

## 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		<a href="#">NCRP-suggested</a>
Aluminum hydroxide	Radium (Ra-226) Strontium (Sr-90)	Blocks intestinal absorption	PO	<b>Adults:</b> 60-100 mL (1200 mg) <b>Children:</b> 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	<a href="#">NCRP-preferred</a>
	Phosphorus (P-32)	Phosphate binder	PO	600 mg tablet TID or 320 mg/5cc TID		<a href="#">NCRP-suggested</a>
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	<a href="#">NCRP-suggested</a>

<a href="#">Calcium carbonate</a>	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	<a href="#">NCRP-suggested</a>
<a href="#">Calcium gluconate</a>	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	<a href="#">NCRP-suggested</a>
<a href="#">Calcium phosphate</a>	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	<a href="#">NCRP-suggested</a>
Deferoxamine (DFOA)	Plutonium (Pu-239)	Chelating agent	IM (preferred route)	2 ampoules (500 mg DFOA/amp)	<ul style="list-style-type: none"> <li>Give a single dose, then obtain <a href="#">bioassay</a> to assess residual body burden of Pu-239</li> <li>Repeat as indicated: 500 mg IM (preferred) or IV q4 hr x2 doses, then 500 mg IVq12 hr for 3 days</li> </ul>	<a href="#">NCRP-suggested</a> 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
<a href="#">DTPA</a> (calcium &	Americium	Chelating	IV (give once	<b>Adults:</b> 1 g in 5 cc 5%	<ul style="list-style-type: none"> <li>Begin</li> </ul>	

zinc)	(Am-241)	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	<p>treatment with Ca-DTPA , then change to Zn-DTPA for maintenance, as indicated</p> <ul style="list-style-type: none"> <li>Duration of therapy depends on total body burden and response to treatment</li> </ul>	DTPA is <a href="#">FDA-approved</a> for intravenous Rx of known or suspected internal contamination with Am, Cm, and Pu only	
	Californium (Cf-252)			<p><b>Children &lt; 12 years:</b> 14 mg/kg/d slow IV push over 3-4 minutes (not to exceed 1 g/day)</p>			DTPA is <a href="#">FDA-approved</a> for nebulized inhalation in adults only, and if the only route of contamination is through inhalation
	Cobalt (Co-60)						
Curium (Cm-244)	Yttrium (Y-90)	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)	<ul style="list-style-type: none"> <li>Irrigation can be accompanied by IV or inhaled DTPA</li> <li>Amount of DTPA absorbed by wound tissues cannot be measured</li> <li>Avoid overdosing with DTPA and/or 2% lidocaine</li> </ul>	DTPA is <a href="#">NCRP-preferred</a> as Rx of the other isotopes listed and <a href="#">NCRP-suggested</a> as a wound irrigation fluid		
Plutonium (Pu-238 and Pu-239)							
<a href="#">Dimercaprol (BAL)</a>	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	<a href="#">NCRP-preferred</a>	

Medical countermeasure	Administered for	Mechanism of action	Route of administration	Dosage	Duration of treatment	References for use
						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
EDTA	Cobalt (Co-60)	Chelating agent	IV	1000 mg/m <sup>2</sup> /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	<a href="#">NCRP-suggested</a>  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	
<a href="#">D-Penicillamine</a> (DailyMed)	Polonium (Po-210)	Chelating agent	PO	<b>Adults:</b> 0.75-1.5 g (250 mg/capsule) QD  <b>Children:</b> 30 mg/kg/day (250 mg/capsule) divided into 4 doses	<ul style="list-style-type: none"> <li>Obtain <a href="#">bioassay</a> to assess</li> <li>Continue only if clinically indicated</li> <li>D-Penicillamine has a narrow therapeutic index; use is <b>associated with high risk</b></li> </ul>	<a href="#">NCRP-suggested</a>  D-Penicillamine is FDA-approved for Rx of copper poisoning only

					of toxicity	
<a href="#">Potassium iodide (KI)</a>	Iodine (I-131)	Blocking agent	PO	<p><b>Adults &gt;40 years:</b> 130 mg/day (For projected thyroid dose <b>≥500 cGy</b>)</p> <p><b>Adults 18 - 40 years:</b> 130 mg/day (For projected thyroid dose <b>≥10 cGy</b>)</p> <p><b>Pregnant or lactating women of any age:</b> 130 mg/day (For projected thyroid dose <b>≥5 cGy</b>)</p> <p><b>Adolescents ≥70 kg:</b> 130 mg/day (For projected thyroid dose <b>≥5 cGy</b>)</p> <p><b>Children &amp; adolescents 3 - 18 years:</b> 65 mg/day (For projected thyroid dose <b>≥5 cGy</b>)</p> <p><b>Infants &amp; toddlers 1 month - 3 years:</b> 32.5 mg/day (For projected thyroid dose <b>≥5 cGy</b>)</p> <p><b>Neonates from birth - 1 year:</b> 16 mg/day (For projected thyroid</p>	<ul style="list-style-type: none"> <li>Some incidents will require only a single dose of KI.</li> <li>Incident managers may recommend additional daily doses if ongoing radioactive iodine ingestion or inhalation represents a continuing threat.</li> <li>See also: <a href="#">Potassium Iodide (KI): Duration of Therapy</a>.</li> </ul>	<p><a href="#">FDA-approved</a></p> <p><a href="#">NCRP-preferred</a></p>

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		<a href="#">NCRP-suggested</a>
<a href="#">Potassium phosphate, dibasic</a>	Phosphorus (P-32)	Phosphate binder	PO (take with full glass of water with meals and at bedtime)	<b>Adults:</b> 1-2 tablets (250 mg/tab) QID <b>Children &gt;4 years:</b> 1 tablet (250 mg/tab) QID		<a href="#">NCRP-suggested</a>
<a href="#">Propylthiouracil</a>	Iodine (I-131)	Blocking agent	PO	Adults: 2 tablets (50 mg/tab) TID	8 days	<a href="#">NCRP-suggested</a>
<a href="#">Prussian blue, insoluble</a>	Cesium (Cs-137)	Ion exchange; inhibits enterohepatic recirculation in GI tract	PO	<b>Adults, children &gt; 12 years:</b> <ul style="list-style-type: none"> <li>1-3 g (2-6 capsules; 0.5 g insoluble Prussian blue per cap) TID; up to 10-12 g/day (based on <a href="#">Goiânia incident data</a>)</li> <li>3 g (6 capsules; 0.5 g insoluble Prussian blue per cap) TID (see: <a href="#">FDA Package Insert</a> )</li> </ul> <b>Children 2 - 12 years:</b>	<ul style="list-style-type: none"> <li>Minimum 30 day course per FDA</li> <li>Obtain <a href="#">bioassay</a> and whole body counting to assess treatment of efficacy</li> <li>Duration of therapy depends on total body burden and response to treatment</li> </ul>	Prussian blue, insoluble, is <a href="#">FDA-approved</a> and <a href="#">NCRP-preferred</a> 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

				<ul style="list-style-type: none"> <li>• 1 g (2 capsules; 0.5 g insoluble Prussian blue per cap) TID</li> <li>• Capsules may be opened and contents mixed with food</li> <li>• See: <a href="#">FDA Package Insert</a> for pediatric prescribing information</li> </ul> <p><b>Children &lt;2 years:</b> Prussian blue is not FDA-approved for use (IND or <a href="#">EUA</a> may be required)</p>		
Medical countermeasure	Administered for	Mechanism of action	Route of administration	Dosage	Duration of treatment	References for use
<a href="#">Sevelamer</a> (DailyMed)	Phosphorus (P-32)	Phosphate binder	PO	<ul style="list-style-type: none"> <li>• 2-4 tablets (400 mg - 800 mg/tab) TID</li> <li>• Not to exceed 1600 mg TID</li> </ul>	5 days if possible; first dose is the most important	<a href="#">NCRP-suggested</a>
<a href="#">Sodium alginate</a>	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		<a href="#">NCRP-suggested</a>
<a href="#">Sodium bicarbonate</a>	Uranium (U-235)	Facilitates increased renal excretion	IV	<ul style="list-style-type: none"> <li>• 2 ampoules (44.3 mEq bicarbonate/ ampoule) in</li> </ul>	Administer therapy until urine pH is 8-9 ; continue Rx for 3 days	<a href="#">NCRP-preferred</a>

				<p>1000 cc 5% dextrose in water (D5W) or 0.9% sodium chloride (normal saline, NS)</p> <ul style="list-style-type: none"> <li>• 250 cc (1-2 mEq/kg) slow infusion</li> </ul>		
			PO	2 tablets Q4 hr		
Sodium glycerophosphate	Phosphorus (P-32)		PO	600-1200 mg, given in divided doses		<a href="#">NCRP-suggested</a>
Sodium phosphate	Phosphorus (P-32)		PO	600-1200 mg, given in divided doses		<a href="#">NCRP-suggested</a>
<a href="#">Succimer (DMSA)</a> (DailyMed)	Polonium (Po-210)	Chelating agent	PO	<ul style="list-style-type: none"> <li>• 100 mg capsules</li> <li>• Administer 10 mg/kg or 350 mg/m<sup>2</sup> every 8 hr for 5 days, then reduce; safety and efficacy in children &lt;12 years has not been established</li> </ul>	Reduce frequency of administration to 10 mg/kg or 350 mg/m <sup>2</sup> every 12 hr for an additional 2 weeks of therapy; typical treatment course: 19 days	<a href="#">NCRP-suggested</a>  DMSA is FDA-approved for the treatment of lead poisoning only
Water	Tritium (H-3)	Facilitates excretion	PO	>3-4 liters/day	3 weeks	<a href="#">NCRP-preferred</a>

#### 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).