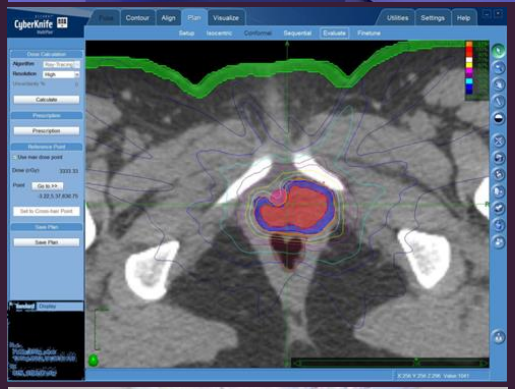
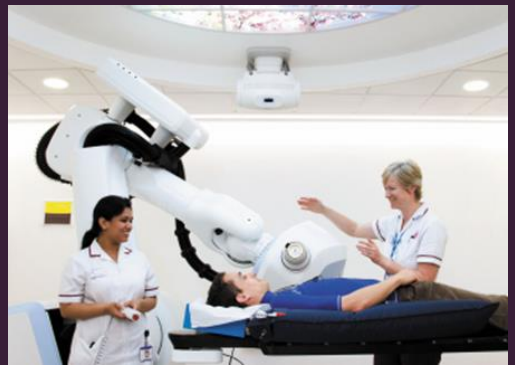
The ROYAL MARSDEN
Private Care

Radiotherapy at RMH: State of the art

Dr Susan Lalondrelle

Consultant Clinical Oncologist



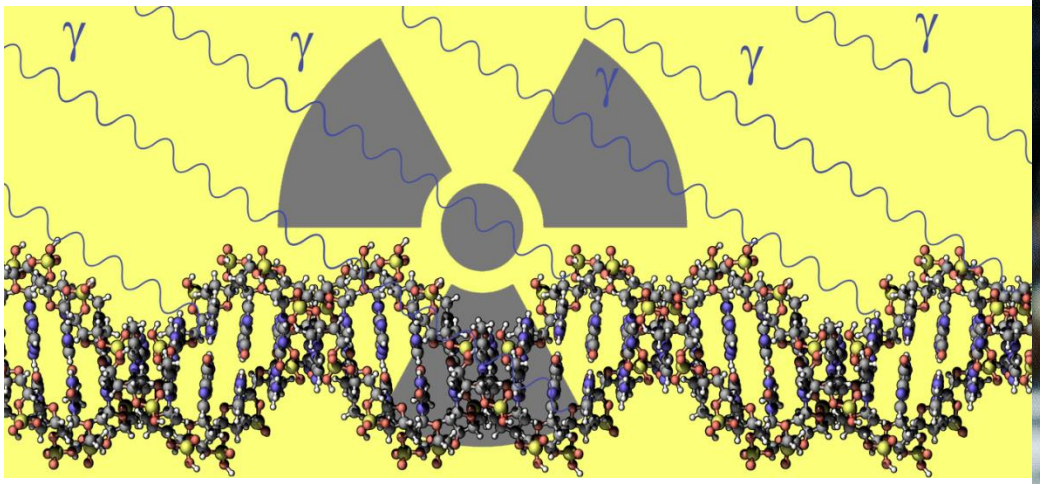


Overview

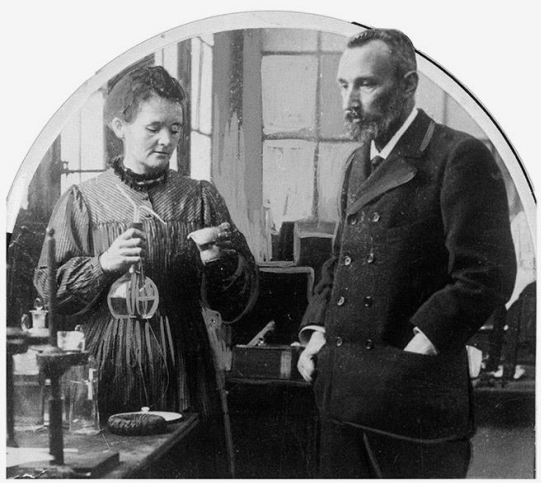
- Why do we use radiotherapy?
- Principles of radiotherapy
- Radiotherapy innovation at RMH

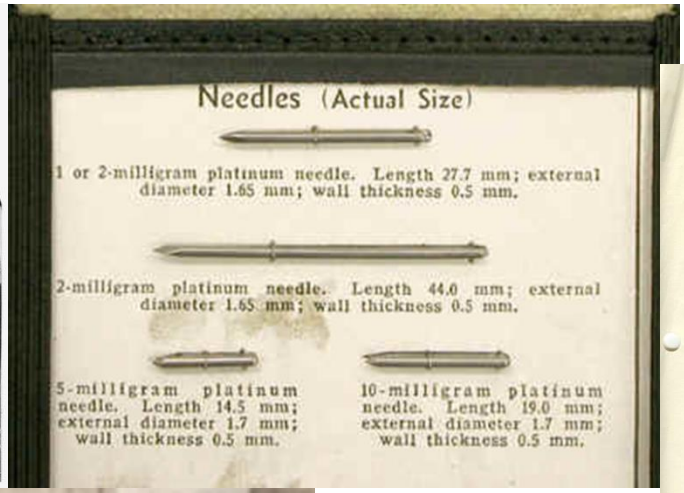
What is radiotherapy?

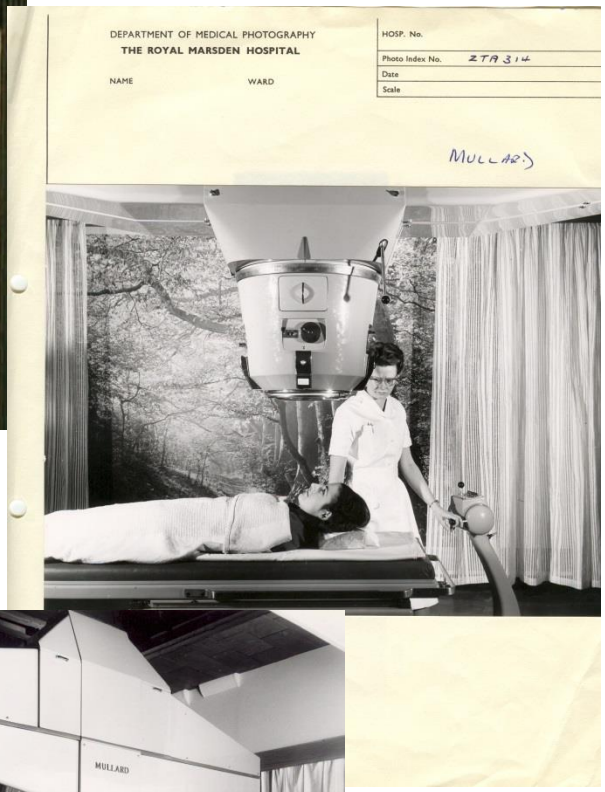
- Ionising radiation damages tumour DNA through
  - direct double strand break
  - indirect free radical damage

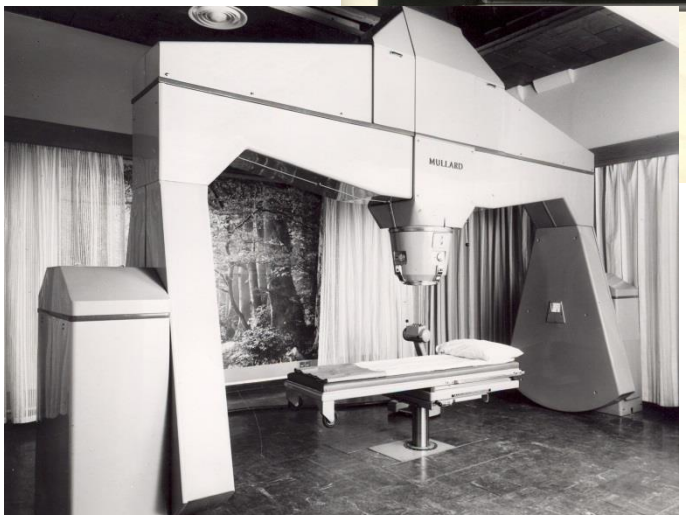


History of radiotherapy









Radium revolution

I SUPPOSITORIES

OUR VITA RADIUM SUPPOSITORIES (HIGH STRENGTH) are one of the outstanding triumphs of Radium Science. These Suppositories are guaranteed to contain REAL RADIUM—in the exact amount for most beneficial effect. They are inserted per rectum, one each night, this being one of the several practical and successful ways of introducing Radium into the system.

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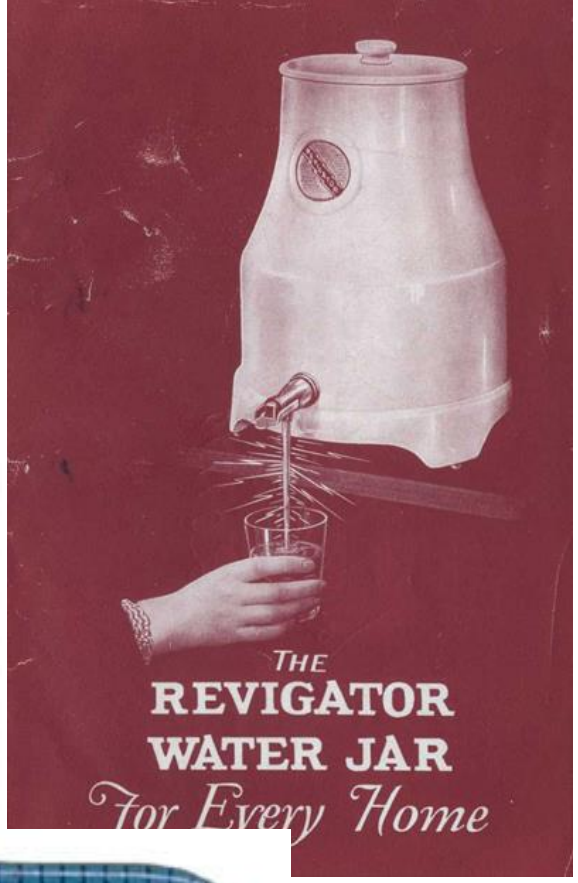
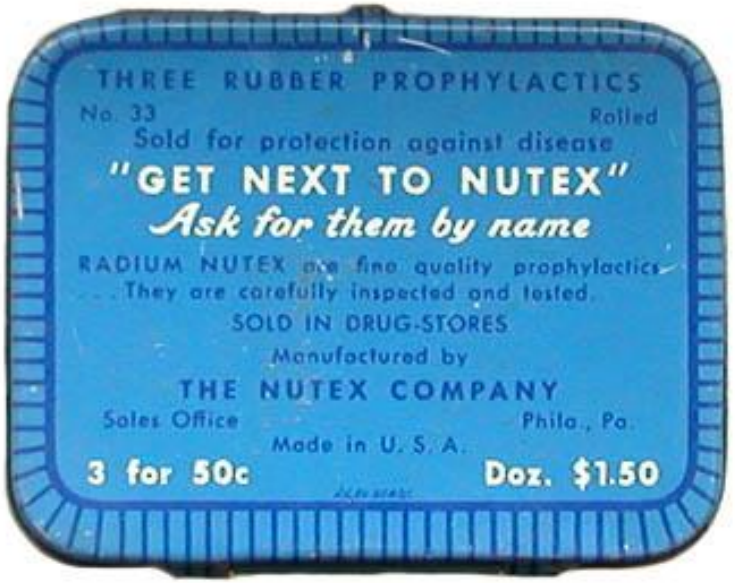
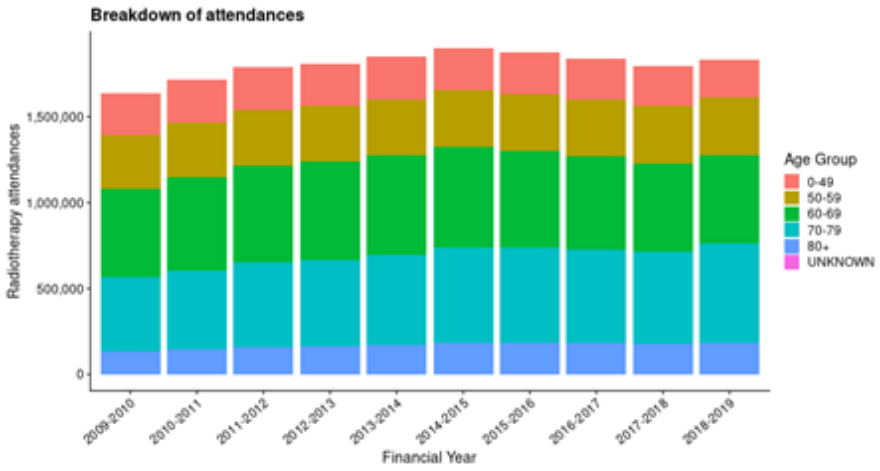
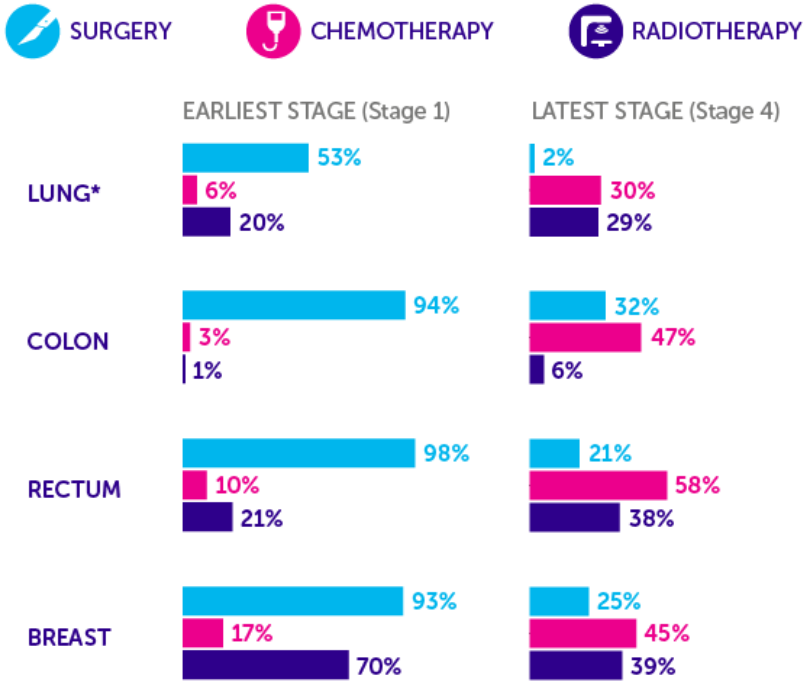




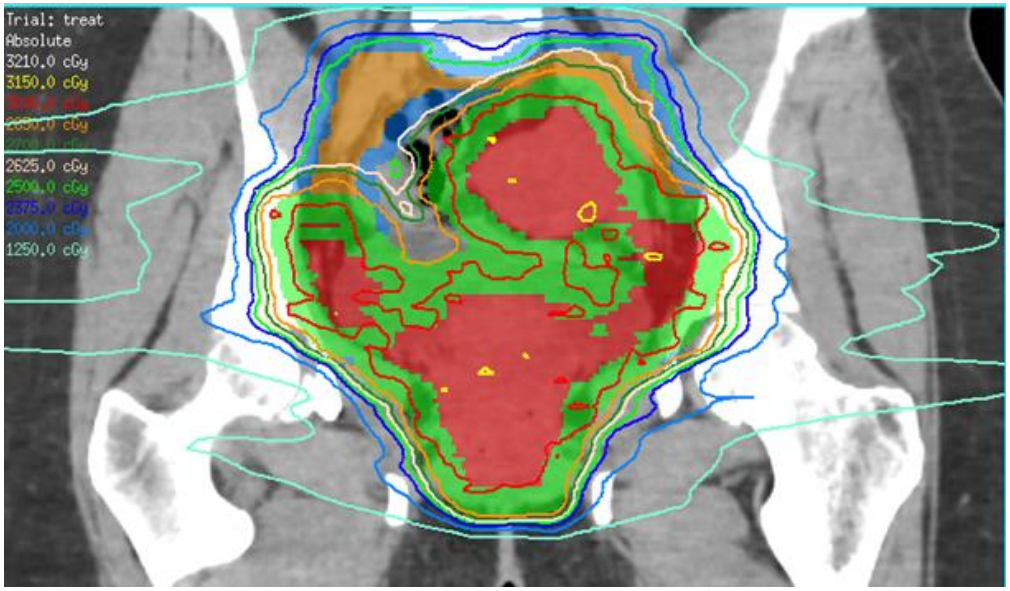
Radiotherapy in the UK today



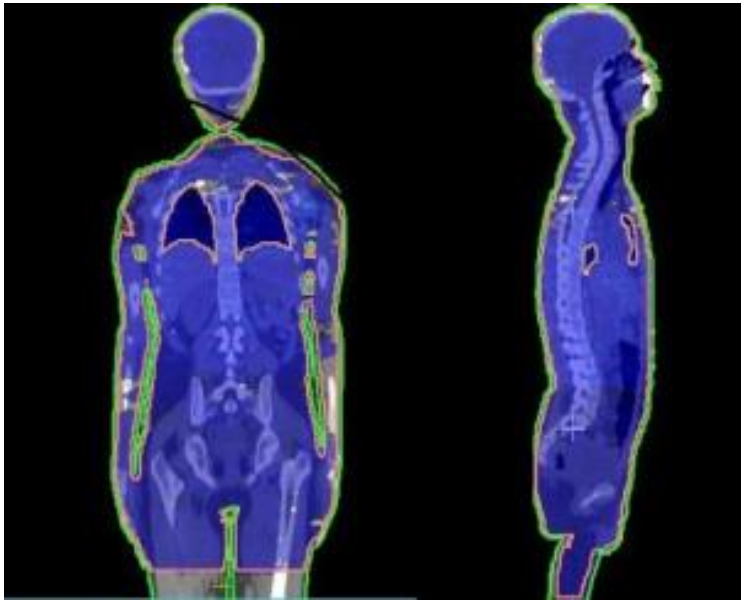


- 50% of all cancer patients will receive RT
- 40% will receive RT with curative intent
- >1.7m RT attendances in the UK /year

What do we treat : BIG TARGETS

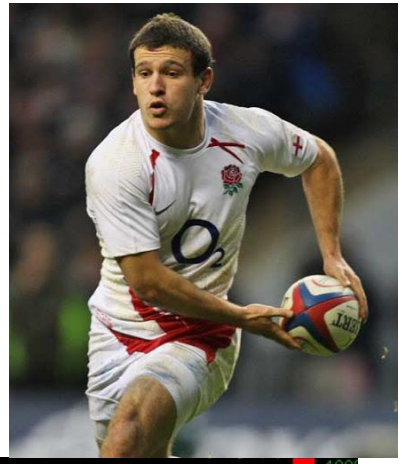


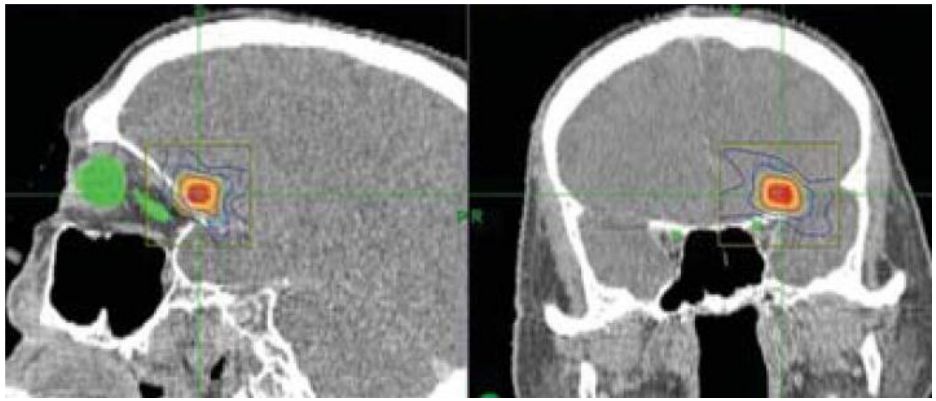
Central pelvic tumour and draining lymph nodes

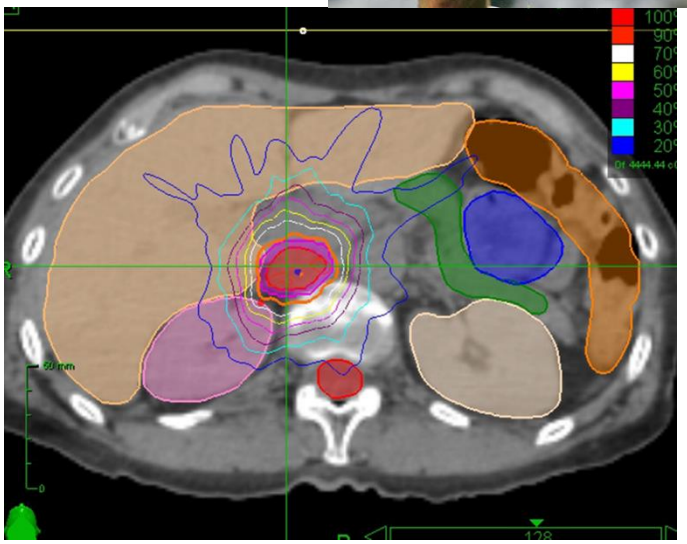


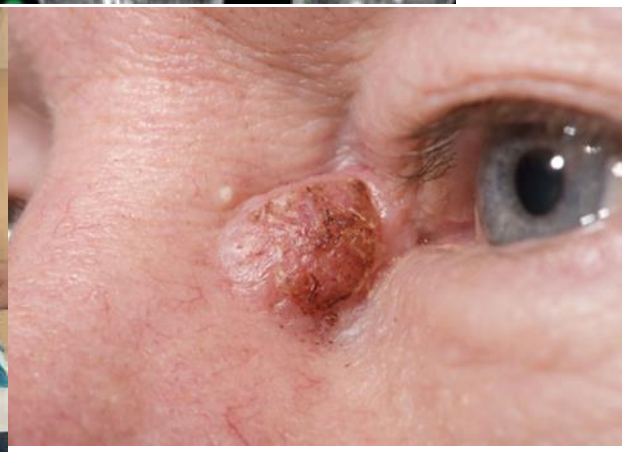
Total Body irradiation

What do we treat: SMALL TARGETS









What do we treat: Moving targets

The RMH RT team

Core Staff

30 consultants

110 radiographers

35 clinical physicists

Supported by

Clinical nurse specialists

Admin team

Research team

Play therapists

Treat approximately 5,000 patients per year equating to 75,000 attendances per year

Radiotherapy Service: Chelsea

Equipment

- Four Varian True Beam linacs
- all IMRT/IGRT capable
- Varian True Beam
- Cyberknife
- HDR Brachytherapy
- Dedicated planning CT

Radiotherapy Service: Sutton

Equipment

- Seven Elekta Synergy linacs
- All IMRT/IGRT capable
- Two planning CT scanners
- Superficial radiotherapy
- UK's first MR Linac (Unity)
- Cyberknife (Summer 2020)
- Raystation

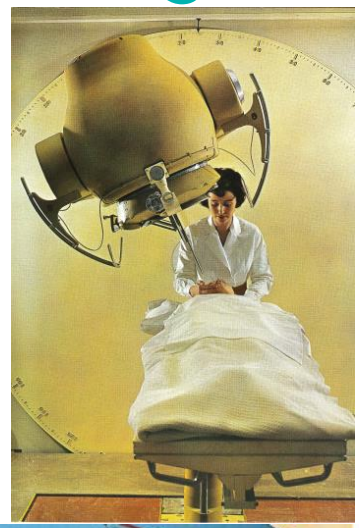
A history of technological innovation through research

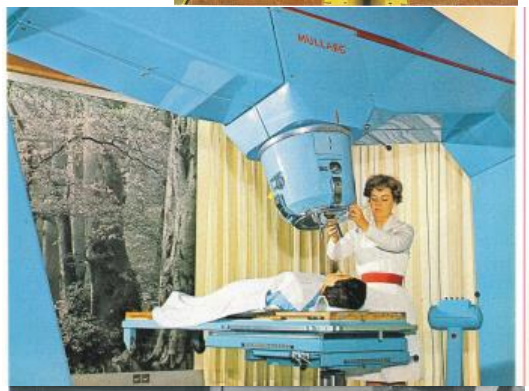
- **1940s**
  First hospital in the UK to use artificial radioisotopes for the treatment of patients

- **1980s**
  Lead for practice changing trials such START trial in breast cancer, showing large and less fractions as good as longer course

- **1990s**
  First hospital in the UK to test multi-leaf collimation. This led to the development of IMRT and more conformal, normal tissue sparing RT

- **2000s**
  First hospital to treat a patient with Intensity Modulated Radiation Therapy (IMRT). **2008**





A history of technological innovation through research

- **2008**

We were the first in the world to deliver volumetric intensity modulated arc therapy (VMAT).

- **2010s**

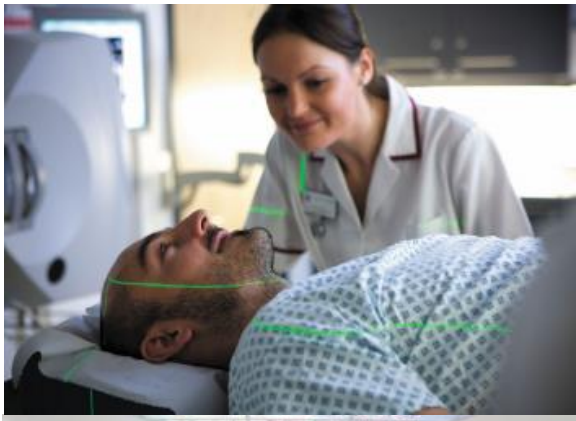
Lead on international CHHiP trial showing that fewer, larger doses of IMRT work are as good as longer courses for men with prostate cancer.

- **2011**

One of the first NHS Trusts to introduce a CyberKnife to deliver stereotactic radiotherapy, facilitating pinpoint therapy in few fractions. Currently leading the international PACE trial using CyberKnife.

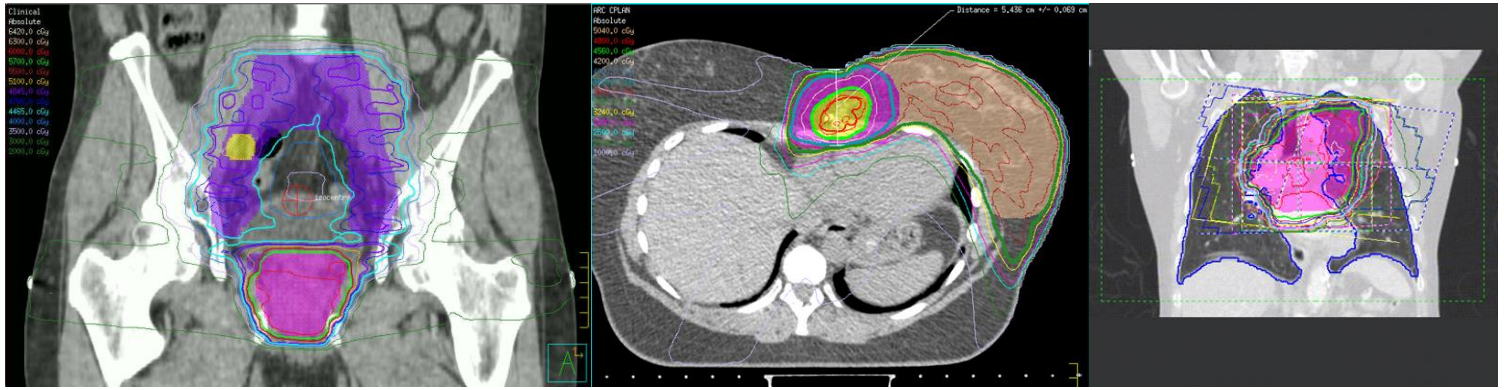
- **2018**

We are the first hospital in the UK and one of only seven centres in the world to install an MR Linac - a state-of-the-art machine which will allow us to see the target with the best imaging there is and then adapt the treatment to it with real time adaptive radiotherapy.

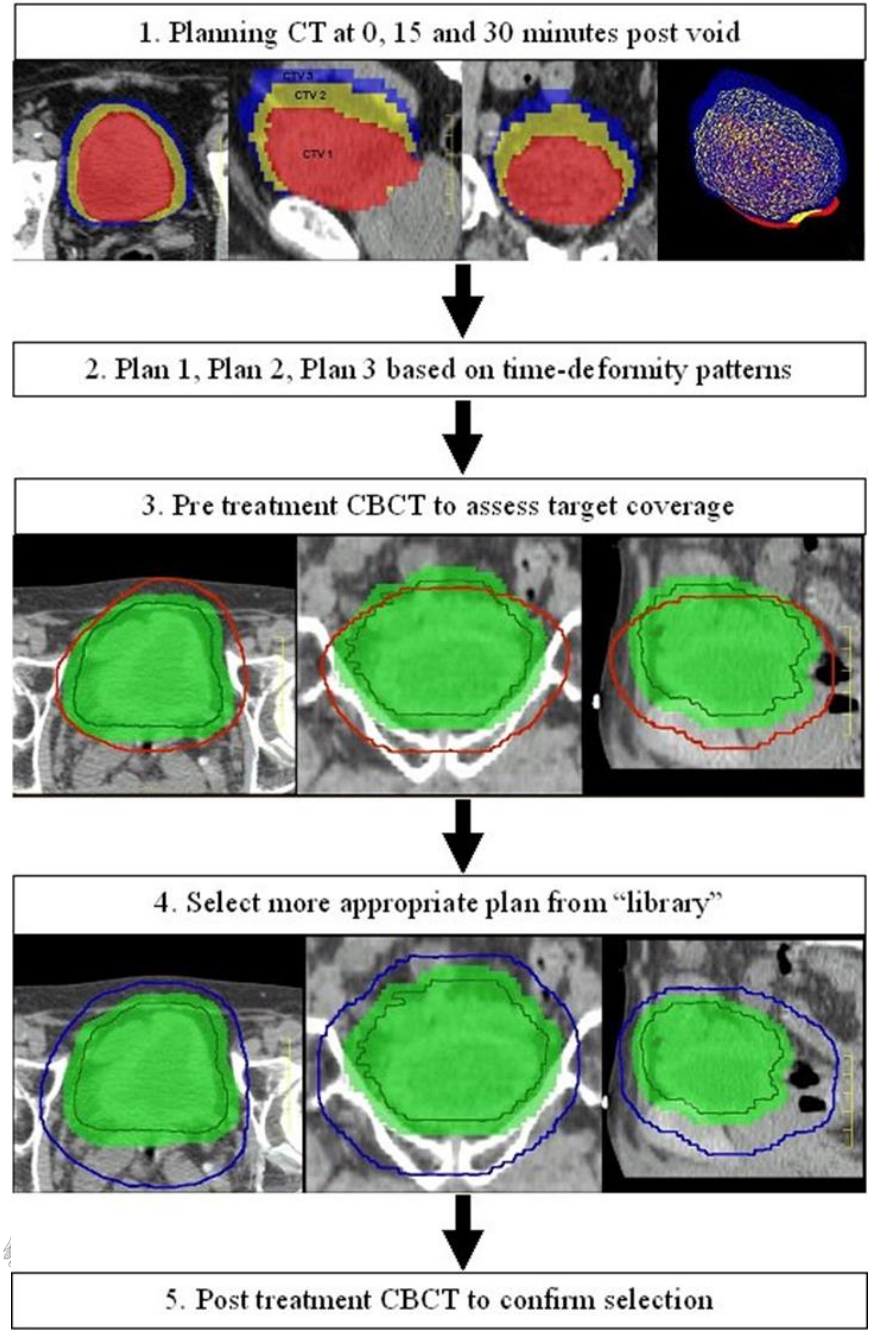


Technology benefits everyone

- IMRT/VMAT delivered as standard for radical treatments
  - Normal tissue sparing = reduced toxicity
  - Integrated boost = less fractions



- IGRT (image guidance) incorporated into ALL treatment verification schedules
  - Daily IGRT reduces set up error
  - Greater accuracy of delivery



IGART: Plan of the day

51% of fractions demonstrated a need for adaptive planning.
73% of fractions would have been delivered correctly using A-POLO.

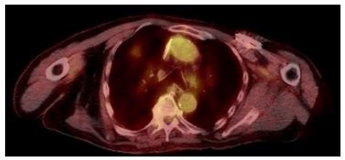
Plan of the day now standard practice for bladder cancer RT

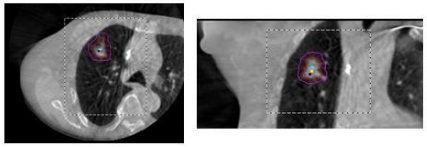
Advanced practice skills& training for staff

The ROYAL MARSDEN

CLINICAL COMPETENCY WORKBOOK

On-line verification for Lung Stereotactic Body Radiotherapy (SBRT)





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Competence Confirmed by	..... Date.....

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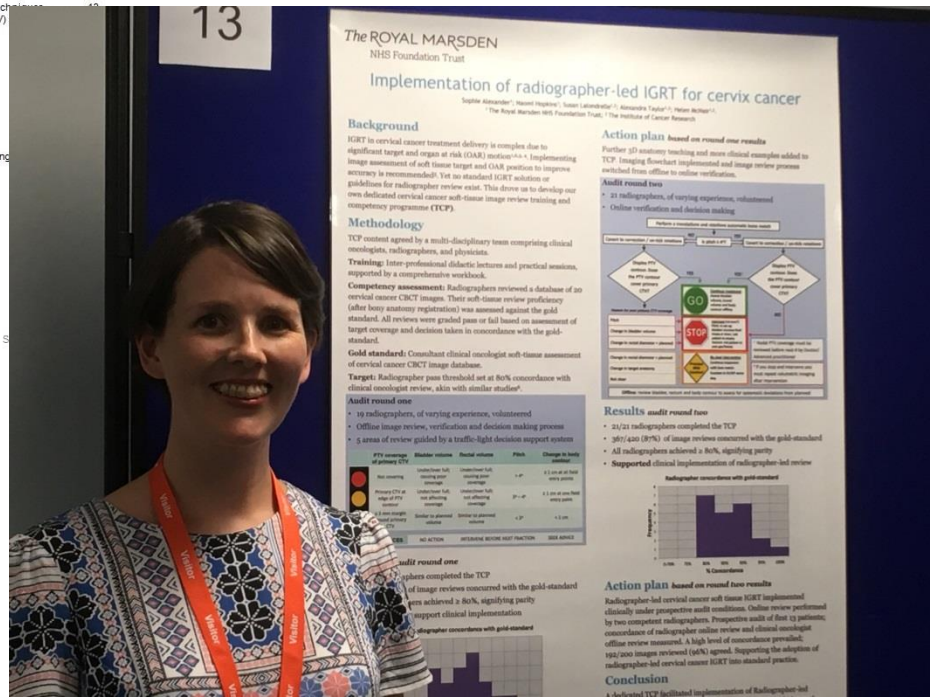
Advanced practitioners in urology

Training programmes for technological competencies

New MRI competent practitioners



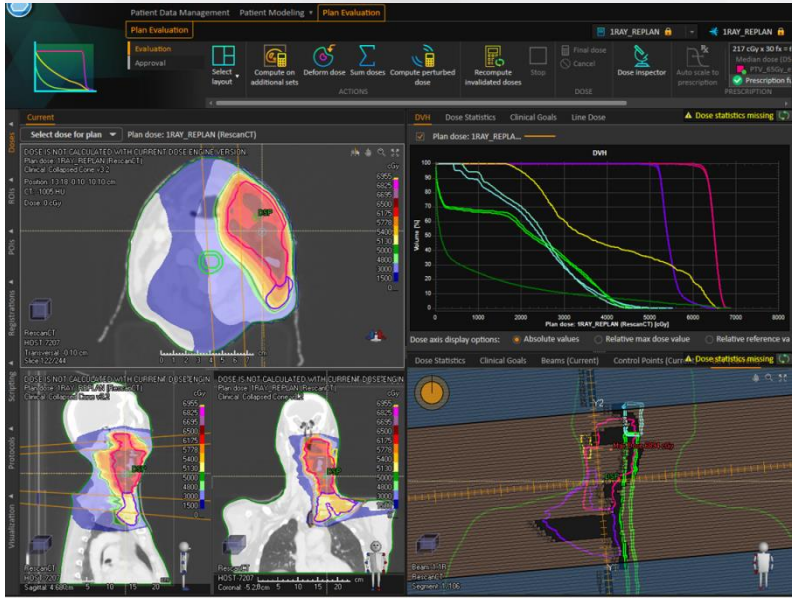
Technical capabilities: Planning

RT planning

Techniques available to support

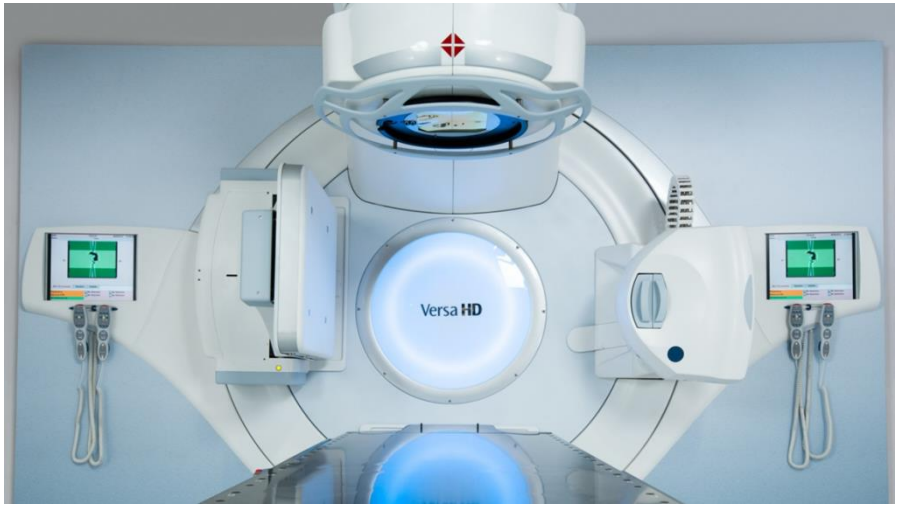
- internal organ immobilisation
- 4DCT
- Active breathing control
- Voluntary breath hold

Fast optimal planning system



Linear Accelerators

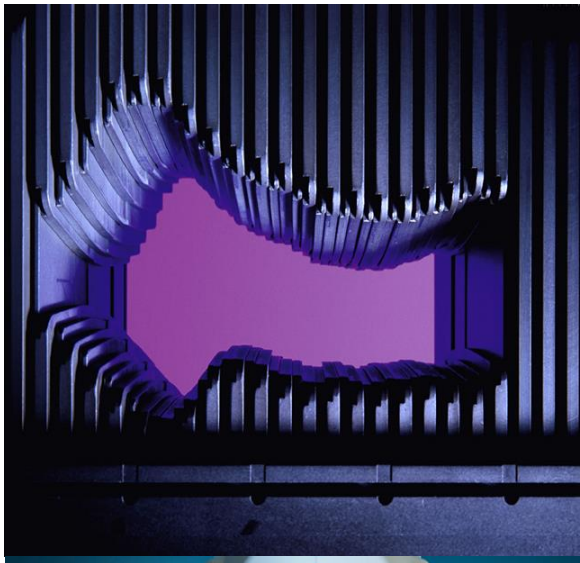
- Small and large field treatments
- On board CBCT IGRT
- 30-40 patients / day
- Treatment slots 10-20 mins



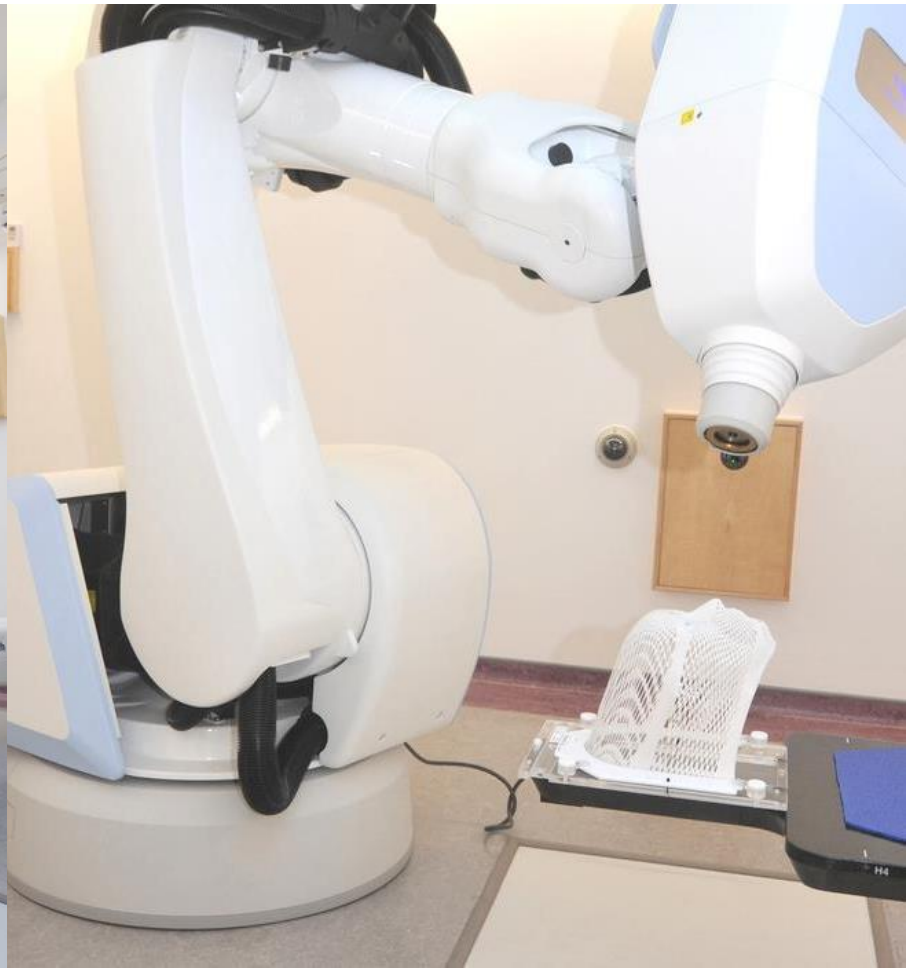
Advanced Linac IGRT technology

With a range of 11 Linear accelerators (and brachytherapy afterloader) we can deliver the most advanced types of radiotherapy

- Volumetric Arc Therapy
- Daily Advanced Image Guidance
- Stereotactic Body Radiotherapy
- Tumour and organ at risk immobilisation
- Adaptive radiotherapy
  - Re-planning to changes in tumour volume and patient shape
  - Online plan of the day selection
- Image guided adaptive brachytherapy



Stereotactic radiotherapy



Cyberknife

Robotic mounting

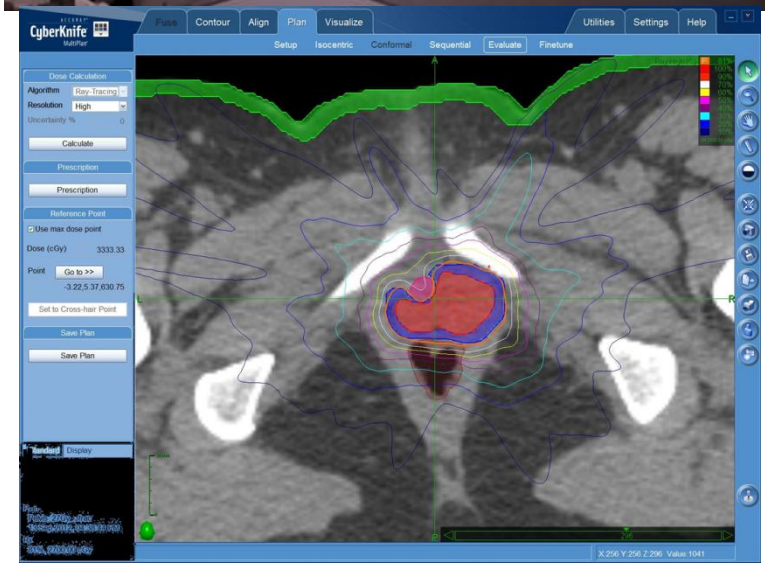
Image guidance / tracking
- Skull based tracking
- X-sight spine
- Fiducials

Mechanical accuracy
- 0.12 millimeter

Total targeting accuracy
- 0.5-0.7mm

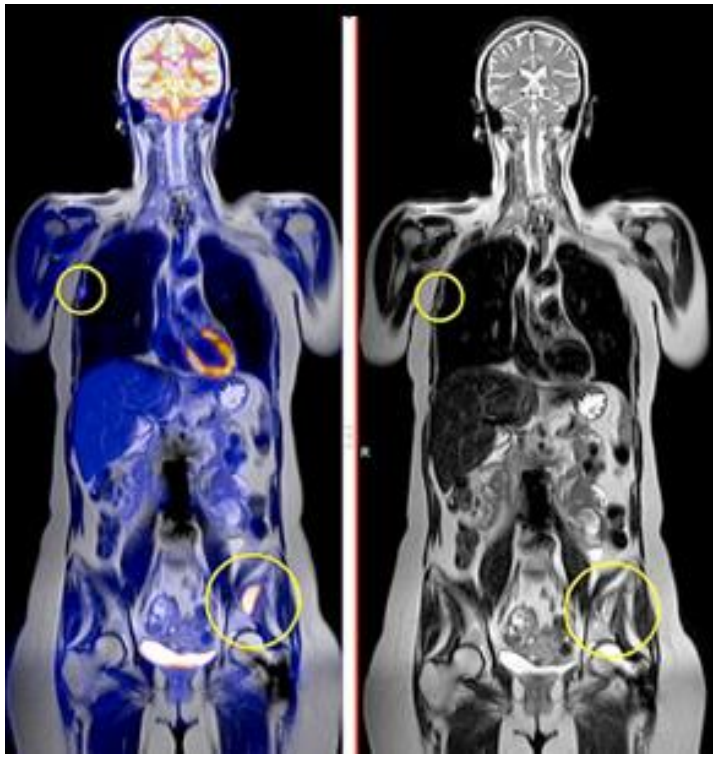
Routine delivery of 150 to 200 beams per fraction

Treatment times 25-120 mins



Can radiotherapy improve outcomes in ‘metastatic disease’?

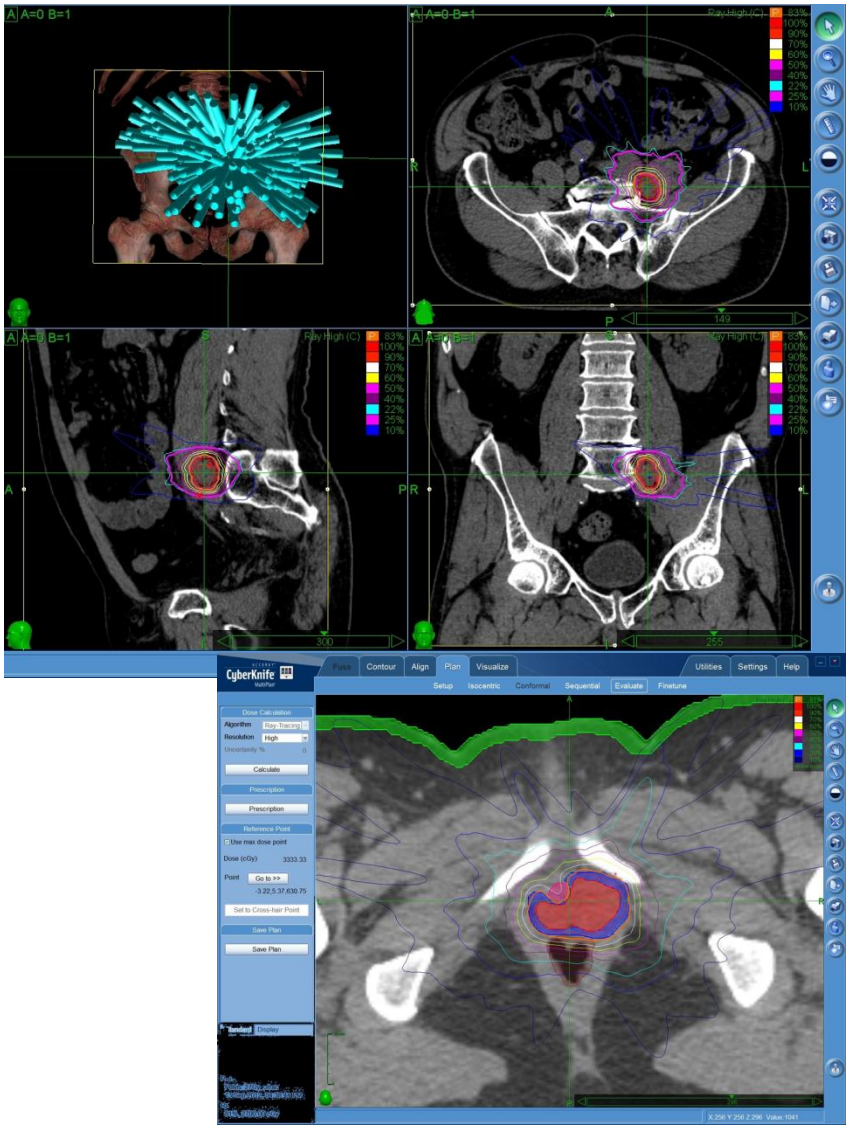
Widespread metastases



‘Oligo’ metastases

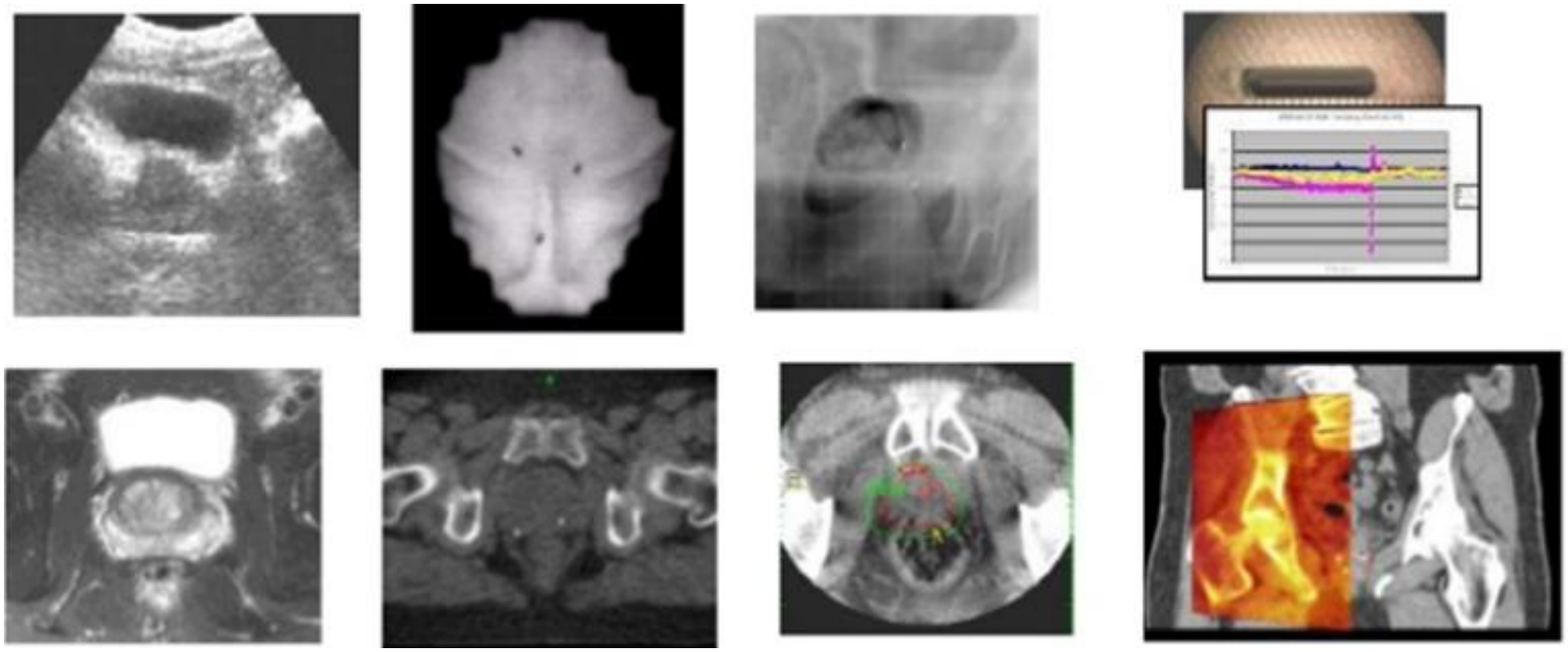
New Treatment Paradigms

- SABR – 3-5 highly focussed ablative doses of radiotherapy
- Fewer treatments
- Cure in (oligo-metastatic) disease?
- Re-irradiation scenarios



Research Leadership:
CORE: Dr Vincent Khoo
HALT : Dr Fiona McDonald
NHSE CtE and PACE: Dr Nick Van As

Image guidance: current best practice

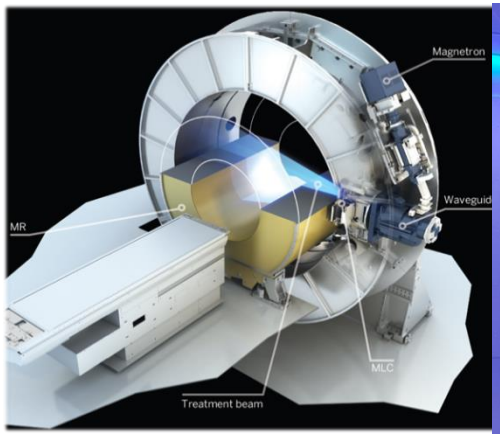


Room for improvement

MR Linac Concept:
Radiotherapy delivery with real time MR imaging

Full integration of three subsystems

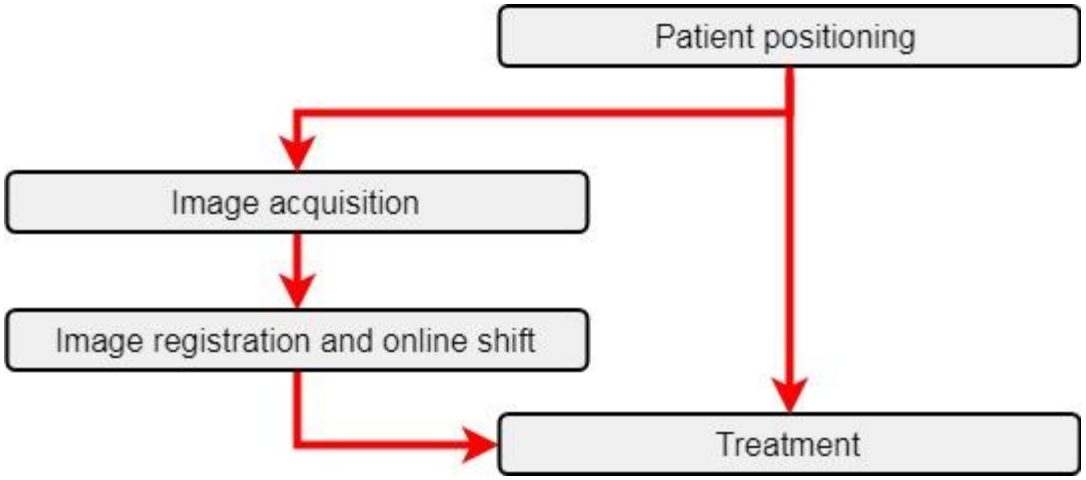
- State of the art Radiotherapy system
  - Treatment volume coincident with MRI imaging volume
    - Linac rotates around the MRI magnet
  - Modified to make it compatible with the MR environment
- 1.5T MRI system
  - Modified to make it compatible with Linac based radiotherapy
- Online adaptive workflow
  - Integrated user experience
  - Online adaptive treatment planning



Unity MR-linac

2015

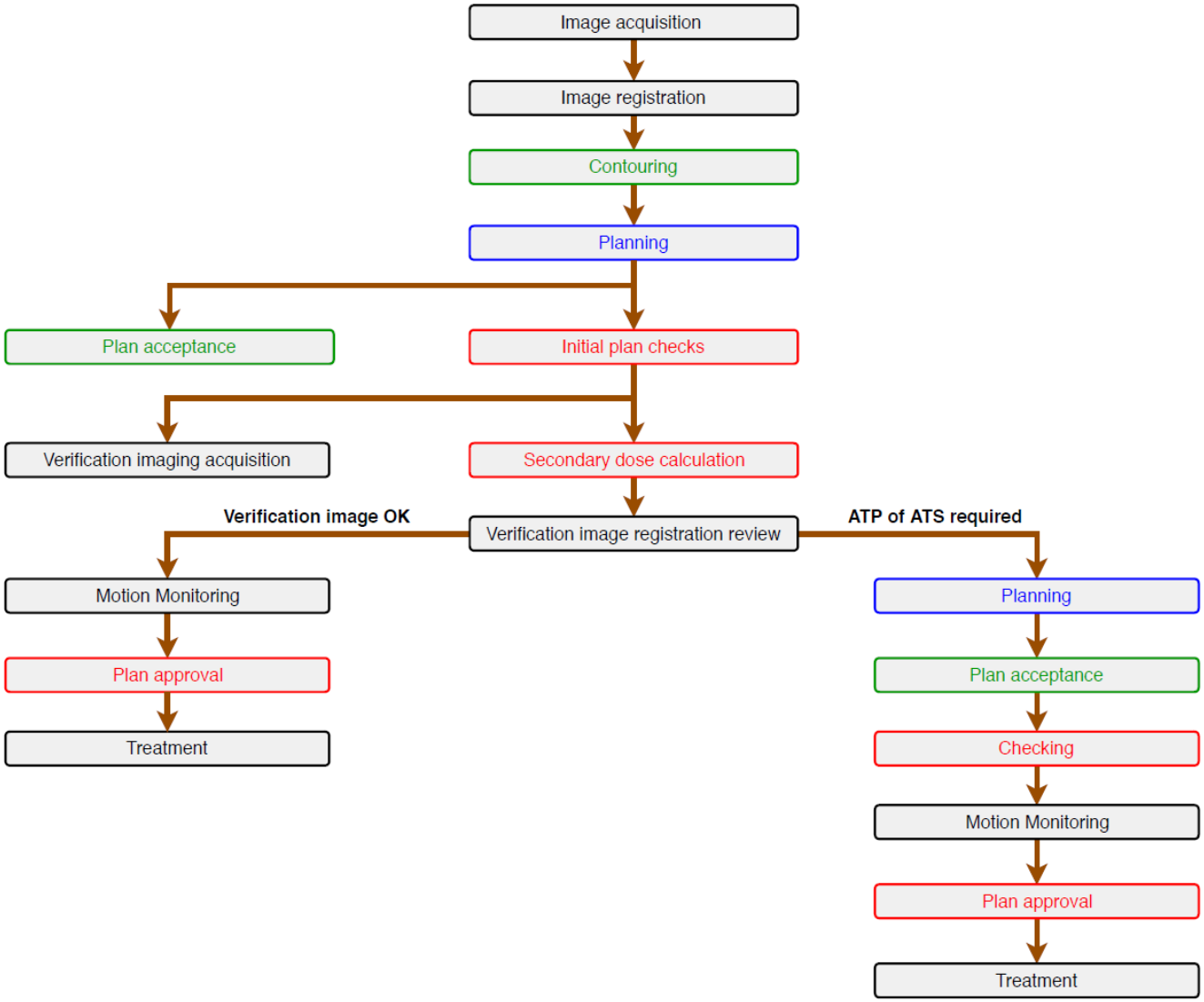
Radiotherapy on a conventional linac



radiographer

MRL Treatment unit workflow

Online adaptive radiotherapy on the MR Linac



radiographer

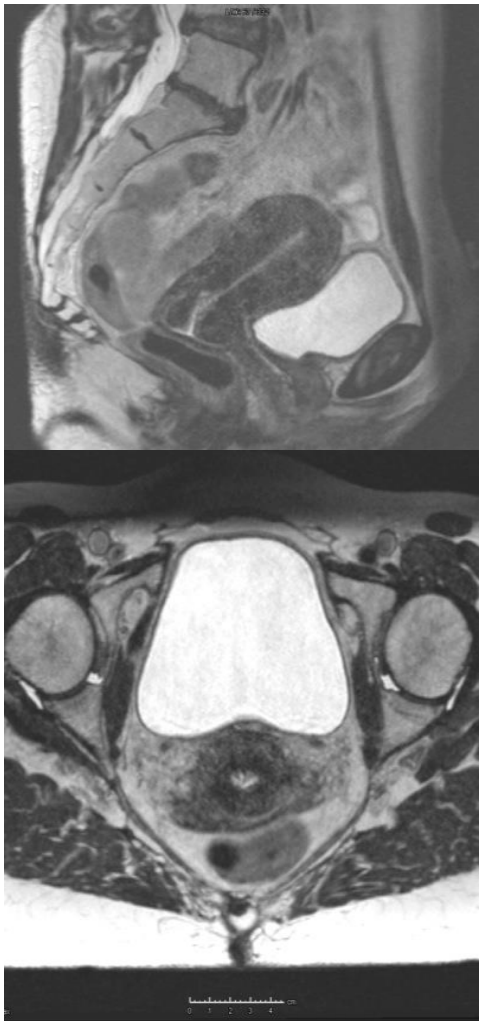
planner

checker

doctor

Key advantages - Resolution
Current best practice -cone beam CT

CBCT vs MRI



Future Radiotherapy Planning Pathway

MRL image acquisition

Autocontouring target and OAR

Functional target identification

Generation plan of the day

Dose delivery

Dose accumulation

Prediction of subsequent plan

MR linac: Changing Paradigms & Expanding Indications

RMH is again at the forefront of implementing new technology:

- first in UK to image and treat (September 2018) using MRL
- leadership in international research consortium
  Dr Alison Tree – prostate
  Dr Anna Kirby – breast
  Dr Susan Lalondrelle – gynaecology
- radical ideas for changing radiotherapy delivery

In Summary…

- Europe's largest comprehensive cancer centre
- Our MDTs bring together world leading experts
- Complete range of treatment modalities offered
- Multi-professional decision making to improve clinical outcomes
- Leadership in cancer research and innovation

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Private Care

Thank you

We are Europe's oldest and largest comprehensive cancer centre. Rated as one of the top 3 cancer centres in the world, we deliver exceptional levels of patient care.