Radioactive isotopes and their health effects
1. Isotopes released in a radioactive accident
Radioactive accident

It is an accident at the nuclear facility, which leads to the release of radioactive substances and (or) of ionizing radiation, exceeding the established limits of safe operation of the facility.

http://toxipedia.org/display/toxipedia/Chernobyl+Accident
Radioactive substances

These are substances of artificial or natural origin, which are capable of ionized disintegration, associated with electromagnetic or corpuscular radiation, such radiation is harmful for living organisms in certain doses.
In case of inclusion of radioactive isotopes in organisms, people can develop such diseases as:

**Acute radiation sickness (ARS)**

This disease is a one-stage injury of all organs and systems of the organism, but first of all it is an acute injury of genetic structures of dividing cells, mostly hematopoietic cells in the bone marrow, lymphatic system, the epithelium of the gastrointestinal tract, skin cells, lungs and other organs due to exposure ionizing radiation.
Radiation injury to biological structures has strictly quantitative character, in other words, small effects may be not visible, and large may cause fatal lesions.

**Chronic radiation sickness**

This disease is an illness, which is caused by repeated irradiation of the organism in small amounts, summarily exceeding 100 rad. The development of the disease is determined not only by the total dose, but by its power (a period of irradiation), during which occur the absorbed dose of radiation in the organism.
Also as the result of the harmful effect of light radiation can be massive burns and eyes damage. A radiation burn is damage to the skin or other biological tissue caused by exposure to radiation.
2. Health Effects of Isotopes Released in a Radioactive Accident
Iodine-129 and Iodine-131

• both are released in a radioactive accident
• both cause problems with the thyroid, and long term exposure causes nodules and thyroid cancer
• Doctors frequently use these isotopes to treat thyroid cancer and hyperactivity
Per capita thyroid doses in the continental United States resulting from all exposure routes from all atmospheric nuclear tests conducted at the Nevada Test Site from 1951-1962.
Strontium-90 ($^{90}\text{Sr}$): bones and bone marrow

Strontium-90 ($^{90}\text{Sr}$) has a half-life of 29 years. Non-radioactive strontium is harmless, but the radioactive form is a health risk because it behaves similarly to calcium. Even though most strontium is excreted, about a fifth of it stays in the body and concentrates in the bones and bone marrow. The result can be cancers. The radiation, like iodine, is in the form of beta decay, which turns it into yttrium-90, which then becomes zirconium.
Teratogenic Mutations

• refers to fetal mutations due to radioactive exposure
• common mutations are smaller head or brain size, slow growth, poor eye development, and mental retardation
Ionising radiation:- Uranium atoms break into smaller atoms and particles, which enter a human cell, strike the nucleus, and damage the DNA, causing it to divide in an uncontrolled way - Cancer.
1. generation ("grandmother")

zygote

2. generation ("mother")

3. generation ("child")
3. Nuclear medicine facilities in Krasnoyarsk, Russia
Center for Positron Emission Tomography

Positron emission tomography is a radionuclide tomographic method for studies of internal organs.
PET diagnostic statistics

- Oncology – 88%
- Cardiology – 10%
- Neurology – 2%

Used isotopes

- $^{15}O \ (T_{1/2}=2,03 \text{ min})$;
- $^{13}N \ (T_{1/2}=9,96 \text{ min})$;
- $^{11}C \ (T_{1/2}=20,4 \text{ min})$;
- $^{18}F \ (T_{1/2}=109,8 \text{ min})$
Department of radionuclide therapy

Radionuclide therapy is an internal method of irradiation, in which the radiation sources are introduced into the body and used as a radiopharmaceutical (treatment of metastases in the liver, lung, thyroid gland, kidney, prostate and others).
Used isotope

\[^{131}\text{I} \ (\text{iodine-131})\]

! Iodine-131 is the most common radioactive by product of nuclear reactors, which is why in the case like Chernobyl in 1986 and Fukushima Daiichi in 2011 it is the biggest health concern.
The location of buildings of the PET and ORNT

The buildings are located outside the city
Sources

- http://www.epa.gov/rpdweb00/radionuclides/strontium.html#affecthealth
- http://www.epa.gov/rpdweb00/understand/health_effects.html#risksforcancer