Cancer Research Wales aims to reduce the impact of cancer on the people of Wales through supporting world class cancer research and education. For cancer patients, radiotherapy is increasing becoming an essential part of their treatment and makes a significant contribution to cancer cure. At Cancer Research Wales we believe it will be important to:

- Improve imaging methods to guide treatment planning for more effective delivery of radiotherapy, coupled with reduced side effects.
- Develop standardised software platforms for radiotherapy that can deliver reproducibility between operators, and departments.
- Provide a research-driven environment for radiotherapy to further improve techniques which will translate into better survival for cancer patients.

Radiotherapy **RESEARCH**

Cancer Research Wales Ymchwil Canser Cymru

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our research saves lives

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Radiotherapy
RESEARCH

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Approximately 40% of all cancer patients will have some form of radiotherapy as part of their treatment programme, with these numbers likely to increase in the future. Cancer Research Wales (CRW) fund several pioneering radiotherapy research projects, which collectively seek to:

- **Improve radiotherapy treatment** planning through the modelling, comparison and critical assessment of different treatment strategies used in practice.
- Design and develop new radiation measuring devices for clinics.
- Create innovative methods and computerised systems for improved radiotherapy of oesophageal cancers.
- Generate standard procedures for the implementation of Positron Emission Tomography (PET) in the radiotherapy of Head and Neck cancers.

Treatment planning systems (TPS) are used to determine the best arrangement of radiation beams for patients. The

two main methods used in treatment planning are known as Pencil Beam Convolution (PBC) and Collapsed Cone Convolution (CCC). Each uses approximations to reduce calculation time. The Monte Carlo (MC) method is an alternative approach that is very accurate but more time consuming. CRW funded scientists are using complex computer systems to generate treatment simulations that can compare all three methods (MC, PBC, CCC). These studies aim to provide more accurate information relating to radiation dose calculations and a better understanding of the relationship between delivered dose and its effects on the patient. This will **ultimately improve the effectiveness of radiotherapy treatments**.

Projects in Swansea are developing novel radiation measuring devices (dosimeters) for use in routine radiotherapy practice. Modern radiotherapy techniques require a more accurate determination of the radiation dose delivered to patients. This has led to the introduction of several new, high resolution dosimeters. Computer models will be created to compare their performance with conventional dosimeters within various complex radiation treatment scenarios. These new devices incorporate the latest artificial diamond technology, and are cost-effective and reliable substitutes for the current detectors that use natural diamond.

Current research in oesophageal cancer is focussed on improving outcomes through better radiotherapy. A standard radiotherapy plan involves the outlining and separation of both tumour and normal tissues for accurate targeting of tumour only. However, treatment planning by different investigators may result in subtle but important variations in outlining. CRW supports research that seeks to address the issues of inter-observer variation by examination of the impact of outline variation on patient outcome in oesophageal cancer. These exciting projects aim to devise innovative methods and computerised systems that can limit user variability within and between radiotherapy departments. It is hoped these will eventually be incorporated into future oesophageal radiotherapy trials and standard care, leading to improved treatments, survival rates and reduction of side effects.

Positron Emission Tomography (PET) is a very sensitive and effective imaging technology for detecting cancerous cells. PET exploits the fact that cancer cells have an increased requirement for sugars compared to healthy tissues. During PET, administered radio-labelled sugars selectively accumulate within cancerous cells. This radioactive build-up is then imaged to create a visual "heat map" which can identify extremely small cancers. PET is often used with conventional scanning techniques such as CT to further improve the outlining of tumour lying within normal tissue and more accurately determine tumour volume and location.

CRW is proud to support innovative research projects that seek to improve the PET based assessment of tumours. Clinicians and scientists are working together to create applied protocols and procedures that will enhance PET/CT image resolution and image acquisition for cancers of the head and neck. This will lead to the generation of standard policies and practices that will improve reproducibility between operators and hasten the introduction of PET as an established method in radiotherapy planning. It is hoped that the outcomes of this research can be applied to other tumour types such as cancers of the lung, breast, brain, prostate and oesophagus.