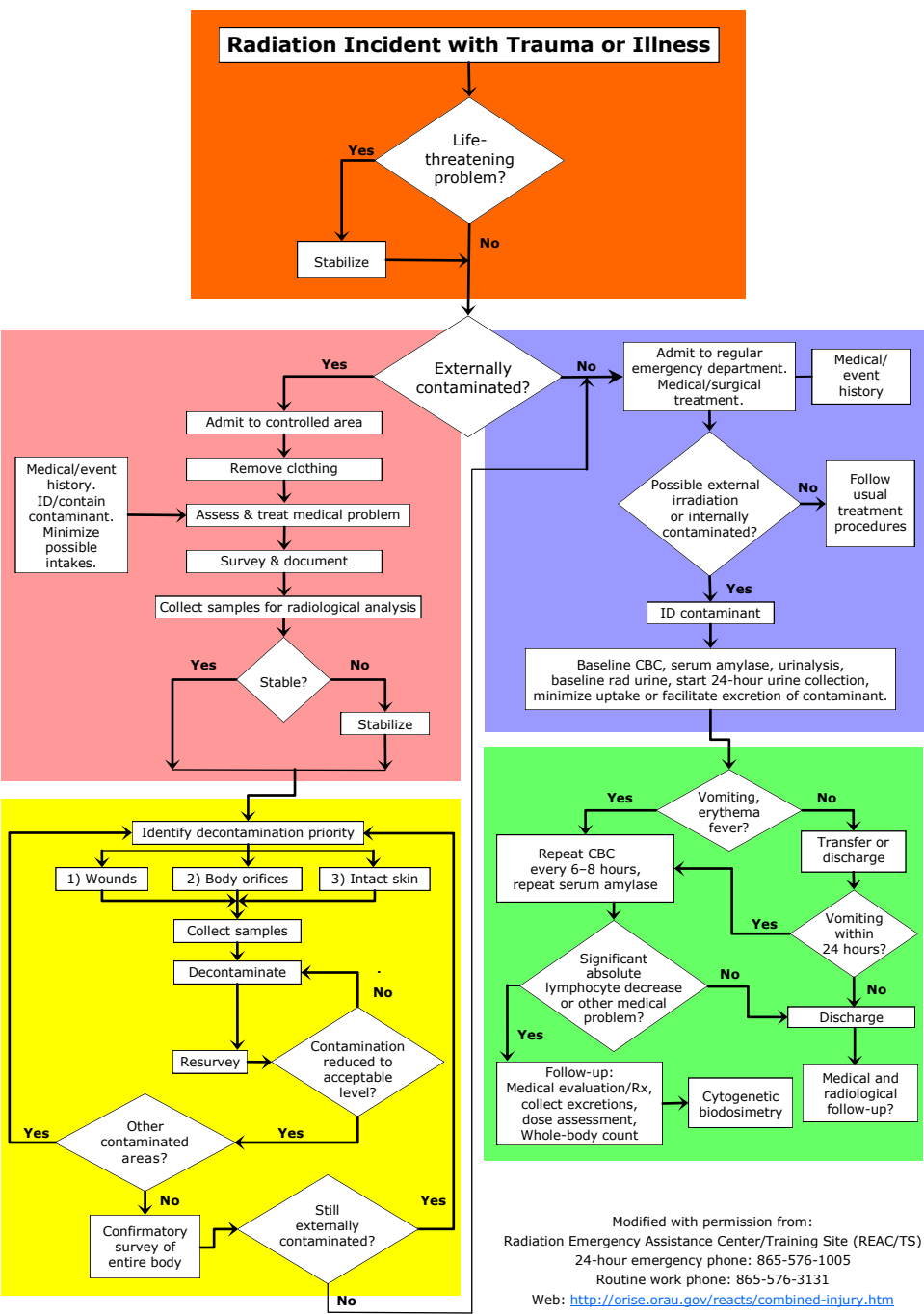


# Radiation Patient Treatment



Modified with permission from:  
 Radiation Emergency Assistance Center/Training Site (REAC/TS)  
 24-hour emergency phone: 865-576-1005  
 Routine work phone: 865-576-3131  
 Web: <http://orise.orau.gov/reacts/combined-injury.htm>

**Table 1. Acute radiation syndrome (ARS)—healthy adults\***

Phase of Syndrome	Whole-body Irradiation from Acute Photon Equivalent Doses		
	Survivability	Highly Survivable	Mild
Dose range (cGy†)	0-100	100-200	200-600
Vomiting: Time of onset: Duration:		5-50% 3-6 hours <24 hours	50-100% 1-6 hours <24 hours
Lymphocyte count (cells/mm <sup>3</sup> )		<1400 at 4 days	<1400 at 48 hours
CNS function	No impairment	No impairment	Routine task performance; cognitive impairment for 6-20 hours
Duration	N/A	7-15 days	0-21 days
Signs and symptoms	None	Moderate leukopenia	Severe leukopenia, purpura, hemorrhage, pneumonia, hair loss after 300 rad (cGy)
Time of onset		>2 weeks	2 days-2 weeks
Critical period		None	4-6 weeks
Principal organ system	None	Hematopoietic	Hematopoietic and gastrointestinal
Hospitalization		0	90%
Duration		45-60 days	60-90 days
Fatality		0%	80-100%
Time of Death			3-12 weeks
Survivability			Survivable to lethal
Degree of ARS			Moderate to severe
Dose range (cGy†)			600-800
Vomiting: Time of onset: Duration:			75-100% <2 hours <48 hours
Lymphocyte count (cells/mm <sup>3</sup> )			<1000 at 24 hours
CNS function			Simple & routine task performance; cognitive impairment for >24 hours
Duration			0-2 days
Signs and symptoms			Severe diarrhea, fever, electrolyte disturbance
Time of onset			0-2 days
Critical period			5-14 days
Principal organ system			Gastrointestinal (mucosal surfaces)
Hospitalization			100%
Duration			2 weeks
Fatality			98-100%
Time of Death			1-2 weeks
Survivability			Lethal
Dose range (cGy†)			800-3000
Vomiting: Time of onset: Duration:			98-100% <1 hour <48 hours
Lymphocyte count (cells/mm <sup>3</sup> )			<800 at 24 hours
CNS function			Transient incapacitation
Duration			0-2 days
Signs and symptoms			Severe diarrhea, fever, electrolyte disturbance
Time of onset			0-2 days
Critical period			5-14 days
Principal organ system			Gastrointestinal (mucosal surfaces)
Hospitalization			100%
Duration			2 weeks
Fatality			98-100%
Time of Death			1-2 weeks
Survivability			Lethal
Dose range (cGy†)			>3000
Vomiting: Time of onset: Duration:			100% <1 hour <48 hours
Lymphocyte count (cells/mm <sup>3</sup> )			<800 at 24 hours
CNS function			Convulsions, ataxia, tremor, lethargy
Duration			0-2 days
Signs and symptoms			Severe diarrhea, fever, electrolyte disturbance
Time of onset			0-2 days
Critical period			5-14 days
Principal organ system			Gastrointestinal (mucosal surfaces)
Hospitalization			100%
Duration			2 weeks
Fatality			98-100%
Time of Death			1-2 weeks

\* Adapted from TM 8-125, Nuclear Handbook for Medical Service Personnel, US Army, 1969. Tabulated data for fatality incidence assumes no treatment.  
 † See table 3, Conversion units.

- I. 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 continuous 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, radionuclide outside the body)
    - Skin contamination with radioactive material (external contamination)
    - Internal radiation resulting from inhaled, absorbed, or ingested radioactive material
- II. Diagnosis**
- Acute radiation syndrome (ARS, table 1)—Expressed in different organ systems at different times after substantial exposure to radiation. Common symptoms include:
    - Skin erythema—Often cyclic, appearing hours to days after exposure and recurring 2–3 weeks later; blistering, desquamation, and ulceration occur a few weeks after high doses.
    - Nausea/vomiting—Appearing within hours after exposure then subsiding (time of onset is inversely related to dose and directly related to severity and duration of exposure).
    - Immunological dysfunction—Beginning a few hours after exposure with secondary infection manifesting days or weeks later.
    - Hemorrhagic tendencies (epistaxis, gingival bleeding, petechiae) within days of exposure.
    - Narrow suppression (lymphopenia, neutropenia, and thrombocytopenia) within hours to days postexposure; a neutrophil spike may be noted shortly after initial exposure and, if seen, would suggest at least a moderate exposure; time to nadir is inversely related to dose; order of suppression is lymphocytes, neutrophils, platelets, erythrocytes.
  - Epilation if dose over 300 cGy with onset 10–20 days postexposure. Following significant (>100 cGy) acute, chronic, or repeated exposures from hidden or contaminated sources, victims may also present individually with symptoms clusters (table 2).

**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

**III. 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 AFRRRI: (301) 295-0530
  - REAC/TS: (865) 576-3131/1005
  - CDC: (770) 488-7100
- Obtain baseline serum amylase and complete blood count (CBC) then repeat CBC every 6–8 hours for 2–3 days. Collect another serum amylase at 24 hours postexposure.
  - Absolute lymphocyte count <500/mm<sup>3</sup> suggests very severe exposure.
- Check for internal contamination: swab both nostrils; collect 24-hour stool and 24-hour urine samples.

**IV. Treatment considerations**

- Evaluate ABCs, stabilize any life threatening injuries and then decontaminate.
  - If inhalation or ingestion of radioiodine is suspected (e.g., reactor accident), consider administering potassium iodide within 6 hours and every 24 hours as needed to protect the thyroid. For KI dosage levels, see AFRRRI's [Medical Management of Radiological Casualties](#), Third Edition (Nov. 2009).
- Provide supportive care based on ARS signs, symptoms, and diagnostic tests: clean environment, fluids, blood products, antiemetics, antibiotics, pain management, etc.
  - Treat symptomatically and close wounds within 36–48 hours.
  - Provide skin and burn care to prevent infection.
  - Focus on prevention and mitigation of infection and sepsis.

**V. Decontamination considerations**

- Exposure without contamination: no decontamination (RSO measurement).
- Exposure with contamination: use universal precautions, remove and bag patient's clothing, decontaminate with soap and water or saline.
- Suspected internal contamination: contact RSO, HP, or nuclear medicine physician.
- Advanced decontamination planning: where feasible, set up a separate decontamination site for nonurgent patients to avoid contaminating treatment facility.

**VI. Reporting**

- If reasonable suspicion of a radiation event, contact hospital leadership.
- Immediately discuss hospital emergency planning implications.
- Contact local public health office (city, county, or state) or CDC: (770) 488-7100.

**Table 3. Conversion units**

Gy = gray Sv = sievert Bq = Becquerel Ci = curie dpm = disintegrations per minute		
p = pico = 10 <sup>-12</sup> n = nano = 10 <sup>-9</sup> μ = micro = 10 <sup>-6</sup> m = milli = 10 <sup>-3</sup> c = centi = 10 <sup>-2</sup> M = mega = 10 <sup>6</sup> G = giga = 10 <sup>9</sup>		
1 Bq = 60 dpm = 27 pCi 37 GBq = 1 Ci 37 MBq = 1 mCi 37 Bq = 1 nCi	1 Gy = 100 rad 1 cGy = 1 rad 10 μGy = 1 mrad 10 nGy = 1 μrad	1 Sv = 100 rem 1 cSv = 1 rem 10 μSv = 1 mrem 10 nSv = 1 prem

- If terrorism suspected, contact FBI (see <http://www.fbi.gov/contactus.htm>).

**Key references and websites**

AFRRRI (2009) [Medical Management of Radiological Casualties, Third Edition](#). Bethesda, MD: Armed Forces Radiobiology Research Institute.

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

Waselenko J, et al. (2004) [Medical Management of the Acute Radiation Syndrome: Recommendations of the Strategic National Stockpile Radiation Working Group](#). Ann Intern Med, 140:1037–51.

<http://www.usuhs.mil/afrrri/>  
<http://www.orau.gov/reacts/guidance.htm>  
<http://remm.nlm.gov>  
<http://www.bt.cdc.gov/radiation>

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 Medicine Response**



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