Medical Imaging:

It's diagnosed and treats patients without any harmful or side effects. its remains one of the best ways to achieve this, as it allows us to see what’s going inside the body without the need for surgery. And can be used for both diagnosis and therapeutic purposes, making it one of the most powerful resources available to effectively care for patients.

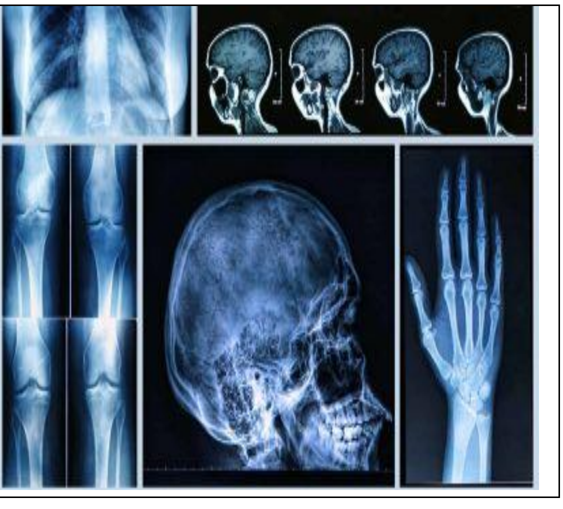
In terms of diagnosis, the common imaging types include:

- X-ray
- MRI (Magnetic Resonance Imaging)
- CT (Computed Tomography)
- Ultrasound
- Nuclear medicine imaging (including positron-emission tomography (PET)).

Each type works slightly differently to create images of what’s going on inside the body.

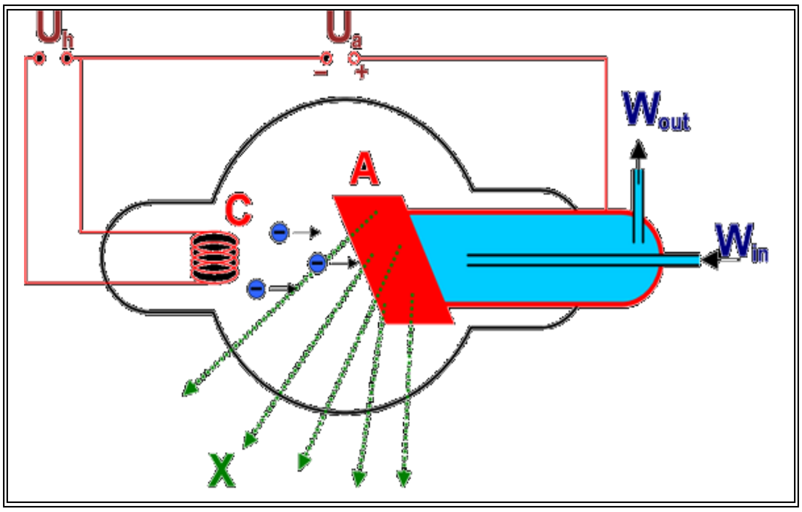
X-Ray Imaging

Its oldest and one of the most frequently methods was used for imaging. It was discovered in 1895, X-rays classified as electromagnetic radiation. Its wavelength and frequency are unable to see with the naked human eye. So, it can penetrate through the skin to create pictures for inside body. This method is ideal for diagnosis, especially skeletal system. And can also be used for detect other issues such as breast cancer (through mammography) and digestive issues.



X-Ray production

X-rays are electromagnetic radiation such as visible light, but they differ from visible light at short wavelengths of about (0.5-2.5)nm, which produced in the x-ray tube which has a source of electrons, high accelerating voltage and metal target. When the electrons are shock with the target, the leakage of energy from electrons is discovered by the effect of x-rays and most kinetic energy of electrons that target the target is transformed to another form of energy (heat). Equation (1) for energy equation, converting less than 1% to x-ray. Figure (1) shows the X-ray tube.



Figure(1) The X-Ray Tube.

$E_k = e\,V = (1/2)\,mv^2$ ………………………………… (1)

Where:

E_K – kinetic energy

e – Electron charge (1.6×10^{-19} C)

V – Applied voltage (volt)

m – Mass of the electron (9.11×10^{-31} kg),

v – Electron velocity (m/sec)

The continuous spectrum properties is silky, the relationship of intensity and wavelength shows in Figure (2). So, The intensity decreased or go to zero value when the electron lose all its energy to the emitted photon .

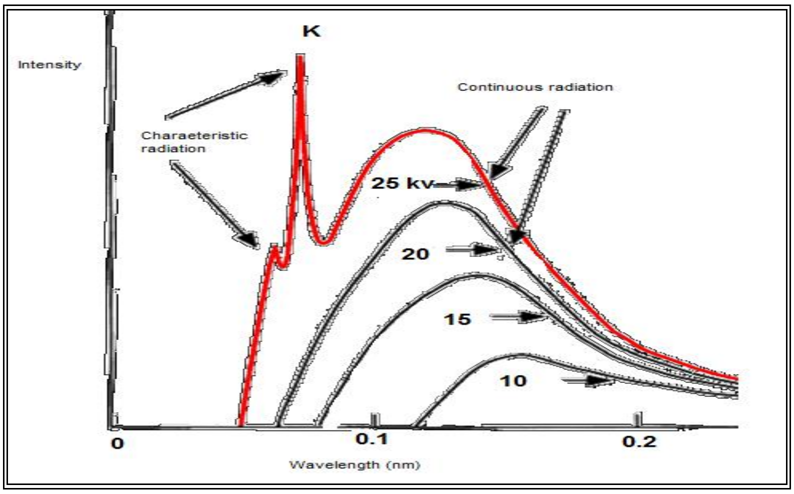


Figure (2) The relation between intensity and wavelength.

The total photon energy that emitted per second depends on the current of x-ray tube and atomic number Z of the target material.

The total photon intensity is explained as an equation :

$I = A . I .Z . V^{m}$ …………. (2)

A – Proportionality constant.

i– Tube current (electrons number per second strike the target)

Z -Atomic number

m – Constant ≈2

X-Ray Absorption:

When the x-ray meet any type of tissues, part of it is absorbed and the other part is transmitted as shown in eq. (1-3,4,5) .

$I \alpha x$ ………… (3)

I– intensity (watt $.sr^{-1}$)

x – Distance (cm)

Equation (1-3) in differential formula:

$dI/I=\mu dx$ ………… (4)

Where μ is linear absorption coefficient

By integration

$I_X=I_0e^{-\mu x}$ ……….. (5)

I_0 – incident beam intensity (watt $.sr^{-1}$)

I_x – transmitted beam intensity (watt $.sr^{-1}$)