The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The general population may be exposed to radon in indoor and outdoor air and drinking water.
- The primary source of indoor radon is from soil; radon in the soil can enter the home through cracks in the floors, walls, or foundations. The release of radon from water may also contribute to indoor levels.
- Exposures to radon gas are accompanied by exposure to radon progeny which are the decay products of radon-222 [e.g., bismuth-214 (^{214}Bi), lead-210 (^{210}Pb), ^{214}Pb, polonium-210 (^{210}Po), and ^{218}Po.

Occupational Populations

- Occupational exposure to radon can occur in mining and milling industries, primarily underground mining of uranium and hard rock. Exposure can also occur during the mining of silver, tin, bertrandite and beryl ores, and other materials.
- Water-plant operators may also be exposed to high levels of radon gas escaping from water during treatment processes.
- Workers at radioactive contaminated sites, natural caverns, phosphate fertilizer plants, oil refineries, utility and subway tunnels, excavation sites, fossil fuel power plants, natural gas and oil piping facilities, health mines and spas, fish hatcheries, and hospitals may also be exposed to radon.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Inhalation exposure to radon delivers the gas and its progeny (e.g., ^{214}Bi, ^{214}Pb, ^{210}Pb, ^{218}Po, and ^{210}Po; some attached to atmospheric particles and the rest unattached) into the respiratory tract.
- Rapid clearance of radon gas from the lung by absorption and exhalation, along with its short half life, will result in steady-state concentrations of radon in blood within 2–3 minutes.
- Absorption half-times for radon progeny are approximately 10–13 hours if they are attached to dust particles and 18–68 minutes if they unattached to particles, respectively.
- Radon and radon progeny are absorbed through the stomach and small intestines.
- Absorbed radon and radon progeny are widely distributed throughout the body.
- Radon is primarily excreted via exhalation and radon progeny are excreted via the urine and/or feces.

Normal Human Levels

- Since the half-life of radon-222 is short, (3.8 minutes) and it is a noble gas, its measurement in biological samples is not practical.

Biomarkers/Environmental Levels

Biomarkers

- Biomarkers of exposure to radon and its progeny include the presence of radon progeny in several human tissues and fluids, including bone, teeth, blood, and hair.
- At present, estimated levels of biomarkers of exposure are not useful for quantifying exposure to radon and its progeny.
- Environmental levels of radon in air, rather than biomarkers of exposure, are used for quantifying exposure to radon and its progeny.

Environmental Levels

Air

- The average outdoor air concentration in the U.S. is 0.4 pCi/L.
- The average annual concentration of radon in U.S. homes is 1.25 pCi/L.

Sediment and Soil

- Normal soil-gas radon measurements are in the range of 270–675 pCi/L.

Water

- The average level of radon in groundwater is 351 pCi/L.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Radon. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Radon

Rn

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
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ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Radon is a Gas

- Radon is a noble gas formed from the natural radioactive decay of radium and is part of the uranium and thorium decay schemes.
- As radon undergoes radioactive decay it emits alpha radiation.
- The most common radon isotope is ^{222}Rn; the half life of ^{222}Rn is 3.82 days.
- Because uranium is ubiquitous in the earth's crust, radon is present in almost all rock and all soil and water.
- Radon has no commercial uses other than as a radiation standard for calibrating radon monitoring equipment.

Routes of Exposure

- Inhalation – Primary route of exposure for the general population and occupational population.
- Oral – Minor route of exposure for the general population.
- Dermal – Minor route of exposure for the general population.

Radon in the Environment

- Radon is continually being formed in soil and released to air. The normal emission of radon from radium in soils is the largest single source of radon in the global atmosphere.
- There is no information on releases of radon to the atmosphere from manufacturing and processing facilities because these releases are not required to be reported.
- The ultimate fate of radon in the environment is transformation through radioactive decay into radon progeny, and finally to lead.
- In groundwater, radon moves by diffusion, and primarily, by the mechanical flow of the water. Radon solubility in water is relatively low and much of it will decay before it can be released from groundwater.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No acute-, intermediate-, or chronic-duration inhalation MRLs were derived for radon.

Oral

- No acute-, intermediate-, or chronic-duration oral MRLs were derived for radon.

Health Effects

- Lung cancer is essentially the only health effect associated with exposure to radon and radon progeny.
- Increased risk of lung cancer has been found in studies of underground miners (primarily uranium miners) and in studies of populations exposed to radon in the home.
- Compared to nonsmokers, cigarette smokers have a greatly increased lung cancer risk from exposure to radon and radon progeny.

Children's Health

- It is likely that the increased risk of lung cancer observed in adults exposed to radon and radon progeny will also be seen in children.
- Age-related differences in susceptibility to the effects of radon and radon progeny have not been demonstrated.