the course of a fractionated radiotherapy treatment or during a PET study. This work examines how transient perfusion of vessels may influence tissue radiosensitivity (including reoxygenation) and FMISO image contrast, as a guide for dose painting.

Material and Methods: Microscopic oxygen and FMISO distributions are simulated in tissue using bespoke MATLAB software which solves coupled partial differential equations by finite difference methods. Dynamic vasculature is modelled by opening and closing individual vessels at random, with time spent in each state sampled from a normal distribution. Oxygen enhancement ratios are calculated from the resulting PO2 maps. The optimal prescription dose is found by simulating a range of dose levels and determining radiobiological cell kill using the linear-quadratic model with repopulation. A novel approach to modelling reoxygenation is adopted in which a tissue’s oxygen consumption in one fraction is reduced by the cell kill in previous fractions.

Results: Predicted FMISO tissue-to-muscle ratios (TMR) are in the range 1.0-2.3, increasing as PO2 decreases to a peak at ~7 mmHg. At very low vascularity, FMISO uptake is limited by the range 1.0 -2.3, increasing as PO2 decreases to a peak at 50 Gy (dynamic vasculature changing every fraction) and 71 Gy (reoxygenation by reduced consumption). The effect of vessel dynamics is negligible if significant reoxygenation of chronic hypoxia occurs.

Conclusion: A model has been demonstrated that predicts realistic FMISO uptake in hypoxic tissue and provides a method for calculating prescription doses with reoxygenation. Individual vessel dynamics do not affect FMISO image contrast at 4 hours, or the prescription dose if global reoxygenation occurs.

Purpose or Objective: With a 5-year survival rate of 5%, pancreatic ductal adenocarcinoma (PDAC) is considered a disease of unmet-need. Preclinical radiobiological research in PDAC has been limited by mouse models that do not recapitulate the human biology and, more importantly, the immense technical challenges in establishing a platform that enables precise irradiation of pancreatic tumours in mice.

Material and Methods: Herein we describe the key steps in the development of a state-of-the-art preclinical image-guided radiotherapy (IGRT) platform that enables precise planning and dose delivery in the KRASLSL.G12D/+; p53R172H/+; PdxCreg/+ (KPC), a genetically-engineered mouse model (GEMM) of PDAC. CT (x-ray computerised tomography) does not provide the soft tissue contrast required for accurate and precise RT planning in the mouse. We demonstrate the use of magnetic resonance imaging (MRI) for RT planning in the mouse abdomen. KPC mice with spontaneous pancreatic tumours were anaesthetised and placed in an MR-CT compatible cradle. A newly-developed respiratory-gated multiple echo contrast scan (8 echoes, TE 6-50 ms) operating at constant TR=3600, was run at 150x150x300 um resolution in a scan time of ca. 9 minutes.

Results: Tumours were undetectable using CT but showed as bright regions on T2-weighted images, as described previously. After registration of the MRI to the CT images RT planning was quite straightforward and beam trajectory and RT dose estimations were performed for a conical arc trajectory. MRI can be used with CT-guided RT system to give soft tissue contrast and enable RT planning. The respiratory gated T2-weighted scans acquired using multiple echoes gave very good contrast, though the scan time was relatively long (ca. 9 minutes). At the expense of SNR this can be reduced to ca. 2 minutes through use of fast spin echo. The different steps will be discussed in detail. Precise beam delivery was confirmed using immunohistochemical staining for γH2AX foci.

Conclusion: Altogether, our IGRT platform represents a novel tool to explore the effects of RT on the biology of PDAC and investigate the mechanisms of treatment resistance. To our best of knowledge, no studies to date have reported such a precise MR-based IGRT platform for preclinical radiobiological research in the KPC model. This platform will enable exploration of the mechanisms of treatment resistance and is expected to provide important radiobiological insight to guide successful future clinical trials that will directly benefit patients with PDAC.

Purpose or Objective: MRI is increasingly used in radiation oncology for target delineation and real-time treatment guidance. The gadolinium-based nanoparticles (GdNP) used in this study are a dual modality probe with MRI contrast and radiosensitization properties. We use a mouse model of pancreatic cancer to demonstrate in vivo contrast enhancement, quantification of GdNP concentration, and...
A rigorous health economics approach requires the cost of the real resources used to be identified (ISPOR, 2007). We report on such an approach to the estimation of the cost of radiation therapy.

Material and Methods: A Time-Driven Activity Based Costing (TDABC) model was created for external photon beam radiotherapy at the national level. The model was developed in an iterative manner by a panel of experts, taking into account current knowledge of resources, products, and clinical processes. The resources were identified through a systematic review of the literature from 1981 to 2015. In TDABC, resource unit costs per minute are defined as the ratio of gross expense to available capacity. The products, defined as courses of treatment for specific tumor indications, were derived from the decision trees developed by the Collaboration for Cancer Outcomes, Research and Evaluation (CCORE). The process map was derived from that developed by the AAPM (2012, Ford).

Results: Resources are organized in 3 categories: personnel, equipment and overhead. Products are grouped per organ site and target volume. For each of these, treatment complexity and diversity are addressed by extending the AAPM process map in three ways:
1. six technique categories, specified as follows: single-field, 2D-RT, 3D-CRT, IMRT, rotational IMRT and stereotactic techniques;
2. eight possible fractionation schedules can be defined;
3. some steps along the patient care pathway are identified separately from the 7 high level steps, see figure. These, reflecting an additional level of treatment complexity, are optional and hence not necessarily applicable to all treatment courses.

The core input required is the time of personnel’s involvement at each process step for every technique and product. This TDABC approach yields two classes of output:
1. costs, at the level of the resources, activities and products, the latter being the sum of the costs of the component process steps; and
2. resource utilization efficiency.

Conclusion: A TDABC model for external photon beam radiotherapy is developed for use at the national level. In the next step, the model is being tested in close collaboration with selected European Radiotherapy Societies, by introducing nation-specific data on the resources consumed, monetary values and resources’ time devoted to each step, reflecting complexity. These data generate national cost estimates per course for a range of radiotherapy treatments. The cost estimates and details of the methodology will be presented.