Radiation Countermeasures for Treatment of Internal Contamination

Medical countermeasure information in this table adapted from:

- Management of Persons Contaminated with Radionuclides: Handbook (NCRP Report No. 161, Vol. I), National Council on Radiation Protection and Measurements, Bethesda, MD, 2008.
- Population Monitoring and Radionuclide Decorporation Following a Radiological or Nuclear Incident (NCRP Report No. 166), National Council on Radiation Protection and Measurements, Bethesda, MD, 2011.
- FDA drug information related to radiation emergencies

Caveats about Radiation Countermeasures for Treatment of Internal Contamination

Medical countermeasure	Administered for	Mechanism of action	Route of administration	Dosage	Duration of treatment	References for use
Aluminum carbonate	Phosphorus (P-32)	Phosphate binder	PO	600 mg tablet TID or 400mg/5 cc TID		NCRP-suggested
Aluminum hydroxide	Radium (Ra-226) Strontium (Sr-90)	Blocks intestinal absorption	PO	**Adults**: 60-100 mL (1200 mg) **Children**: 50 mg/kg, not to exceed the adult dose	Give one dose within 24 hr of radionuclide intake to block intestinal absorption; administer before absorption occurs	NCRP-preferred
	Phosphorus (P-32)	Phosphate binder	PO	600 mg tablet TID or 320 mg/5cc TID		NCRP-suggested
Barium sulfate	Radium (Ra-226) Strontium (Sr-90)	Blocks intestinal absorption	PO	100-300 g (as a single dose in 250 cc water)	Give one dose within 24 hr of radionuclide intake to block intestinal absorption; administer before absorption occurs	NCRP-suggested

Calcium carbonate	Radium (Ra-226) Strontium (Sr-90)	Competes for bone binding sites	PO	Use as directed on label	Begin therapy within 12 hr of radionuclide intake if possible	NCRP-suggested
Calcium gluconate	Radium (Ra-226) Strontium (Sr-90)	Competes for bone binding sites; phosphate binder	IV	5 ampoules (500 mg Ca/amp) in 500 cc 5% dextrose in water (D5W); infuse over 4-6 hours	6 days; begin therapy within 12 hr of radionuclide intake if possible	NCRP-suggested
Calcium phosphate	Radium (Ra-226) Strontium (Sr-90)	Increases excretion	PO	1200 mg	Give one dose within 24 hr of radionuclide intake to block intestinal absorption; administer before absorption occurs	NCRP-suggested
Deferoxamine (DFOA)	Plutonium (Pu-239)	Chelating agent	IM (preferred route)	2 ampoules (500 mg DFOA/amp)	• Give a single dose, then obtain bioassay to assess residual body burden of Pu-239 • Repeat as indicated: 500 mg IM (preferred) or IV q4 hr x2 doses, then 500 mg IVq12 hr for 3 days	NCRP-suggested DFOA is FDA-approved for Rx of acute and chronic iron poisoning only
			IV (slow infusion)	2 ampoules (500 mg DFOA/amp) at 15 mg/kg/hr		
Medical countermeasure	**Administered for**	**Mechanism of action**	**Route of administration**	**Dosage**	**Duration of treatment**	**References for use**
DTPA (calcium &	Americium	Chelating	IV (give once	**Adults**: 1 g in 5 cc 5%	• Begin	

zinc)	(Am-241) Californium (Cf-252) Cobalt (Co-60) Curium (Cm-244) Plutonium (Pu-238 and Pu-239) Yttrium (Y-90)	agent	daily as a bolus or as a single infusion, i.e., do not fractionate the dose)	dextrose in water (D5W) or 0.9% sodium chloride (normal saline, NS) slow IV push over 3-4 minutes or 1 g in 100-250 cc D5W or NS as an infusion over 30 minutes **Children < 12 years**: 14 mg/kg/d slow IV push over 3-4 minutes (not to exceed 1 g/day)	• treatment with Ca-DTPA , then change to Zn-DTPA for maintenance, as indicated • Duration of therapy depends on total body burden and response to treatment	DTPA is FDA-approved for intravenous Rx of known or suspected internal contamination with Am, Cm, and Pu only DTPA is FDA-approved for nebulized inhalation in adults only, and if the only route of contamination is through inhalation DTPA is NCRP-preferred as Rx of the other isotopes listed and NCRP-suggested as a wound irrigation fluid
			Nebulized inhalation (for use in adults only)	1 g in 1:1 dilution with sterile water or NS over 15-20 minutes		
			Wound irrigation fluid	1 g Ca- or Zn-DTPA and 10 cc 2% lidocaine in 100 cc 5% dextrose in water (D5W) or 0.9% sodium chloride (normal saline, NS)	• Irrigation can be accompanied by IV or inhaled DTPA • Amount of DTPA absorbed by wound tissues cannot be measured • Avoid overdosing with DTPA and/or 2% lidocaine	
Dimercaprol (BAL)	Polonium (Po-210)	Chelating agent	IM (300 mg/vial for deep IM injection only)	2.5 mg/kg QID x2 days (days 1 & 2), then BID x1 day (day 3), then QD (days 4-10)	10 days	NCRP-preferred

						Dimercaprol (BAL) is FDA-approved for Rx of arsenic, gold and mercury poisoning and when used together with EDTA for Rx of acute lead poisoning only
Medical countermeasure	**Administered for**	**Mechanism of action**	**Route of administration**	**Dosage**	**Duration of treatment**	**References for use**
EDTA	Cobalt (Co-60)	Chelating agent	IV	1000 mg/m^2/day in 500 cc 5% dextrose in water (D5W) or 0.9% sodium chloride (normal saline, NS); infuse over 8-12 hours	Given as a single dose	NCRP-suggested EDTA is FDA-approved for Rx of lead poisoning only
			IM	Divide IV dose equally into two doses and administer 8-12 hours apart	Given as a divided dose	
D-Penicillamine (DailyMed)	Polonium (Po-210)	Chelating agent	PO	**Adults:** 0.75-1.5 g (250 mg/capsule) QD **Children:** 30 mg/kg/day (250 mg/capsule) divided into 4 doses	• Obtain bioassay to assess • Continue only if clinically indicated • D-Penicillamine has a narrow therapeutic index; use is **associated with high risk**	NCRP-suggested D-Penicillamine is FDA-approved for Rx of copper poisoning only

					of toxicity	
Potassium iodide (KI)	Iodine (I-131)	Blocking agent	PO	**Adults >40 years**: 130 mg/day (For projected thyroid dose **≥500 cGy**) **Adults 18 - 40 years**: 130 mg/day (For projected thyroid dose **≥10 cGy**) **Pregnant or lactating women of any age**: 130 mg/day (For projected thyroid dose **≥5 cGy**) **Adolescents ≥70 kg**: 130 mg/day (For projected thyroid dose **≥5 cGy**) **Children & adolescents 3 - 18 years**: 65 mg/day (For projected thyroid dose **≥5 cGy**) **Infants & toddlers 1 month - 3 years**: 32.5 mg/day (For projected thyroid dose **≥5 cGy**) **Neonates from birth - 1 month**: 16 mg/day (For projected thyroid	• Some incidents will require only a single dose of KI. • Incident managers may recommend additional daily doses if ongoing radioactive iodine ingestion or inhalation represents a continuing threat. • See also: Potassium Iodide (KI): Duration of Therapy.	FDA-approved NCRP-preferred

				dose **≥5 cGy**)		
Medical countermeasure	**Administered for**	**Mechanism of action**	**Route of administration**	**Dosage**	**Duration of treatment**	**References for use**
Potassium phosphate	Phosphorus (P-32)	Phosphate binder	PO	600-1200 mg, given in divided doses		NCRP-suggested
Potassium phosphate, dibasic	Phosphorus (P-32)	Phosphate binder	PO (take with full glass of water with meals and at bedtime)	**Adults**: 1-2 tablets (250 mg/tab) QID **Children >4 years**: 1 tablet (250 mg/tab) QID		NCRP-suggested
Propylthiouracil	Iodine (I-131)	Blocking agent	PO	Adults: 2 tablets (50 mg/tab) TID	8 days	NCRP-suggested
Prussian blue, insoluble	Cesium (Cs-137)	Ion exchange; inhibits enterohepatic recirculation in GI tract	PO	**Adults, children >12 years**: • 1-3 g (2-6 capsules; 0.5 g insoluble Prussian blue per cap) TID; up to 10-12 g/day (based on Goiânia incident data) • 3 g (6 capsules; 0.5 g insoluble Prussian blue per cap) TID (see: FDA Package Insert) **Children 2 - 12 years**:	• Minimum 30 day course per FDA • Obtain bioassay and whole body counting to assess treatment of efficacy • Duration of therapy depends on total body burden and response to treatment	Prussian blue, insoluble, is FDA-approved and NCRP-preferred for Rx of known or suspected internal contamination with radioactive Cs and/or radioactive or non-radioactive thallium; FDA-approved for ages > 2 years old only

				• 1 g (2 capsules; 0.5 g insoluble Prussian blue per cap) TID • Capsules may be opened and contents mixed with food • See: FDA Package Insert for pediatric prescribing information **Children <2 years**: Prussian blue is not FDA-approved for use (IND or EUA may be required)		
Medical countermeasure	**Administered for**	**Mechanism of action**	**Route of administration**	**Dosage**	**Duration of treatment**	**References for use**
Sevelamer (DailyMed)	Phosphorus (P-32)	Phosphate binder	PO	• 2-4 tablets (400 mg - 800 mg/tab) TID • Not to exceed 1600 mg TID	5 days if possible; first dose is the most important	NCRP-suggested
Sodium alginate	Radium (Ra-226) Strontium (Sr-90)	Blocks intestinal absorption	PO (take with a full glass of water)	5g BID x1 day, then 1 g QID		NCRP-suggested
Sodium bicarbonate	Uranium (U-235)	Facilitates increased renal excretion	IV	• 2 ampoules (44.3 mEq bicarbonate/ ampoule) in	Administer therapy until urine pH is 8-9 ; continue Rx for 3 days	NCRP-preferred

				• 1000 cc 5% dextrose in water (D5W) or 0.9% sodium chloride (normal saline, NS) • 250 cc (1-2 mEq/kg) slow infusion		
			PO	2 tablets Q4 hr		
Sodium glycerophosphate	Phosphorus (P-32)		PO	600-1200 mg, given in divided doses		NCRP-suggested
Sodium phosphate	Phosphorus (P-32)		PO	600-1200 mg, given in divided doses		NCRP-suggested
Succimer (DMSA) (DailyMed)	Polonium (Po-210)	Chelating agent	PO	• 100 mg capsules • Administer 10 mg/kg or 350 mg/m^2 every 8 hr for 5 days, then reduce; safety and efficacy in children <12 years has not been established	Reduce frequency of administration to 10 mg/kg or 350 mg/m^2 every 12 hr for an additional 2 weeks of therapy; typical treatment course: 19 days	NCRP-suggested DMSA is FDA-approved for the treatment of lead poisoning only
Water	Tritium (H-3)	Facilitates excretion	PO	>3-4 liters/day	3 weeks	NCRP-preferred

References for use
FDA approved: Countermeasures so marked have been approved as treatment for internal contamination with the listed radioisotope by the US Food and Drug Administration (FDA).

NCRP preferred: Countermeasures so marked have been listed as preferred treatments for internal contamination with the listed radioisotope by the National Council on Radiation Protection and Measurements [Management of Persons Contaminated with Radionuclides: Handbook (NCRP Report No. 161, Vol. I)]. Except where noted, use of these countermeasures has not been approved by the US Food and Drug Administration (FDA).

NCRP suggested: Countermeasures so marked have been listed as suggested treatments for internal contamination with the listed radioisotope by the National Council on Radiation Protection and Measurements [Management of Persons Contaminated with Radionuclides: Handbook (NCRP Report No. 161, Vol. I)]. Use of these countermeasures has not been approved by the US Food and Drug Administration (FDA).