

Radiation Measurements for Hospital Response to a Radiological Dispersal Device

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Outline

- The goal of hospital response to an RDD.
- What will you know, and when?
- RDD types
- Instrument types
- The importance of keeping emergency room responders trained and familiar with the instrumentation.

Goal of Hospital Response to RDD

Effectively treat patients without
contaminating staff and other patients

RDD Response Guidance

From the First 100 Minutes Document¹:

- Recognize that radiation is present (0-5 min).
- Inform responders & public of initial hot zone and shelter-in-place zone and request assistance (5-10 min).
- Initiate lifesaving rescue ops (without waiting for radiation monitoring to begin) 5-40 min.
- Measure & map radiation levels (15-90 min).
- Evacuate & monitor populations (>70 min).

What will the hospital know, and when?

- Ideally, early on, there will be information on type of radiation (within minutes of first response).
- It's possible that the detailed information may not be available until after the first patient(s) arrive at the hospital (15 – 90 minutes).
- If no initial information is available, then the hospital will need determine radiological details.
- Is the right expertise available?
- Is the right instrumentation available?

RDDs- Types of Radiation

Type of Radiation	Example Radionuclides	Sources	Availability
Beta-Gamma	I-131, Cs-137, Ir-192, Co-60	medical radioisotopes, irradiators, industrial radiography sources	most available
Beta only	Sr-90	Medical radioisotopes, radioisotope thermoelectric generators (RTG)	somewhat available
Alpha	Ra-226, Am-241, Th-232, Po-210	Medical radioisotopes, research, national laboratories	not very available

Instrument Types

1. Personal Radiation Detector (PRD).
2. Portal Monitor and Area Monitor
3. Pancake Geiger Mueller (GM)
4. GM (non-pancake)
5. Scintillation Detector
6. Alpha Detector
7. Isotope Identifier

Personal Radiation Detector (PRD)

- Typically gamma radiation only.
- Can set dose and dose rate alarms.
- Fire, EMS, Police, and some hospitals use PRDs.
- Good for warning purposes in unknown areas.
- Not effective for alpha and beta sources.

PRD Examples



DoseGuard



Ultra Radiac

Each brand of PRD has its own procedure for setting alarms and changing the display.

Portal Monitor and Area Monitor

- Typically gamma radiation only.
- Can set rate alarms (cpm or uR/hr).
- Used at hospitals to identify contaminated patients and other sources.
- Procedures should specify actions for an alarm.
- Good for maintaining a non-contaminated area.
- Not effective for alpha and beta sources.

Portal and Area Monitor Examples



Contains 4 large area
plastic scintillators



Contains 2"x2"
Sodium Iodide
Scintillator

Pancake Geiger Mueller (GM)

- Responds to alpha, beta, and gamma.
- Indicates counts/minute (cpm) and is normally not a dose rate instrument.
- Used extensively for frisking personnel for contamination. (frisker)
- Not effective in a high background area.
- Probe face can be damaged.

Pancake GM Examples



Pancake GM
Probe with Meter



Some pancake GM's
have tungsten shield
for directionality



New version
with contained
electronics

Geiger (GM) Detectors (non-pancake)

- Typically responds to beta and gamma, with a sliding shield for beta/gamma discrimination.
- May read in cpm or mR/hr or R/hr.
- Can be used over a wide range of dose rates.
- May have an internal detector or external probe.
- Rugged instruments, not easily damaged.

Geiger (GM) Examples



Internal GM
detector



External GM
probe – sliding
beta shield



New type with
contained
electronics



Civil Defense
GM – reads out
in R/hr

Ion Chambers

- Typically responds to beta and gamma, with a sliding shield for beta/gamma discrimination.
- Typically reads out in mR/hr or mrem/hr.
- Can be used over a wide range of dose rates.
- The actual ion chamber is typically inside the meter for survey meters.
- Not as rugged as GM; mylar covering over chamber can be damaged when taking beta measurements.

Ion Chamber Examples



Ion Chamber
Survey Meter



Note mylar
cover with
“open window”



This ion chamber
available in
pressurized version

Scintillation Detectors

- Typically responds to gamma only, but beta scintillators and alpha scintillators are available.
- Typical read out in cpm or uR/hr.
- Very sensitive.
- Not useful at high dose rates.
- Sodium Iodide detectors are energy dependent.

Scintillation Detector Examples



1" x 1" Sodium
Iodide – Probe
only



Micro-Rem Survey Meter with plastic scintillator

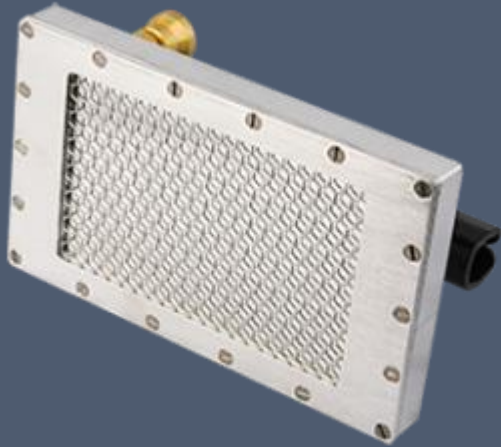


Example of a meter
that could be
attached to
scintillation probe
or GM probe

Alpha Detectors

- Some are alpha only, and some respond to other radiations also.
- Alpha scintillator is alpha only.
- Proportional counter is alpha-beta.
- Pancake GM is alpha-beta-gamma.
- Alpha probes have a very thin covering and must be held close to the radiation source.

Alpha Detector Examples



Alpha beta
proportional
detector



Alpha
scintillator



Alpha-beta
scintillator

Isotope Identifier

- Typically gamma only.
- Some have multiple detectors and also detect neutrons.
- Specialty instruments, not commonly available.
- Use a scintillator (e.g., NaI or CZT) or semiconductor (Ge).
- Will either identify an isotope or a class of isotopes (medical, industrial, etc.).

Isotope Identifier Examples



Identifies isotopes,
also neutron
detection.



Uses High Purity
Germanium for
Isotope ID; also
neutron detection.

Are medical personnel prepared for RDD Response – maybe not all...

- “I know where the box of detectors is, but I don’t know how to use them.”
- Frisking a person took about 5 seconds.
- Frisking a person took about 12 minutes.
- Use of incorrect instrument for the task.

Summary

- After an RDD, hospitals will need to understand what type of radiation is incoming with patients, and how to measure that radiation.
- Their plan should consider the specific instrumentation available and the expertise of the likely responders.
- Ensure responders maintain familiarity with the available instrumentation.

Reference

Ref. 1:

Radiological Dispersal Device Guidance, Planning for the First 100 Minutes

November 2017, Department of Homeland Security, National Urban Security Technology Laboratory, National Nuclear Security Administration, Federal Emergency Management Agency.