a picture of health

Over the past 80 years, **X-rays**, **magnetic resonance imaging (MRI)**, **computed tomography (CT)** scans, **ultrasound** and **positron emission tomography (PET)** scans have allowed doctors to see the heart beating, the lungs breathing, the brain thinking, the stomach digesting, cancers growing and a host of other bodily activities taking place.

Computed tomography (CT) scan

A CT scanner irradiates the body with X-rays from multiple directions. Computer algorithms combine the X-ray images to create a complete "slice" through the body. Primarily used to diagnose and guide treatment for a wide range of conditions in every part of the body, to detect or exclude the presence of more serious problems and to determine whether a previously treated disease has recurred.

Neat fact

Godfrey Hounsfield, the principal inventor of CT scanning, worked for Electric and Musical Industries (EMI), the same company that signed The Beatles. EMI's profits from The Beatles enabled it to pursue this cutting-edge technology.

Positron emission tomography (PET) scan

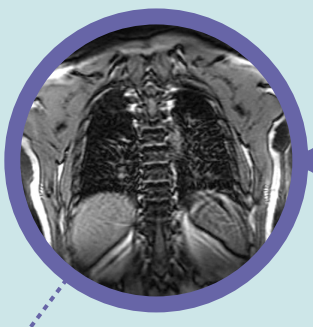
A radioisotope is "tagged" to molecules like glucose and injected, inhaled or ingested into the body. The glucose is absorbed by tissues, where it decays and emits positrons (positively charged particles), which collide with electrons in the body and emit gamma rays. Computer algorithms translate the gamma rays into cross-sectional slices of the body or organ. Tissues that take up more of the radioisotope appear brighter on the image, indicating the level of organ or tissue function. Primarily used to find disease in organs or tissues, to evaluate the function of organs such as the heart or brain and to determine the effectiveness of a cancer treatment.

Neat fact

George de Hevesy experimented with radioactive materials in his own body starting in the early 1900s, beginning a new field of nuclear medicine and earning him a Nobel Prize in Chemistry in 1943. In one of his early experiments, Hevesy used radioactive material to see whether his landlady was reusing old food for new dishes. He caught her red-handed by putting radium in his leftover meat pie one day and scanning his soufflé a few days later.

Magnetic resonance imaging (MRI)

An MRI scanner produces a strong magnetic field that aligns the weakly magnetic hydrogen atoms in the body. A coil sends out a radio frequency signal that flips the hydrogen atoms out of alignment with the magnetic field, making them spin. When the signal ends, the atoms return to their previous alignment in the field as their spinning slows down. Both actions cause them to emit radio frequency signals that are read by the coil and sent to a computer to be constructed into a cross-sectional image similar to that of a CT scan. Primarily used for soft-tissue imaging and detailed depictions of anatomical abnormalities. Of particular value in situations where the irradiation of a CT scan could be dangerous to the patient.



Neat fact

MRI technology relies on a phenomenon called "nuclear magnetic resonance (NMR)," in which atomic nuclei can be induced to spin. The scanning technique took on that name until, in the throws of the Cold War, it became clear that anything containing the word "nuclear" was frightening to the public. The NMR became known, instead, as MRI.

Ultrasound

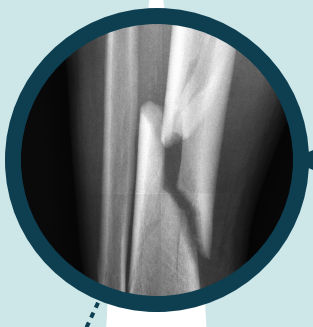
High-frequency sound waves bounce off tissue surfaces in the body. By measuring the time it takes for the reflected sound waves to travel back to the receiver, a computer is able to convert the "echoes" into an image. Primarily used for conducting prenatal exams of fetuses, evaluating breast masses and the brains of premature infants, looking at flow through blood vessels, diagnosing abnormalities in the abdomen, eye and heart and guiding procedures, such as needle biopsies of tumours.

Neat fact

Ultrasound for medical imaging arose when American veterans returning from the Second World War sought new applications for the sonar technologies used to detect enemy submarines.

X-ray

The electrons in an electron beam decelerate as they approach a positively charged tungsten anode, producing short wavelength radiation known as X-rays, which pass through opaque body parts. The X-rays are absorbed differently by different tissues. For instance, bones don't let as many X-rays pass through as does soft tissue, so they appear white in the final image. Primarily used to look at bones, to diagnose conditions in the abdomen and chest, to take mammograms and in emergency room trauma situations.



Neat fact

Wilhelm Conrad Röntgen, who discovered X-rays, was awarded the first Nobel Prize in Physics in 1901. X-rays were originally developed on film in a dark room, like photographs. Now they are produced digitally.

Timeline

- **X-ray** — Discovered in 1895; came into widespread use in the 1930s.
- **Ultrasound** — Introduced in the 1950s.
- **PET** — Early experiments with radioactive tracers began in early 20th century. The first clinical PET scanner introduced in 1952.
- **CT** — First human CT scan performed in England in 1971.
- **MRI** — Development began in the 1960s; introduced into practice in the 1980s.

Read our In-depth report at Innovation.ca to find out how Canada is leading the charge on medical imaging research.

SOURCES
MRI image: http://www.rad.msu.edu/Course/RAD553/image_lib/body/BT21_d.htm
PET image: http://radiographics.rsna.org/content/28/7/1869/F12.expansion.html

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