

Chapter 4 Sources of ionizing radiation

Ionizing radiation enters our lives in a variety of ways. It arises from natural processes, such as the decay of uranium in the Earth, and from artificial procedures like the use of X rays in medicine. So we can classify radiation as natural or artificial according to its origin. Natural sources include cosmic rays, gamma rays from the Earth, radon decay products in the air, and various radionuclides found naturally in food and drink. Artificial sources include medical X rays, *fallout* from the testing of nuclear weapons in the atmosphere, discharges of radioactive waste from the nuclear industry, industrial gamma rays, and miscellaneous items such as *consumer products*. Later chapters have more information on both classes of source.

Each source of radiation has two important characteristics, the dose that it delivers to human beings and the ease with which we can do something to affect such doses. Until recently, radiation from natural sources seemed both unremarkable and unalterable — a background phenomenon. We now know, however, that doses from the decay products of radon gas (itself a product of uranium decay) in the home can be remarkably high in some areas, although it is fairly easy to reduce them in existing homes and to avoid high concentrations of the gas when building new homes. In contrast, we cannot do much to change our exposure to the other natural sources of radiation. This basic background of cosmic rays, gamma rays, and natural radioactivity within the body gives rise to an annual dose of about 1 mSv or more to an average citizen of the world. A comparable dose (at least) from radon decay products is also unavoidable in practice for most people.

It is easier, in most cases, to control artificial sources of radiation because we can alter or terminate the procedure producing the radiation, but there is always a balance to be made. It is important, for instance, to pay attention to the doses from medical X ray examinations, but it would be unwise to reduce them where this would lead to a loss of essential diagnostic information.

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was established in 1955 to estimate the potential health risks from radioactive fallout from atmospheric nuclear weapons tests. Today, UNSCEAR regularly publishes data on doses from all sources. The results of the latest review, published in 2000, are reflected in the pie chart on the next page. The annual dose, averaged over the population of the world, is about 2.8 mSv in total. Over 85 per cent of this total is

Absorbed dose is expressed in a unit called the gray, named after the English physicist

Harold Gray
(1905–1965)



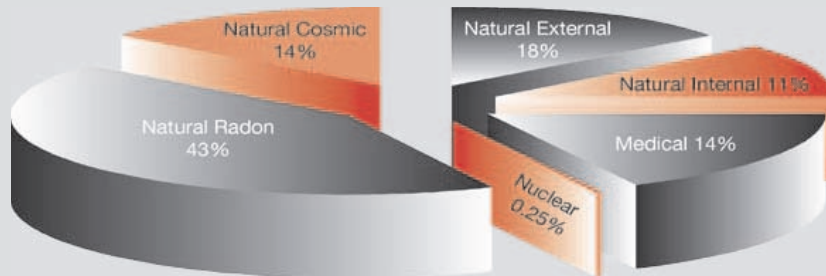
Rolf Sievert
(1896–1966)

Equivalent dose is expressed in a unit called the sievert, named after the Swedish physicist

Compiled from data in Tables 1 and 2 of UNSCEAR 2000 Report to the UN General Assembly

Average radiation exposure from all sources = 2.8 mSv/a

from natural sources with about half coming from radon decay products in the home. Medical exposure of patients accounts for 14 per cent of the total, whereas all other artificial sources — fallout, consumer products, occupational exposure, and discharges from the nuclear industry — account for less than 1 per cent of the total value.



The greatest variations in dose arise from radon decay products in the home, which can give annual doses of 10 mSv or more. Annual doses for those exposed to radiation at work are, at present, limited by law in most countries to 50 mSv or less, but only a small fraction of the workforce exceeds 20 mSv. It is unlikely that many members of the public receive more than a fraction of 1 mSv in a year from incidental exposure to artificial sources. Doses to patients in some diagnostic procedures may be around 10 mSv. For consumer products that contain radioactive material, such as smoke alarms and luminous watches, annual doses are at most 1 µSv (1 millionth of a sievert), although less common items, such as gas mantles containing thorium, may cause as much as 0.1 mSv in a year in certain circumstances.

Average annual doses to the world population from all sources of radiation

Source	Dose (mSv)
<i>Natural</i>	
Cosmic	0.4
Gamma rays	0.5
Internal	0.3
Radon	1.2
<i>Artificial</i>	
Medical	0.4
Atmospheric nuclear testing	0.005
Chernobyl	0.002
Nuclear Power	0.0002
Total (rounded) mSv	2.8