measure radiation rates

X-ray: radiation very much like gamma rays, but most often generated by machines

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Appendix Nine: The Smoky Bomb Threat

By PETER D. ZIMMERMAN

London

December 19, 2006 Op-Ed Contributor

The exotic murder-by-polonium of the former K.G.B. spy Alexander Litvinenko has embroiled Russia, Britain and Germany in a diplomatic scuffle and a hunt for more traces of the lethal substance. But it also throws into question most of the previous analyses of “dirty bombs,” terrorist attacks using radioactive isotopes wrapped in explosives (or using other dispersion techniques) to spread radioactive material in crowded areas.

Essentially all analysts, myself included, played down the possibility of using alpha radiation — fast-moving helium nuclei ejected during the radioactive decay of certain isotopes, such as of polonium 210, the substance that killed Mr. Litvinenko — as a source of dirty bombs. We concentrated instead on isotopes that emit penetrating gamma rays, which are basically super-powered packets of light, hard to shield and effective at a yard or more.

The alpha radiation from polonium can be easily shielded — by a layer of aluminum foil, a sheet or two of paper, or the dead outer layer of skin. And so, the reasoning went, alpha radiation could not hurt you as long as the source stayed outside your body. Exactly. Mr. Litvinenko was apparently killed by polonium that he ate or drank or inhaled. That source was so physically small that it was hard to see, perhaps the size of a couple of grains of salt and weighing just a few millionths of a gram.

Dirty bombs based on gamma emitters, analysts have learned, can't kill very many people. Mr. Litvinenko's death tells us that “smoky bombs” based on alpha emitters very well could.

Polonium 210 is surprisingly common. It is used by industry in devices that eliminate static electricity, in low-powered brushes used to ionize the air next to photographic film so dust can be swept off easily, and in quite large machines placed end-to-end across a web of fabric moving over rollers in a textile mill. It is even used to control dust in clean rooms where computer chips and hard drives are made.

It may be difficult to get people to eat polonium; it isn't hard to force them to breathe it. The problem for a radiological terrorist is to get his “hot” material inside people's bodies where it will do the most harm. If the terrorist can solve that problem, then alpha radiation is the most devastating choice he can make. Precisely because alpha particles stop in such a short distance, they deposit all of their energy in a relatively small number of cells, killing them or causing them to mutate, increasing the long-term risk of cancer.

The terrorist's solution lies in getting very finely divided polonium into the air where people can breathe it. Without giving away any information damaging to national

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security, I see several fairly simple ways to accomplish this: burn the material, blow it up, dissolve it in a lot of water or pulverize it to a size so small that the particles can float in the air and lodge in the lungs.

It would be unwise for me to dwell on the details of just how one goes about getting a hot enough fire or breaking polonium into extremely fine “dust.” In the end, however, the radioactive material will appear like the dust from an explosion, or the smoke from a fire. My point is to demonstrate the urgent need for new thinking in the regulatory arena, not to give away important information.

Air containing such radioactive debris would appear smoky or dusty, and be dangerous to breathe. A few breaths might easily be enough to sicken a victim, and in some cases to kill. A smoky bomb exploded in a packed arena or on a crowded street could kill dozens or hundreds. It would set off a radiological emergency of a kind not seen before in the United States, and the number of people requiring life support or palliative care until death would overwhelm the number of beds now available for treating victims of radiation. First responders dashing unprotected into the cloud from a smoky bomb might be among the worst wounded. Fire and police departments around the country will need alpha radiation detectors, since the counters they carry now cannot see alphas.

Some of the steps involved with making a good smoky bomb from polonium would be dangerous for the terrorists involved, and might cost them their lives. That, unfortunately, no longer seems like a very high barrier.

What can we do to stop them? We must make it far less easy for them to acquiring polonium in deadly amounts. Polonium sources with about 10 percent of a lethal dose are readily available — even in a product sold on Amazon.com. Only modest restraints inhibit purchase of significantly larger amounts of polonium: as of next year, anyone purchasing more than 16 curies of polonium 210 — enough to make up 5,000 lethal doses — must register it with a tracking system run by the Nuclear Regulatory Commission. But this is vastly too high — almost no purchases on that scale are made by any industry.

The commission (and the International Atomic Energy Agency as well) is said to be considering tighter regulations to make a repeat of the Litvinenko affair less probable. There is talk that it might tighten the polonium reporting requirement by a factor of 10, to 1.6 curies. That’s better, but still not strict enough.

The biggest problem is that the regulatory commission’s regulations do not restrict the quantity of polonium used in industry. This may make it quite easy for terrorists to purchase large amounts of one of the earth’s deadliest substances. A near-term goal should to require specific licensing of any person or company seeking to purchase alpha sources stronger than one millicurie, about a third of a lethal dose. A longer-term goal ought to be eliminating nearly all use of polonium in industry through other technologies.

That is a technical challenge and would cost some money, but it would certainly be less

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expensive than coping with the devastation of a smoky bomb.

Peter D. Zimmerman, a nuclear physicist, is a professor of science and security in the Department of War Studies at King's College London. He was chief scientist of the United States Senate Foreign Relations Committee from 2001 to 2003.

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Appendix Ten: Manual for First Responders to a Radiological Emergency

This Manual was published by the International Atomic Energy Agency (IAEA) in October 2006.

The aim of this Manual is to provide practical guidance for those who will respond during the first few hours to a radiological emergency (referred to here as ‘first responders’) and for national officials who would support this early response. It provides guidance in the form of action guides, instructions, and supporting data that can be easily applied by a State to build a basic capability to respond to a radiological emergency. This guidance should be adapted to fit the user State’s organizational arrangements, language, terminology, concept of operation and capabilities.

The full text of this Manual can be found at

http://www-pub.iaea.org/MTCD/publications/PDF/EPR_FirstResponder_web.pdf

The following “Questions and Answers” have been excerpted from the manual: Appendix IV - Frequently asked questions in a radiological emergency: suggested answers.

CAUTION: These answers are general in nature and must be revised based on the emergency and local conditions and arrangements.

General opening remarks: I am with *[insert name of official source of information and recommendations]* and we are the official source of information concerning this emergency. We understand that you may be concerned or even frightened. It is very early in the emergency and many things are very uncertain but I will keep you informed of any information that can help you to make responsible decisions. I may not be able to answer all your questions either because I do not know the answer, so I will not speculate, or for security reasons.

Answers to questions:

1. Who is in charge? *[Insert name]* is responsible for coordinating the joint response to this emergency. The official in charge is *[insert name of official source of information and recommendations]*. For further information, the public should contact *[name and phone number or website address]*.

2. What can I do to ensure that my family and I are safe now? You should follow the directions from *[name of official source of recommendations]*. Currently you are advised to *[summarize current recommendations, see Instruction 3]*. You should also be careful when considering the assessments and recommendations from non official

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sources. In the past such assessments and recommendations have resulted in people taking actions that were not justified and have done more harm than good.

3. *Is my family safe now? What could be the consequences for my health?* Based on experience from past emergencies, it is very unlikely that anyone, including unborn children, has been exposed to a radiation level that will result in any detectable health effects. However, in some cases, it may be necessary to conduct a further evaluation to determine if someone needs medical treatment or follow-up. Therefore some people may be asked to come in for a further assessment. Being called in for such assessment is a precaution and does not mean that you are at undue risk. It is important to realize that assessing the risk from a radiological emergency is highly specialized and can only be performed by someone with experience in this area.

4. *Why is it safe to be outside the safety boundary around the site of an emergency?* During an emergency, initial measurements are taken to determine the areas in which people can safely remain. These measurements consider the immediate effects possible from the levels of radiation present. The boundary for any evacuation areas is established using criteria to ensure that people outside this area remain safe until further tests are performed. This includes considering children playing on the ground and pregnant women. Those living very close to such boundaries are safe from immediate effects in the short term. However, it would be prudent to [*list recommendations to the people outside the inner cordoned area, see Instruction 3*]. Over a longer period, some of the areas near the boundary may require further measures, such as decontamination or brief evacuation, to reduce the risk of longer term effects from the cumulative exposure to low levels of radiation. In order to determine whether any such measures are needed, teams may be sampling and monitoring for radioactive contamination in the area. This does not mean that the area is unsafe; ongoing monitoring provides officials with the information needed to determine whether or not further measures might be needed in the area.

5. *What is contamination and is it dangerous? Are the food, water, milk and other products safe?* As a result of a radiological emergency, radioactive dust or liquid could get on the ground, products, food, in the water or even on a person. This is called contamination. The levels of contamination that could represent a health hazard would be very high, many times the amounts of radioactive material normally found in nature. The hazard from any contamination can only be determined based on criteria developed by experts and measurements taken by trained personnel. The criteria we are using to assess contamination are established well below the levels that could result in any health effects. (Therefore based on our current evaluation the following [*list*] are safe. **(or)** We are currently carrying on our evaluation and will inform you immediately on the results; but until notified you should [*insert recommendation*].)

6. *I was monitored and contamination was found. Am I safe?* People who may have been contaminated as a result of an emergency are monitored to assess the risk. Very low levels of radioactive materials can be detected by the instruments used to monitor for contamination. The levels of contamination that could represent a health hazard would be very high: many times the minimum amounts of radioactive material that can be detected

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by monitoring instruments or that are normally found in nature. The criteria used to determine if a person is contaminated to levels which warrant some actions (for example, showering and changing clothing) were established well below the levels that could result in any health effects. However, in some cases, it may be necessary to conduct a further evaluation to determine if someone needs medical treatment or follow-up. Therefore some people may be asked to come in for a further assessment. Being called in for such an assessment is a precaution and does not mean that you are at undue risk. It is important to realize that assessing the risk from a radiological emergency is highly specialized and can not be performed by anyone without experience in this area.

7. I am pregnant — what are the dangers for my baby?

It requires very high levels of exposure to radiation to cause even a small chance that the baby will be affected. These levels would be at least a million times what you normally receive from natural sources of radiation in an hour. Determining the risk to the baby is very complex and does not depend solely on the levels of exposure to radiation. Local officials have criteria to identify those who should be assessed. Being called in for such an assessment is a precaution and does not mean that your baby or you are at undue risk. The risk to your baby can only be assessed by an expert with experience in this field.

8. Why are higher doses for the public acceptable in this emergency rather than during the normal operation of a nuclear facility? Around a nuclear facility, such as a nuclear power plant, the dose limits for the public are established well below levels at which any health effects, including cancers, would be seen in anyone, including pregnant woman or children. This is done to ensure that the facility is operated safely and that an accident is unlikely to cause any health concern. During an emergency dose criteria are established that also ensures that all members of the public are safe. The dose criteria used to decide on the actions taken during an emergency are established based on many factors such as ensuring those that are at risk in the near term are protected first.

9. How can I find out what dose I may have received and what it means to my health?

We recognize that everyone is concerned about their health and the health of their loved ones. It is very early in the development of the emergency situation and it will be some time before an accurate assessment of the possible health consequences of the emergency can be made. It is important to realize that assessing the health risk from a radiological emergency is a highly specialized task and the risk can only be assessed by those who have experience in the field. We know that this emergency has caused considerable anxiety and you would like definitive answers now. But we also realize that it is important that any assessment be as good as possible. Therefore, we will inform every one of their risks and actions you should take as soon as possible. In some cases, it may be necessary to conduct a further evaluation to determine if someone needs medical treatment or follow-up. Therefore, some people may be asked to come in for a further assessment. Being called in for such an assessment is a precaution and does not mean that you are at undue risk.

10. Immediately following the emergency I was checked for contamination and I was told to change my clothes, take a shower, and listen for official instructions; what

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am I listening for? The first responders screened people for external contamination using hand held instruments to determine who needed immediate decontamination to prevent serious injury. In the next phase of the response, specialists trained in radiological assessment determine the specific type, form and quantity of radioactive materials present at the scene. Based on their analysis they may recommend that additional monitoring or evaluations be performed to better determine the dose received by specific individuals. Some people may be requested to present themselves for additional monitoring and evaluation. The request could be made by a public official using local radio or television if large numbers of people were involved, or you could be individually contacted if only a small number of people were exposed to the radiological hazard.

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Appendix Eleven: Radiation Event Medical Management – Guidance on Diagnosis and Treatment for Medical Providers

The US Department of Health and Human Services published in March of 2007 a web site, entitled, “Radiation Event Medical Management – Guidance on Diagnosis and Treatment for Medical Providers”.

This information can be found at <http://remm.nlm.gov/>

The goals of this site are to:

- provide guidance for health care providers, *primarily physicians*, about clinical diagnosis and treatment during mass casualty radiological/nuclear events
- provide just-in-time, evidence-based, usable information with sufficient background and context to make complex issues understandable to those *without* formal radiation medicine expertise
- provide web-based information that is also downloadable in advance, so that it would be available during an event if the internet is not accessible

REMM was produced by the Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response, Office of Planning and Emergency Operations, in cooperation with the National Library of Medicine, Division of Specialized Information Services, with subject matter experts from the National Cancer Institute, the Centers for Disease Control and Prevention, and many US and international [consultants](#).

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Appendix Twelve: Members of the State Expert Panel on Radiation Incidents

Radiological State Expert Panel

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