U3A Science and Technology Group
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Radiotherapy: How technology drives improvement
Hazel McCallum

Radiotherapy – the treatment of disease with radiation – has been around for over a hundred years, particularly in the treatment of cancers. Hazel McCallum, Consultant Clinical Scientist, has worked with radiotherapy for most of her career and here she charted the changes and improvements she has seen since the mid-1980's.

Radiotherapy covers a wide range of treatments; Hazel's talk was concerned with high energy X-rays, the form that many cancer patients will receive. Treatment X-rays have sufficient energy and intensity to deliver a large dose to the target volume, rapidly severely damaging cells to the point where they will die. Diagnostic X-rays are needed to define target volumes inside a patient They have much lower energy and intensity and create images of bones and organs without causing significant damage to cells.

In the 80's and 90's treatment and diagnostic imaging were done separately. Images were captured on X-ray film and because tissue and organs had low contrast, the position of bones was used to locate the target area – a tumour could rarely be seen directly. A target box inside the body was defined using two orthogonal X-ray images. As it was crucial that the treatment X-rays from four directions went only through this box, the patient was positioned carefully using cushions and moulds that could be reproduced at each treatment. The images also defined the placing of heavy metal pieces that would block the X-rays from the areas that should not be irradiated. All of this was done manually – there were no computers and no automated systems to move blocks.

The 2000's brought many major improvements. CT diagnostic scans gave high resolution, high contrast 3D images of organs; much smaller target volumes could be defined; treatment X-rays could be delivered from many angles instead of four; digital images and computers define the target better; automation gave real time adjustment of blocking pieces as the treatment X-ray was rotated round the patient; real-time confirmation of hitting the target is possible.

Modern X-ray radiotherapy is much faster and safer than 40 years ago. Incidental damage to surrounding organs is less, while high doses of X-

rays are delivered to smaller targets. Developments are still taking place to better define the tumour and deliver the dose to just that volume.

Hazel's talk was well received and generated many questions.