LA-UR-19-28429
Approved for public release; distribution is unlimited.

Title: Los Alamos Radiation Protection Internal Dosimetry (Bioassay) Pamphlet

Author(s): Klumpp, John Allan

Intended for: Report

Issued: 2019-08-21

FAQs

What is a radionuclide intake?

A radionuclide intake happens when a radioactive material enters the body through inhalation or ingestion or through a wound. Because the radiation produced by some materials (such as plutonium, americium, uranium, and tritium) cannot leave the body, we look for the materials themselves in urine samples.

How/when will I get my bioassay results?

Small doses from tritium and uranium will be reported on your next annual dose report. If a plutonium or americium dose is possible, we will request more urine samples to determine if you have had an intake and, if you have, to calculate a dose. If we do not contact you, your results are normal (from those radionuclides, zero dose on your annual dose report).

What happens if I have an intake?

If you have an intake, we will review the data with you and answer your questions. We may ask for an in-person interview. Workers with radionuclide intakes almost never report physical health effects, but they often say they or their family members experience anxiety. The Laboratory can provide education and emotional support.

Who should I contact if I have questions?

For questions about receiving, filling, or dropping off your bioassay kit, contact the Bioassay Office. For questions about the analysis of a possible intake, contact the dosimetrist who notified you. For general questions about internal dosimetry, contact any of the internal dosimetrists.

Internal Dosimetry Contacts

Bioassay Office, 7-6275

Tom Waters, 5-2940
twaters@lanl.gov

John Klumpp, 7-0325
jaklumpp@lanl.gov

Luiz Bertelli, 4-0292
lbertelli@lanl.gov

Deepesh Poudel, 5-1798
dpoudel@lanl.gov

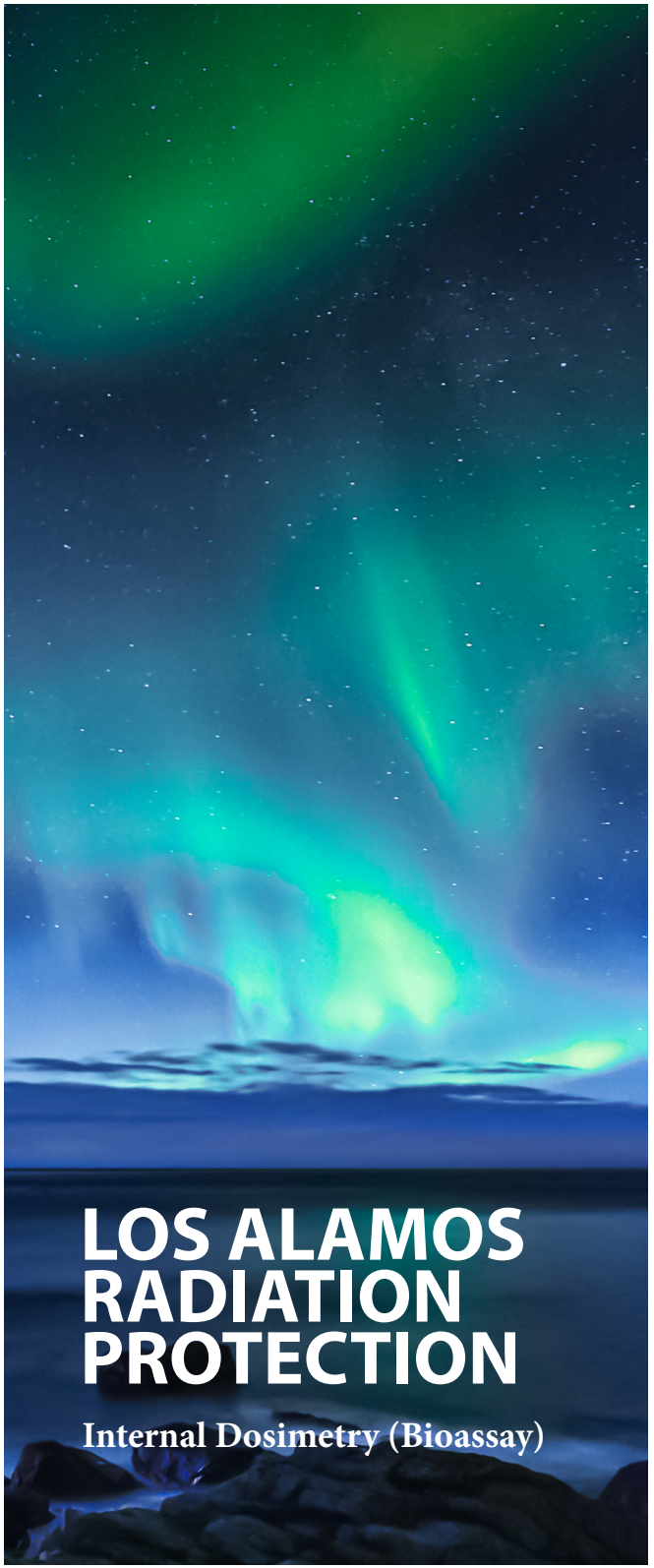
What We Do

Our job is to look for intakes of radioactive materials and to calculate radiation doses if an intake occurs. We do this by looking for evidence of radioactive materials in urine samples we routinely collect. We also ask for urine samples if something out of the ordinary happens, and because we do not want to miss anything, we often order samples even when an intake is unlikely. For that reason, most samples confirm that there was no intake.

To calculate radiation doses, we start by measuring the amount of radioactive material in a urine sample. From that measurement, we can estimate how much of the material is currently in the body. We already know how quickly different materials leave the body, so if we know when the intake happened, we can figure out the intake's size. Finally, from the size of the intake, we can calculate the total radiation dose the intake will cause.

Some materials we work with can stay in the body for many years. Therefore, we report the total dose that an intake will cause over the next 50 years. This is called the 50-year committed dose. We can often detect 50-year committed doses that are tens or even hundreds of times smaller than the dose you will receive naturally over that same time. We still do not know if very low doses of radiation are harmful or if only large doses can overcome the body's natural defenses. At Los Alamos, we assume that there is no "threshold" for harm and that all doses represent some risk.

Because radiation and radioactive materials are so common in nature, it is not always possible to tell from a single sample whether materials detected in your urine really came from an intake. For that reason, if the results of a sample are higher than expected, we may need to ask for more samples to find out if an intake really happened or if it is just a "false alarm."



LOS ALAMOS RADIATION PROTECTION

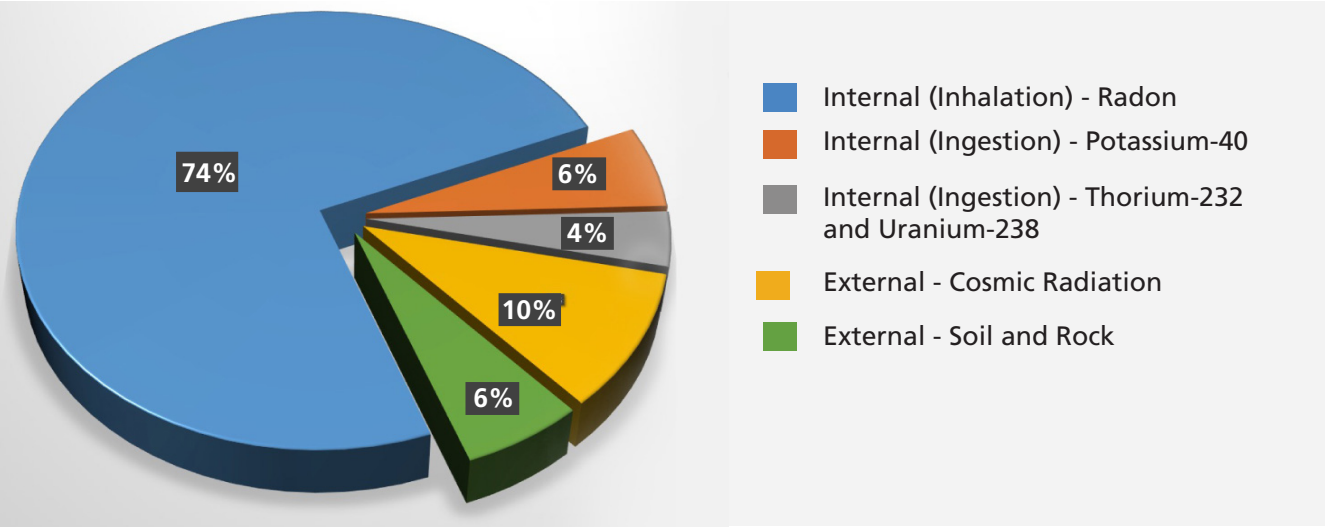
Internal Dosimetry (Bioassay)

Natural Radiation Sources

We are all constantly exposed to radiation from outer space, the sun, and radioactive materials in the ground. We also constantly take radioactive materials into our bodies. For example, we get radon from the air, uranium from drinking water, and potassium from food, such as strawberries and bananas.

In the U.S., the annual radiation dose from natural sources is about 310 millirems (mrem). Of that, about 84%, or 260 mrem, is an internal dose from materials we eat and inhale. The natural radiation at a given location depends on elevation and geology. The dose varies from Florida's 131 mrem per year to South Dakota's 962 mrem per year. In Los Alamos, with its high altitude and radon in the soil, the natural radiation dose is a bit higher than average—about 520 mrem per year. The chart below breaks down the various sources of natural radiation dose. Because natural radiation has always existed, our bodies usually can repair the damage radiation causes. However, we have seen that radiation doses many times higher than the natural radiation dose can cause illness, including an increased risk of cancer.

Doses from Natural Radiation



Radiation Explained

Particles or waves energetic enough to knock electrons out of atoms are called ionizing radiation, and in this pamphlet, "radiation" means ionizing radiation. Radiation has many sources, including x-ray machines and radioactive materials. Regardless of source, radiation affects the body in the same way—it ionizes atoms, setting off chemical reactions that can damage cells. Every time an atom inside the body is ionized, the body also absorbs a certain amount of energy. Therefore, radiation "dose" is determined by the amount of energy absorbed by the body.

Radiation is dangerous only when it enters the body. Its ability to do that depends on its energy, weight, and electrical charge—the factors that affect how far different kinds of radiation can travel. In general, radiation with more energy travels farther before stopping. For example, some kinds of radiation can be blocked only by several feet of lead, while other kinds cannot penetrate clothing or human skin. Lighter particles (particles with less mass) generally can travel farther through air and human tissue. Heavier particles cannot go as far but cause more damage to the tissues they do hit. We take that fact into account when calculating doses.

Internal vs. External Doses

Radiation doses from sources outside the body are external doses. External doses happen only when radiation, such as x-rays, penetrates the skin and travels far enough to reach sensitive tissues. External doses are monitored by detectors worn outside the clothing (for example, a TLD badge).

Radiation doses from sources inside the body are internal doses. Internal doses happen when a radioactive material is eaten or inhaled or when it enters through a wound. The radiation from many materials, such as plutonium-238, has a very short range, so those materials must enter the body before they can cause radiation doses. The internal doses these materials cause can be determined only by detecting and measuring the materials themselves in a urine sample. Measurements designed to detect radioactive materials in urine are called bioassay measurements.

Internal doses are not worse than external doses. Most doses we detect are hundreds of times smaller than doses that cause health concerns. Even very conservative estimates about the health effects of very small intakes predict risks much too small to detect.