Guidelines For Hospital Response To Radiological Incidents

Kansas Department of Health & Environment

Bureau of Air & Radiation

March 2006

Table of Contents

This document is intended as a guide to assist Kansas hospitals who treat patients who may have been exposed or contaminated with radioactive materials. It is not intended to take the place of more detailed plans and procedures or the necessary training to ensure that all hospital staff involved are educated and informed of their roles and responsibilities.

BACKGROUND

There are many different scenarios for radiological incidents that may result in injured/contaminated persons. Examples of possible scenarios include:

PEACETIME:
- a transportation accident where radioactive material was released
- an accident involving an industrial source or from the medical use of radioactive materials
- an incident at a nuclear power plant

WAR/TERRORISM:
- a radiological dispersion device ("RDD" or "dirty bomb")
- an improvised nuclear device ("IND")

Acts of radiological terrorism differ from radiological accidents in several key ways. Accidents occur almost exclusively at well-characterized fixed facilities, or along prescribed transit routes. Facility operators have a good understanding of the kinds of radiological incidents that may occur, and have developed safeguards, plans, and procedures to deal with them. Accidents may also occur along transit routes, but these are relatively rare and substantial planning and exercising occurs for transportation accidents as well. Acts of radiological terrorism, however, may occur virtually anywhere. Major cities are potential targets of such incidents. The number of potential targets and the diverse circumstances of potential attacks make focused response planning almost impossible. Even a rural setting could fall victim, if for example, a device were to go off prematurely.

Peacetime

About 300 million domestic materials shipments per year are categorized as hazardous.[1] Of the hundreds of millions of packages sent in these shipments, only about 5 to 10 million contain radioactive materials, mostly of radioisotopes for medical, research, and industrial applications. During the 50+ years that radioactive materials have been shipped domestically, there have been relatively few accidents. There have been no deaths or injuries that can be attributed to the radioactive nature of the cargo.[2] The enforcement of packaging regulations and safety measures during shipment and handling of hazardous materials promises to keep the accident risk at a low level.

The Kansas Department of Health and Environment/Bureau of Air and Radiation registers all radiation-producing devices and licenses all radioactive materials in Kansas. Requirements for obtaining a license or being registered include having a trained and qualified Radiation Safety Officer for the material. It is unlikely that a hospital would be required to deal with a radioactively contaminated patient from this source without having expertise available to assist them.

There are two nuclear power plants which may affect Kansas: Cooper Nuclear Station (Brownville, Nebraska) and Wolf Creek Generating Station (Burlington, Kansas). The likelihood of an incident at either of these facilities that results in a release of radioactive materials offsite is extremely slim. However, there are extensive plans and procedures to respond to any such incident already in place. Hospitals in Kansas who may receive a contaminated/injured patient from an incident at Wolf Creek currently receive annual training to prepare them for such an event.

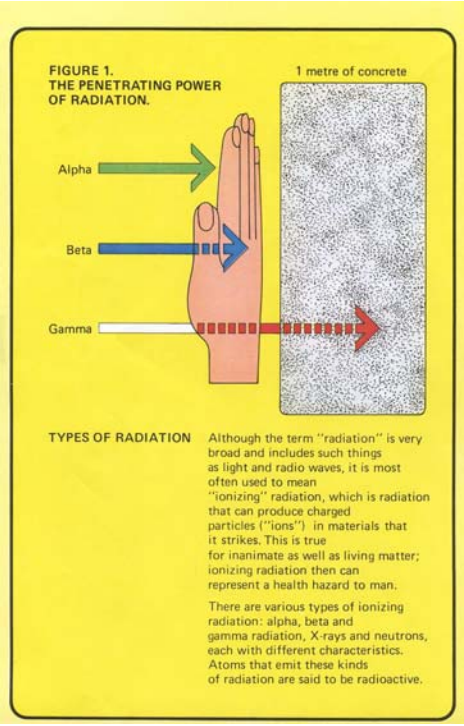
War/Terrorism

A Radiological Dispersal Device (RDD) poses a threat to public health and safety though the spread of radioactive materials by some means of dispersion. The mode of dispersal typically conceived as an RDD is an explosive device coupled with radioactive material, which presents an added immediate explosive threat to human life and property. Other means of dispersal, both passive and active, may be employed. Such incidents may include covert pumping, spraying or hand-distribution of a radioactive liquid, aerosol or powder, spraying from aircraft, injection into air-handling systems and other possible methods. There are a wide range of possible consequences that may result from an RDD. These may range from a very small, localized area (such as a single building) to large areas, conceivably many square miles. However, the likelihood of a large impacted area is low. In most plausible scenarios, the radioactive material would not cause acutely harmful radiation doses, and the public health concern from those materials would be chronic risk of cancer to exposed individuals. Hazards from fire, smoke, shock, shrapnel (from an explosion), industrial chemicals, and other chemical or biological agents may also be present.

An Improvised Nuclear Device (IND) is a nuclear weapon. The nuclear yield achieved by an IND produces extreme heat, powerful shockwaves, and prompt radiation that would be acutely lethal for a significant distance. It also produces radioactive fallout, which may spread far downwind and deposit over very large areas. There may be a large radius of severe damage from blast and heat.

RADIATION BASICS

There are four main types of nuclear radiation. These types of radiation are called "ionizing radiation" because they can cause ionization (change of electrical charge) of the matter with which they react.



ALPHA
An alpha particle can travel a few inches in air, and is stopped by a single sheet of paper or the dead layer of skin. Alpha radiation is considered an "internal hazard", meaning that it poses a risk to the body only if the material is ingested or inhaled.

BETA
Beta radiation has more penetrating power than alpha. Beta radiation can be shielded by a thin layer of aluminum or plastic, and is primarily a hazard for the skin and eyes. Beta emitting radioactive materials can cause skin burns, sometimes called "beta burns" if left in prolonged contact with the skin.

GAMMA
Gamma radiation is a wave of energy, not a particle, and has high penetrating ability. Gamma rays are shielded by dense materials such as lead and steel, and are considered an external hazard.

NEUTRON
Neutron radiation is usually encountered where active nuclear fission (splitting) is occurring, such as in an operating nuclear reactor or a detonating nuclear weapon. Neutrons are very penetrating and can affect all organs.

UNITS OF RADIATION MEASUREMENT
- The basic unit of radiation is the Roentgen (R). The roentgen measures the amount of ionization in air from gamma or X-rays. The Roentgen and the milliRoentgen ("milli"=1/1000) are likely to be encountered using typical radiation detection equipment.

- Another unit is the Radiation Absorbed Dose (RAD). The RAD represents the actual amount of energy that radiation deposits in any material.

- For dose measurement in people, the Roentgen Equivalent Man (Rem) is used. The Rem describes the biological effect of radiation energy on human tissue (1milliRem=1/1000 Rem).

- Counts per Minute (cpm): Unit used to describe an exposure rate. The number of ionizing events during a period of time is being counted. Cpm is the proper unit for instrument readings when measuring beta-gamma emitting surface contamination.

For our purposes, we will consider the R, Rem and Rad to be interchangeable.

EXPOSURE

On average, a resident of the United States receives an annual radiation exposure of 375 milliRem (mrem) from natural and manmade sources:

Radiation Exposure from Various Sources

Source	Exposure
External Background Radiation	60 mrem/yr, U.S. Average
Natural K-40 Radioactivity in Body	40 mrem/yr
Air Travel Round Trip (NY-LA)	5 mrem
Chest X-ray Effective Dose	10 mrem per film
Radon in the Home	200 mrem/yr (variable)
Man-made (medical x-rays, etc.)	60 mrem/yr (average)

Source: Health Physics Society

The two types of radiation exposure are chronic and acute. Chronic exposures are exposures received over a long period of time. For example, the exposure to background radiation discussed above is a chronic exposure. Acute exposure is a large amount of radiation exposure in a short period of time. In adults, the bone marrow tends to be the most sensitive to radiation. For that reason, blood changes are the first evidence of radiation exposure. Without medical treatment, the risk of health effects is as follows:

- Less than 25 Rem: No observable effects
- 25 to 100 Rem: Slight blood changes, no other observable effect
- 100 to 200 Rem: Vomiting may occur within three hours of exposure. Moderate blood changes are possible. Except for blood-forming system, recovery will occur in essentially all cases within a few weeks.
- 200-600 Rem: Vomiting for most people occurs within three hours. Loss of hair after two weeks, severe blood changes, hemorrhaging and infection. Death may occur. The recovery period is one month to one year.
- Over 600 Rem: Vomiting occurs within one hour. Other effects include severe blood changes, hemorrhage, infection and hair loss. Probability of death is 80 percent (for 600 Rem) within two months. Survivors convalesce over a long period of time.

These types of doses will likely only be seen in the event of an IND. Other types of scenarios should not result in doses that even come close to showing physical effects. With an IND, the closer one is to "ground zero", the higher the radiation dose received and the more severe the effect of the blast in terms of destroyed houses and buildings and subsequent fires. Thus, it is difficult to distinguish death due to radiation from that due to injuries and/or burns.

The Kansas Protective Action Guides provide radiation dose limits for the general public and for emergency workers. Except for in special circumstances, the highest level allowed for lifesaving activities by an emergency worker is 25 rem. For activities other than lifesaving, the allowed dose is 5 rem for emergency workers and 1 rem for the public.[3] When an emergency worker reaches an exposure of 500 mR, as read on their direct reading dosimeter, they shall contact their supervisor. Other then lifesaving activities, when an emergency worker reaches an exposure of 1R (1000 mR) on their dosimeter they should exit the area and contact their supervisor. This information shall be provided to radiation staff at Kansas Department of Health and Environment who are responsible for ensuring worker dose limits are not surpassed. No health effects as described previously will be detected at these exposure levels.

There are three basic practices used to maintain exposures As Low As Reasonably Achievable (ALARA):

1. Time (reduce exposure time)

2. Distance (increase distance from the source of radiation)
3. Shielding (keep something in between the individual and the source of radiation)

EXPOSURE VS CONTAMINATION

Radiation *exposure* is being bombarded with radiation. An individual who has been exposed to radiation is not radioactive. Radioactive *contamination* is radioactive material wherever it is not wanted. (Becoming contaminated requires physical contact with the radioactive material).

THE HOSPITAL

The hospital emergency room may receive contaminated/injured patients who come with a wide variation of radiation protection capabilities. In some cases the hospital staff may find prompt and elaborate help available with historical and exposure information, medical advisors, radiation instrumentation, and health physics assistance. In others, only extremely modest help, if any, will be offered. The importance of pre-planning at the hospital cannot be overemphasized.

When persons are involved in off-site transportation accidents, emergency room physicians can expect almost no immediate technical support. The police or highway patrol will, at best, have limited capacity to assess radiation hazards and local emergency management may take some time to mobilize. Health physicists at Kansas Department of Health and Environment can be consulted and advice quickly given by telephone, but they will require some time for travel to provide on-site consultation.

Since the patient who is contaminated seldom has adequate information as to the specific radionuclides involved in the accident, the individuals who do have this information should be contacted as quickly as possible. When accidents occur after working hours or on weekends, collection of this information sometimes becomes difficult.

It is essential that the hospital emergency plan be prepared in advance for proper management of radioactively contaminated patients. The medical and nursing staff should be trained in the basic principles of decontamination and radiological safety.

MEDICAL RESPONSE

Following are listed some general guidelines and steps to be taken by a hospital during a medical response where radioactive materials may be involved:

RADIATION EMERGENCY AREA (REA) PREPARATION

1) Remove unnecessary equipment from designated Emergency or Treatment Room. Bring in any extra supplies you may need.

2) If available, place herculite or other substance on floor. Line waste containers with large plastic bags and label.

3) Put decontamination tabletop on Treatment Room gurney.

4) Place warning rope and signs.

5) Establish Buffer Zone and control points to distinguish Buffer Zone from Treatment Room.

6) Buffer Zone & Treatment Room = REA

> *Medical considerations and treatment always take precedence over efforts to reduce or control contamination. The risk of possible self-contamination and radiation exposure should not impede vital medical services.*

STAFF PREPARATION

1) Protective Clothing:

- Surgical Scrubs
- Protective Shoe Covers
- First Pair of Gloves
- Gown
- Second Pair of Gloves
- Cap and Mask

2) Dosimetry (See Appendix A for additional information and recommendations on dosimetry.)

- Permanent Record Dosimeter (TLD)
- Low Range Direct-Reading Dosimeter 0-200mR or 0-500mR
- Form on which to record individual doses

3) Prepare Monitoring Equipment (See Appendix A for additional information and recommendations on radiation monitoring equipment.)

- Staff should receive training on radiation detection instruments and survey techniques.
- One instrument stays in Treatment Area
- One instrument stays in Buffer Zone
- One instrument is available for monitoring ambulance personnel, vehicle and equipment.

PATIENT ARRIVAL AND TRIAGE

IT SHOULD BE NOTED EMPHATICALLY THAT RADIOACTIVE CONTAMINATION (WHETHER INTERNAL OR EXTERNAL) IS NEVER IMMEDIATELY LIFE THREATENING. CONTAMINATION ON A PATIENT WOULD NOT POSE A HEALTH THREAT TO HOSPITAL PERSONNEL OR A CONTAMINATION RISK TO THE HOSPITAL FACILITY. THEREFORE, A RADIOLOGICAL ASSESSMENT OR DECONTAMINATION SHOULD NEVER TAKE PRECEDENCE OVER SIGNIFICANT MEDICAL CONDITIONS. NORMAL UNIVERSAL PRECAUTIONS ARE ADEQUATE TO PROTECT FROM RADIOACTIVE CONTAMINATION.

1) Triage only according to injuries.

2) Immediately transfer patient to Treatment Area.

3) Immediately begin medical evaluation

4) If not already done so, remove patient's clothing and place in bag.

5) Complete turnover of patient care with EMS as appropriate. Allow EMS to exit Treatment Area. Have EMS remain in REA until monitored.

6) One survey meter should be used for the Treatment Area including patient, staff and equipment. One meter stays in the Buffer Zone to be used for staff, equipment and hallways. One meter should be used for ambulance and EMS staff.

7) As soon as possible sweep the Buffer Zone and hallway with masslin cloth and survey masslin. If masslin cloth is contaminated, bag and label it and decontaminate hallway with water and soap. Monitor the ambulance interior for any contamination.

MEDICAL ASSESSMENT

1) While treating patient be sure to save any samples that may be useful in further treatment of contamination or internal contamination. The following must be saved, if obtained, and labeled:

   Swabs from nasal, ear, oral; vomit; skin wipes; foreign material; hair/nails; urine; wound dressings; exudate

2) The samples are transferred to the Buffer Zone attendant at control points using proper contamination control procedures.

   - Buffer Zone attendant holds open plastic bag.
   - Attending personnel place sample container into bag (at no time does the attendant or the sample touch the outside of the bag.

   - Bag is then sealed and labeled again if necessary.

3) Contamination control must be maintained during X-ray procedures.

RADIOLOGICAL ASSESSMENT

1) Only after patient is stabilized will a survey for contamination be made.

2) Monitoring of patient should start at the head and finish at the feet. Entire body should be monitored with results being called out to Buffer Zone attendant who will record them. The most likely places for contamination are feet and hands.

3) Ensure that the appropriate units of measurement are used: Counts Per Minute (cpm).

4) Monitoring speed depends upon the response time of the instrument. The typical recommended speed, for a survey meter with a pancake probe, is 3-6 inches/second with the probe being held 1-3 inches from the individual/object being surveyed.[4]

5) Again, any samples taken must be saved and labeled.

In general, any individual or surface on which the survey result is 100 cpm or more above the measured background level should be considered contaminated.*

**this assumes a GM instrument with a 10% efficiency. If the instrument efficiency is other than 10%, please consult KDHE for a more accurate contamination threshold.*

DECONTAMINATION

Refer to Appendix B for further information on decontamination procedures.

1) Objectives are to prevent the spread of contamination (internally and to attendants) and to prevent injury caused by the presence of radioactive materials on the body.

2) Performed from highest level of contamination to lowest.

3) Start with the simplest technique (soap and water) and progress to more aggressive techniques.

4) Record results.

TREATMENT

Treatment of patients who have received external radiation doses or internal contamination (extent of internal contamination will be unknown until results of sample analysis are obtained) [5]:

- If the patient has a contaminated wound, the primary objective is to treat the wound and then decontaminate to prevent the further spread of radioactive contamination and prevent its absorption from the wound into the body.

- Life sustaining treatment for patients who received extremely high doses (i.e., up to 600 rem – IND scenario) include IV fluids, antibiotics, catheterization, pain relief. The prevention and management of infection is the mainstay of therapy.

- For internal contamination, may need to dilute, purge, or facilitate fecal and/or urinary elimination of radionuclides to reduce absorbed dose.

- Potassium iodide (KI) administration can be used to reduce radiation exposure to the thyroid gland from radioactive iodine. Radioactive iodine is only expected to be present in the event of an IND or possibly from an incident at a nuclear power plant (NOTE: It is Kansas policy to evacuate the public prior to an exposure of radioactive iodine from a nuclear power plant incident and not to provide KI to the public.). Effectiveness of the administration of KI decreases rapidly with time after exposure. Administration of KI four hours after exposure will only block about 50 percent and administration more than 12 hours post-exposure will have little effect. In most cases, the value of KI administration is expected to be low and there is little reason to consider distributing KI to adults in the event of terrorist incidents [6]. Contaminated patients will not have a sufficient amount of iodine contamination to justify the use of KI for hospital workers.

- Prussian Blue (Radiogardase) is for the treatment of known or suspected internal contamination with radioactive cesium, and radioactive thallium only. It binds and reduces GI re-absorption speeding up the excretion from the body. It should be taken as soon as possible after exposure but is still effective if taken after exposure time has elapsed.

- Ca-DTPA and Zn-DTPA known as pentetate calcium trisodium and pentetate zinc trisodium injections. These are for treating internal contamination of plutonium, americium, or curium by increasing the rate of elimination from the body. Ca-DTPA should be administered as first dose and if additional treatment is needed Zn-DTPA should then be used. These treatments are generally administered into the blood stream, however in cases for people who only have contamination by inhalation, they can be administered by nebulized inhalation.

FINAL SURVEY

1) Put patient on clean gurney.

2) Do final radiological survey. Record results.

PATIENT TRANSFER AND EXIT

1) Move patient on treatment room gurney to control line.

2) Ensure that the patient is moved onto a clean stretcher. Only clean attendants should take patient out on pathway.

ONGOING CONTAMINATION CONTROL

1) Ensure that any items used in Treatment Area are placed in the lined containers.

2) Double-bag accumulated contaminated material and remove from Treatment Area.

3) Frequent surveys of the attendants should be made. Contaminated gloves and gowns are placed in bags and fresh ones are worn.

WHERE TO GET ADDITIONAL ASSISTANCE

According to the Kansas Emergency Response Plan, the Kansas Department of Health and Environment/Bureau of Air and Radiation will be contacted whenever there is an incident involving radioactive materials that occurs in the state. Hospitals should contact KDHE to obtain additional information and guidance pertaining to handling a contaminated/injured patient. When staff is available, KDHE will send one or more health physicists to the hospital to assist with monitoring and decontamination of contaminated patients.

Following is the contact information to contact the Kansas Department of Health and Environment/Bureau of Air and Radiation/Radiation and Asbestos Control Program:

During normal office hours:

785-296-1560

Off-duty hours, weekends, holidays:

785-296-8013 or 1-800-275-0297

(After hours, the duty emergency officer will locate the appropriate person to return your call. If your call is answered by an answering machine, provide the appropriate information and remain at your telephone until you are called back.)

List of References

[1] NUREG –0170, Vol 1 and 2, *Final Environmental Statement of the Transportation of Radioactive Material by Air and Other Modes*, Nuclear Regulatory Commission, 1977

[2] FEMA REP-5, Rev 2, *Guidance for Developing State, Tribal, and Local Radiological Emergency Response Planning and Preparedness for Transportation Accidents*, November 2000.

[3] DHE/REP40, Revision 6, 9/05, Kansas Protective Action Guides

[4] *Contamination Monitoring Guidance for Portable Instruments Used for Radiological Emergency Response to Nuclear Power Plant Accidents*, FEMA Rep 22, Table 1, October 2002.

[5] NCRP Report No. 65, *Management of Persons Accidentally Contaminated with Radionuclides*, 1979.

[6] NCRP Report No. 138, *Management of Terrorist Events Involving Radioactive Material,* 2001.

<u>RADIATION DETECTION INSTRUMENTS AND EQUIPMENT</u>

Radiation cannot be detected by human senses. A variety of hand-held and laboratory instruments are available for detecting and measuring radiation.

SURVEY METERS

The most common hand-held or portable instruments are:

1. **Geiger Counter, with Geiger-Mueller (G-M) Tube or Probe** — A G-M tube is a gas-filled device that, when a high voltage is applied, creates an electrical pulse when radiation interacts with the wall or gas in the tube. These pulses are converted to a reading on the instrument meter. If the instrument has a speaker, the pulses also give an audible click. Common readout units are: milliroentgens per hour (mR/hr), and counts per minute (cpm). *G-M probes that offer a large surface area (e.g., "pancake" type) are most often used with hand-held radiation survey instruments for contamination detection of alpha, beta, and gamma.*

> ***This instrument type is recommended for radiation surveys of patients and equipment at a hospital.***

2. **MicroR Meter, with Sodium Iodide Detector** — A solid crystal of sodium iodide creates a pulse of light when a gamma ray interacts with it. This pulse of light is converted to an electrical signal by a photomultiplier tube (PMT), which gives a reading on the instrument meter. The pulse of light is proportional to the amount of light and the energy deposited in the crystal. If the instrument has a speaker, the pulses also give an audible click. Common readout units are: microroentgens per hour (μR/hr), and/or counts per minute (cpm). Sodium iodide detectors can be used with hand-held instruments or large stationary radiation monitors. A Sodium Iodide Detector will only detect gamma radiation.

3. **Ionization (Ion) Chamber** — An air filled chamber with an electrically conductive inner wall and central anode and a relatively low applied voltage. When primary ion pairs are formed in the air volume, from x-ray or gamma radiation, the central anode collects the electrons and a small current is generated. This in turn is measured by an electrometer circuit and displayed digitally or on an analog meter. These instruments are designed to provide and accurate measure of absorbed dose to air, which thru appropriate conversion factors, can be related to dose to tissue. Ion chambers that aren't sealed from the outside air must be corrected for change in pressure and humidity. Common readout units are: milliroentgens and roentgen per hour (mR/hr or R/hr).

4. **Portal Monitor ---** designed for rapid screening for a large number of people or vehicles. These are portable monitors and when set-up can accommodate walkers, wheelchairs, gurneys and can be adjusted to also accommodate vehicles. Once erected and set-up for use, the monitor continuously checks and updates background radiation and alarms at a predetermined level set by the operator. An individual or vehicle can be monitored for as little 1 mCi every 10-15 seconds.

DOSIMETERS

Personal dosimetry is used to measure external exposures to individuals:

Direct-Reading Dosimeters (DRD) — A sealed cylindrical air filled chamber, sometimes called a Self-Reading Dosimeter (SRD) or Pocket Ion Chamber (PIC), with a charged quartz fiber that can be directly viewed thru a built-in microscope. This filament can be seen against a scale from typically zero "0" to 200 mR or 0 to 2 R. Ionizing gamma radiation passing thru the chamber causes a discharge of the device and a deflection of the fiber upscale. When properly maintained and calibrated, these devices provide an accurate direct measure of external exposure. DRDs measure gamma radiation only. The advantage of these DRDs is instantaneous indication of external radiation exposure. Annual calibration and quarterly leakage checks are recommended.

A direct reading dosimeter with a low range such as 0-200 mR is recommended to be worn by all hospital staff involved in handling a contaminated/injured patient.

Permanent Record Dosimeter (Thermoluminescent Dosimeter (TLD), Optically Stimulated Dosimeter (OSD) Badge) — The TLD or OSD badge is a personal monitoring device with special material or chemical compounds (e.g., lithium fluoride) in powder or solid form that retains deposited energy from radiation exposure. Though the direct-reading dosimeters described above can be re-charged and used repeatedly by different staff members, a TLD or OSD is permanently assigned to one individual. Results of exposure measurements from a TLD or OSD can only be obtained after the device has been sent to a lab to be analyzed. A TLD or OSD is considered the permanent exposure record for the staff member who utilized it. A TLD or OSD will measure at a minimum gamma and beta radiation exposure.

It is recommended that hospital staff involved in handling a contaminated/injured patient be provided with a TLD or OSD at the time of the incident. The staff member should utilize that TLD or OSD for the entire length of the response, and then it will be sent to a laboratory to obtain the exposure it recorded.

Film Badge — A film badge is one of the earliest devices used to measure worker exposure to gamma radiation and x rays. Initially packets of dental x-ray film were worn and developed periodically to view the degree of darkening. With appropriate calibration of exposure versus optical density, these devices provide an accurate measure of worker external exposure and a permanent record. In most cases, film badges are being replaced with TLDs or OSDs.

Electronic Dosimeters — An electronic dosimeter has been available since the early 1980s. These devices use energy compensated G-M tubes or solid-state detectors with supporting electronics in a package typically the size of a deck of playing cards. Features vary with respect to size, ruggedness, user control, display of accumulated dose and/or dose rate, alarm set point, battery life, computer interface, etc.

SUMMARY

In order to be prepared to treat patients who may be contaminated with radioactive materials, it is recommended that a hospital be equipped with at least three G-M type survey meters. For monitoring a large number of contaminated/injured patients, the use of a portal monitor is recommended. Hospitals should have sufficient numbers of direct-reading dosimeters with a low scale (e.g. 0-200 mR or 0-500mR), at least one dosimeter charger, and TLDs or OSDs to equip all staff working in the Radiation Emergency Area.

APPENDIX B

GUIDANCE ON DECONTAMINATION OF PATIENTS

Decontaminate patients who have areas of contamination that exceed the action level of 100 cpm above background (assuming G-M type instrument with 10% efficiency). Individuals who have no contamination in excess of the action level should be advised to shower and launder their clothing as soon as the required facilities are conveniently available.

If contamination is detected on clothing, remove or direct the individual to remove the contaminated clothing and survey the skin for contamination. Removing the clothing will eliminate approximately 90% of the contamination. If no further contamination is found, provide a change of clothing and advise the individual to shower when convenient.

If the injuries to the individual do not preclude it and if contamination is found on the skin or scalp in excess of the action level, direct the individual to the showers for decontamination with the methods listed in the table on the following page.

Follow personnel decontamination procedures very carefully so that contamination will not be spread and/or allowed to enter body openings or wounds as a result of careless and hurried techniques. The areas of contamination should already be well defined before beginning decontamination. Special emphasis should be placed on identifying and cleaning areas of concentrated contamination. As outlined in the table on the next page, the mildest methods of cleansing should be used first, progressing to more harsh methods only when necessary.

Perform a complete re-survey after each decontamination effort and record results. If contamination remains in excess of action levels after the decontamination procedures have been performed, contact the Kansas Department of Health and Environment, Bureau of Air and Radiation, for additional assistance and possible referral to a designated medical facility for further decontamination, bioassay, and/or treatment. The character of the nuclides involved will dictate the methods used to handle persistent contamination and the need for bioassay.

PERSONNEL DECONTAMINATION METHODS		
Surface	Method	Technique
Skin	Warm Water Alone or Soap & Water	Protect non-contaminated adjacent skin areas by covering with waterproof drapes. Wash area thoroughly for 2-3 minutes and rinse. Blot area dry with a disposable towel. Survey and record the results. If contamination persists, repeat once or twice.
Skin and Hands	Lava Soap	Use light pressure with heavy lather. Wash for several minutes. Rinse. Repeat as required. Use care not to scratch or erode the skin.
Skin and Hands	Mechanic's Waterless Hand Cleaning Cream	Wash thoroughly. Rinse.
Skin and Hands	Tide, Cornmeal, and Warm Water	For persistent contamination on the palms, elbows, knees, or calloused skin, wash with a paste made of Tide, Corn Meal, and tepid water. CAUTION: This decontamination mixture is very abrasive and extreme care should be exercised not to abrade the skin excessively.
Skin and Hands	Clorox	For persistent contamination on small localized areas, try gentle application of Clorox using a cotton swab applicator or gauze pad. Rinse thoroughly with water.
Hair	Shampoo and Warm Water	Wash hair with mild shampoo. Rinse thoroughly. Repeat as necessary. For persistent, localized hair contamination, remove hair by clipping. CAUTION: shaving may cause abrasion of skin and should be used only when all other techniques are ineffective.
Eyes	Warm Water	Roll back the eyelid. Flush with large amounts of water. Use isotonic irrigants if available – apply to eye and flush with large amounts of water.
Nose, Mouth, ears	Warm Water	Gently clean orifices by using wetted swabs or flushing. Contaminated individuals should avoid swallowing rinses from nose or mouth.
Wounds	Sterile Saline	Protect non-contaminated adjacent skin areas by covering with waterproof drapes. Irrigate wound with sterile saline, or dab with gauze pads soaked in sterile saline.
Leather goods, shoe soles, metal, plastics, etc.	Tape	Use dabbing technique with sticky side of tape.

Always start with the least aggressive method of decontamination (soap and water). As long as the mild method is lowering the contamination, it is working. Only when the least aggressive method stops being effective should a more aggressive method be used.