Key references and websites

AFRRI (2003) Medical Management of Radiological Casualties Handbook, Second Edition. Bethesda, MD: Armed Forces Radiobiology Research Institute.

Koenig K, et al. (2005) Medical Treatment of Radiological Casualties: Current Concepts. Ann Emerg Med, 45(6): 643–52.

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http://www.afrri.usuhs.mil
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Table 2. Symptom clusters following significant radiation exposures

Headache Fatigue Weakness	Partial and full thickness skin damage Epilation (hair loss) Ulceration
Anorexia Nausea Vomiting Diarrhea	Lymphopenia Neutropenia Thrombocytopenia Purpura Opportunistic infections

Table 1. Acute radiation syndrome (ARS)

Phase of syndrome	Whole-body irradiation from acute photon equivalent doses						
	Feature	Subclinical range (rad or cGy)		Sublethal range (rad or cGy)		Lethal range (rad of cGy)	
		0–100	100–200	200–600	600–800	800–3000	>3000
Initial or prodromal	Nausea, vomiting: Time of onset: Duration:		5–50% 3–6 h <24 h	50–100% 1–6 h <24 h	75–100% <2 h <48 h	90–100% <1 h <48 h	100% <1 h <48 h
	Lymphocyte count (cells/mm^3)		<1400 at 4 d	<1400 at 48 h	<1000 at 24 h	<800 at 24 h	
	CNS function	No impairment	No impairment	Routine task performance Cognitive impairment for 6–20 h	Simple and routine task performance Cognitive impairment for >24 h	Progressive incapacitation	
Latent	Duration	>2 wk	7–15 d	0–7 d	0–2 d	None	
Manifest (obvious) illness	Signs and symptoms	None	Moderate leukopenia	Severe leukopenia, purpura, hemorrhage, pneumonia, hair loss after 300 rad (cGy)		Diarrhea, fever, electrolyte disturbance	Convulsions, ataxia, tremor, lethargy
	Time of onset		>2 wk	2 d – 2 wk		2–3 d	
	Critical period		None	4–6 wk		5–14 d	1–48 h
	Organ system	None		Hematopoietic and respiratory (mucosal) systems		GI tract Mucosal systems	CNS
Degree of ARS			Mild	Moderate-severe	Very severe	Lethal	
Hospitalization	% Duration	0	<5% 45–60 d	90% 60–90 d	100% 90+ d	100% 2 wk	100% 2 d
Fatality		0%	0%	0–80%	80–100%	98–100%	
Time to death				3–12 wk		1–2 wk	1–2 d

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September 2007

Uniformed Services University of the Health Sciences
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Understanding exposure to radiation

Exposure may be known and recognized or clandestine through:

- large recognized exposures (nuclear bomb or damage to a nuclear power station)
- small radiation source emitting continous gamma radiation, producing group or individual chronic intermittent exposures from medical treatment devices or from water or food pollution

Exposure may result from any one or a combination of the following:

- external sources (uncontrolled nuclear reaction, radioisotope outside the body)
- skin contamination with radioactive material (external contamination)
- internal radiation from absorbed, inhaled, or ingested radioactive material (internal contamination)

Diagnosis

The acute radiation syndrome (ARS: table 1) follows a predictable pattern after substantial exposure or catastrophic events. Specific symptoms, especially with a 2- to 3-week prior history of nausea/vomiting:

- thermal burn-like skin effects without-documented thermal exposure
- immunological dysfunction with secondary infections
- a tendency to bleed (epistaxis, gingival bleeding, petechiae)
- marrow suppression (neutropenia, lymphopenia and thrombocytopenia)
- epilation (hair loss)

Following significant (>100 cGy) acute, chronic, or repeated exposures from contaminated or hidden sources, victims may also present individually with symptom clusters (Table 2).

Confirmation of cases

Contact radiation safety officer (RSO) or health physicist (HP) for help. For projecting clinical effects, contact:

- nuclear medicine or radiation oncology physician
- Medical Radiobiology Advisory Team at AFRRI: 301-295-0530
- REAC/TS: 865-576-3131/1005
- CDC: 770-488-7100

Obtain serum amylase and complete blood count with differential every 6–8 hours:

- absolute lymphocyte count <500 mm^3 suggests very severe exposure
- short-term rise in neutrophil count suggests at least a moderate acute exposure

Swab mucosa (all body orifices–each nostril, both ears, mouth, rectum). Collect:

- 24-hour stool if GI contamination suspected
- 24-hour urine if any internal contamination suspected

Treatment considerations

Patient with life-threatening condition: treat, then decontaminate.

Patient with non-life-threatening condition: decontaminate, then treat.

If radioiodine inhaled or ingested (e.g., reactor accident), consider prophylactic potassium iodide in first 0–12 hours post-exposure to protect thyroid.

Absent any expert guidance, provide supportive care (clean environment, fluids, blood products, antiemetics, antibiotics, pain management, etc.); treat symptomatically and close wounds within 36 hours. Focus on prevention and mitigation of infection and sepsis.

Decontamination considerations

Exposure without contamination: no decontamination (RSO measurement).

Exposure with contamination: universal precautions, remove and bag patient's clothing, decontaminate with soap and water or saline.

Internal contamination: contact RSO, HP, or nuclear medicine physician.

Advance decontamination planning: when feasible, set up to decontaminate stabilized patients before treatment to avoid contaminating the facility.

Reporting

- If reasonable suspicion of a radiation event, contact hospital leadership (chief of staff, hospital director, etc.).
- Immediately discuss hospital emergency planning implications.
- Contact local public health office (city, county or state) or CDC (770-488-7100).
- If terrorism suspected, contact FBI (see http://www.fbi.gov/contactus.htm).

Directorate of Military Medical Operations
Armed Forces Radiobiology Research Institute
8901 Wisconsin Avenue
Bethesda, MD 20889-5603
http://www.afrri.usuhs.mil
301-295-0316

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