Radiation Therapy in Oncology

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Introduction ...

- Needs and demands of Radiotherapy
- Uses and benefits of DICOM in RT
- Basic RT Process
- Practice 10 years ago; today; look to the future
- DICOM:
  - Reduces errors
  - Improves survival and quality of life
  - Some clinical techniques wouldn't be possible without it

Setting the scene ...

- It is projected that the world-wide incidence of cancer will rise from 10 million to 20 million and that the death rate will rise from 6 million to 10 million by 2020
- Around 50% of cancer therapies involve Radiotherapy
- Clinical advances in Radiotherapy planning and delivery techniques increase the survival chances and quality of life for patients

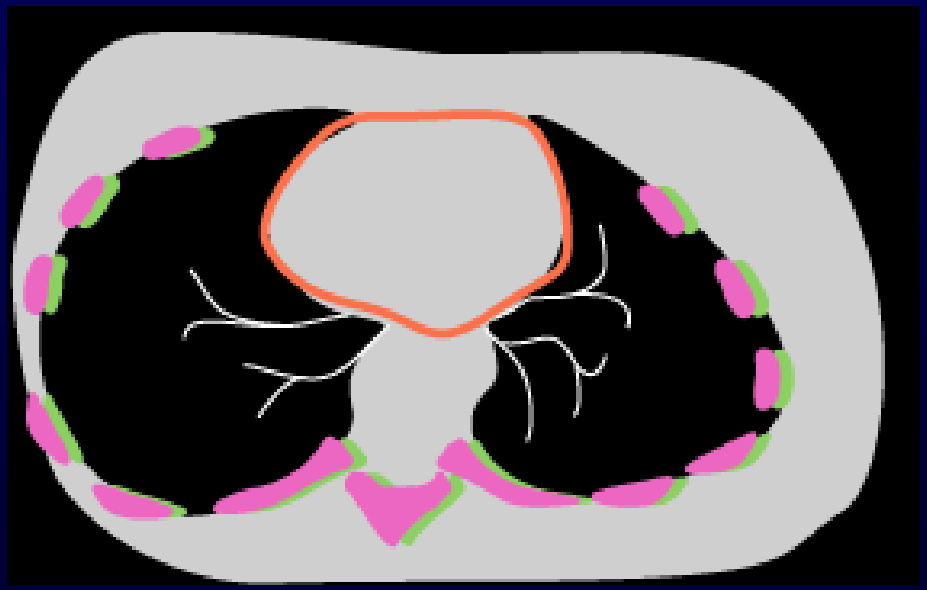
External beam radiotherapy

The clinical aim of Radiotherapy ...

- To maximise the “therapeutic index” by:
  - delivering lethal doses of radiation to cancerous cells (so increasing chances of survival), while
  - sparing normal tissue (so reducing side-effects and increasing quality of life)
- This is achieved by precisely shaping and directing the radiation beams based on information from medical images

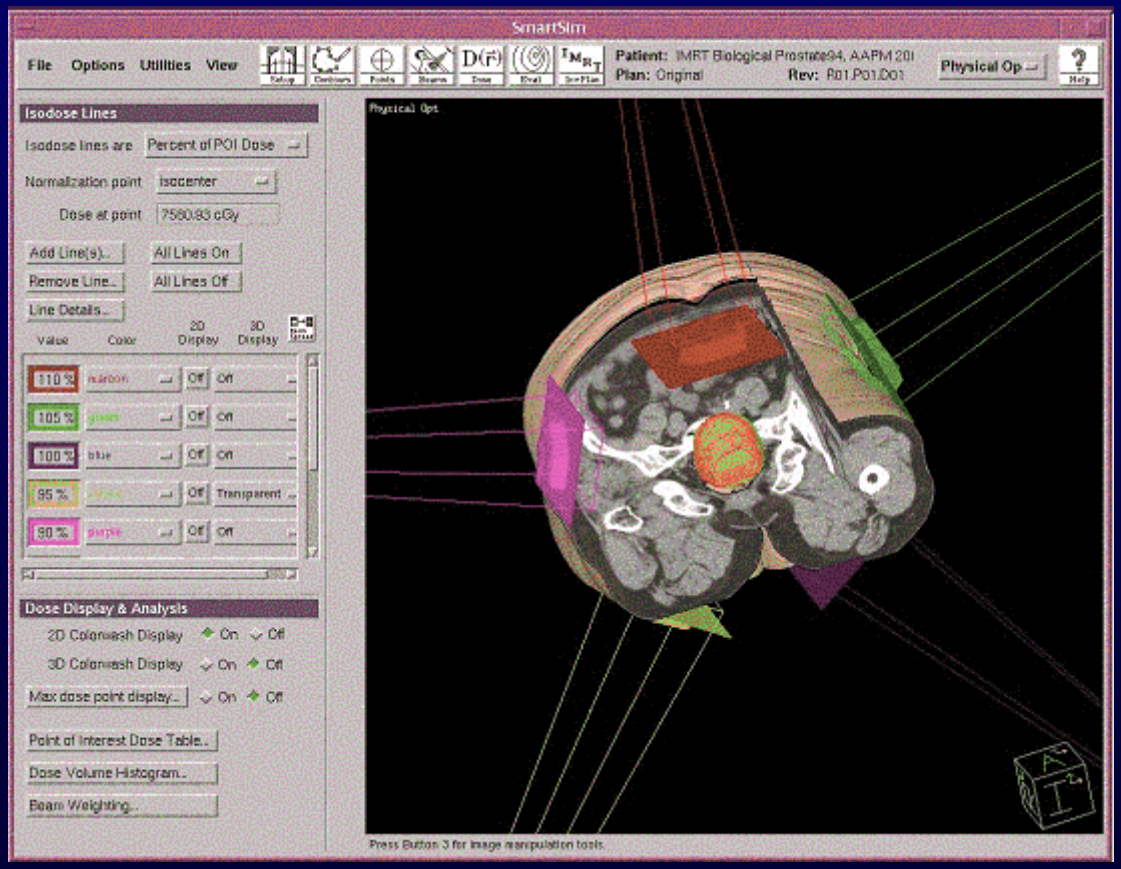
Basically …

- Medical images (usually CT scans) lead to …
  - Defined regions (tumour, organs at risk)



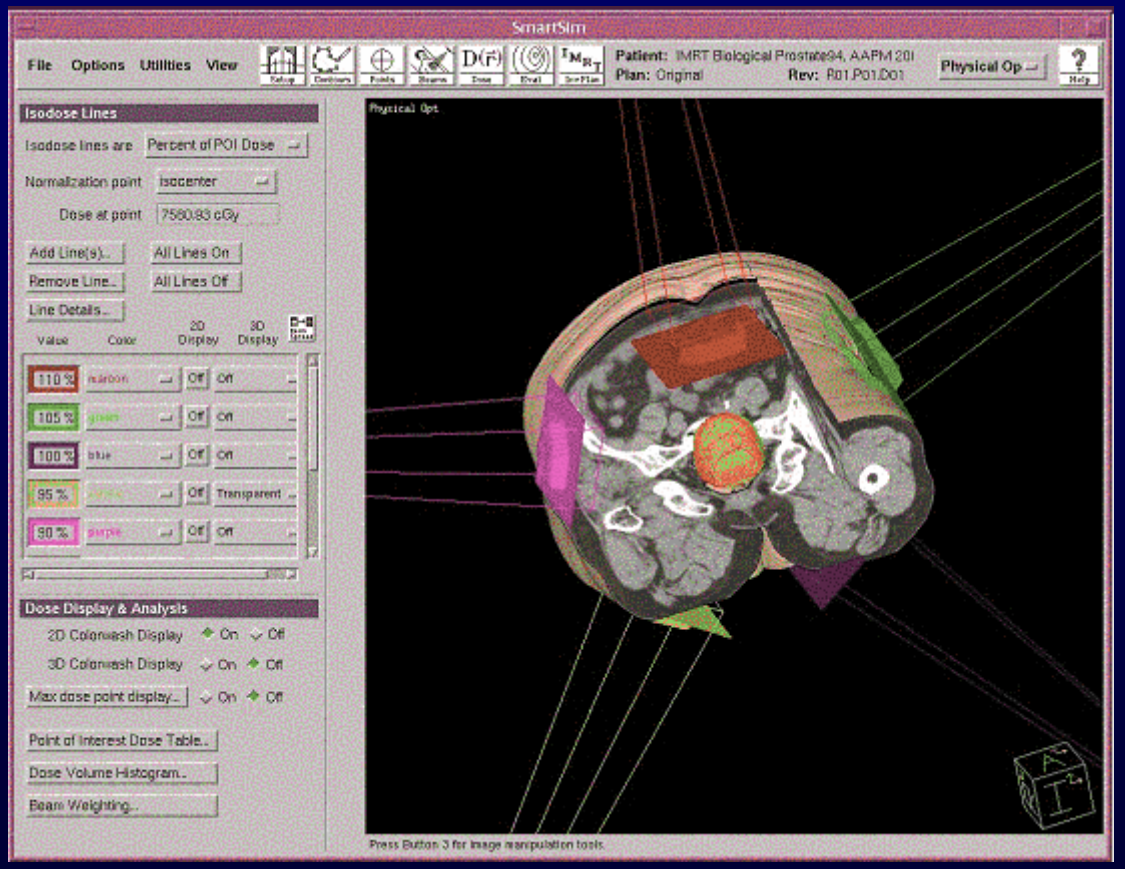
Basically …

- The contoured images in turn define the optimal position of the patient and the linac (geometry)



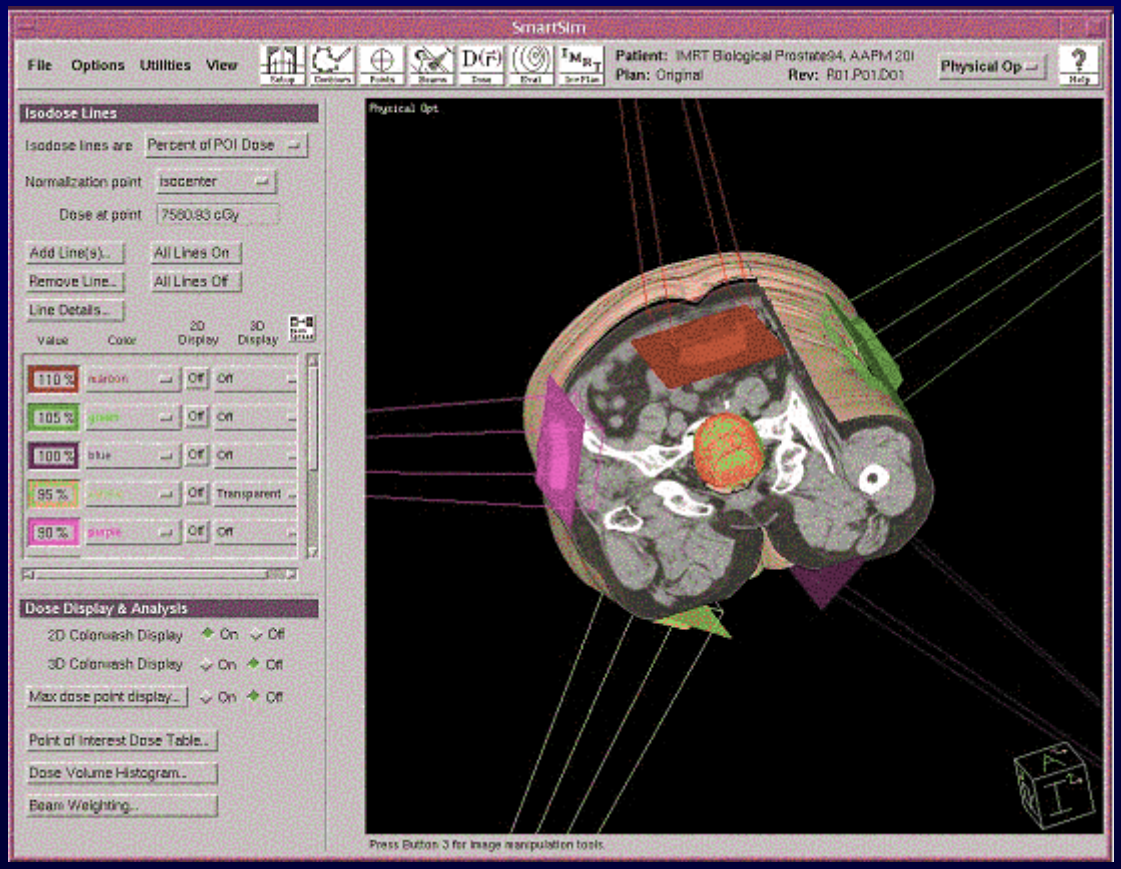
Basically …

- The desired treatment dose leads to a schedule of treatment sessions and the dosimetric part of the plan (energy level and amount of radiation to deliver)



Basically …

- And a treatment plan is born ...



Originally ...

- An example of planning a treatment course was to:
  - Take simulator film
  - Acquire a CT scan
  - Transfer CT images
  - Generate a treatment plan
  - Print out the plan
  - Type in the plan to the linac
  - Fit lead blocks
  - Take port films
  - Monitor doses

- This is error-prone, time-consuming and only able to transfer simple (small) amounts of data

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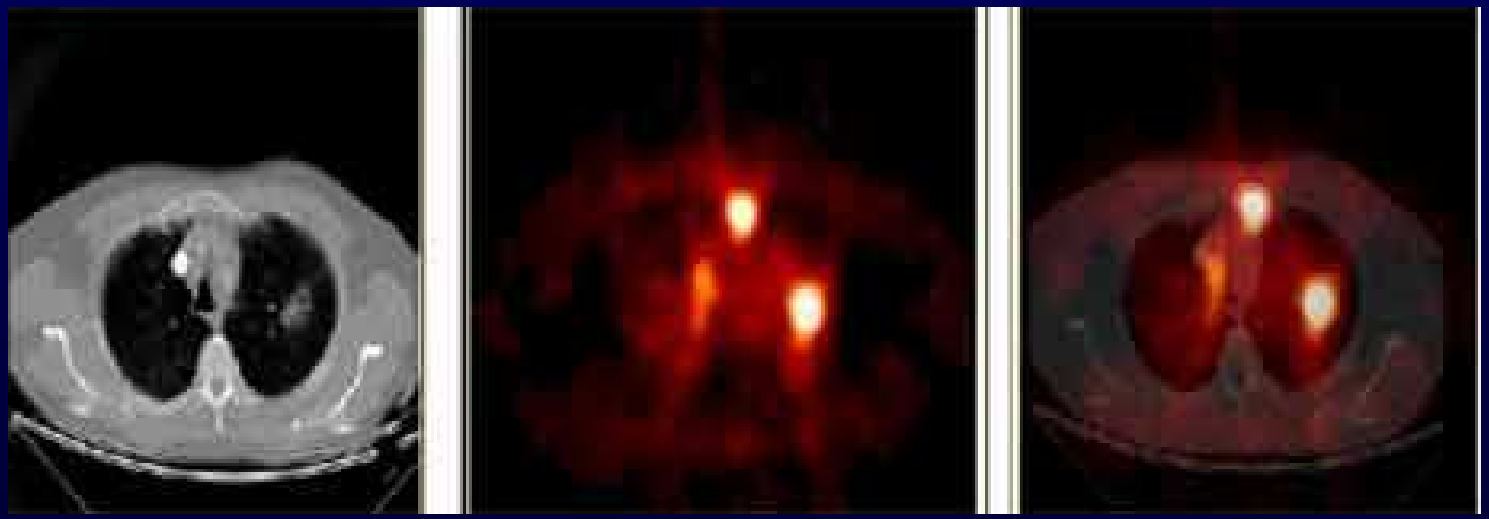
The problem gets bigger ...

- The advent of CT-Simulators removes the need for separate physical simulator films
- CT images have become much larger as CT scanners provide greater resolution

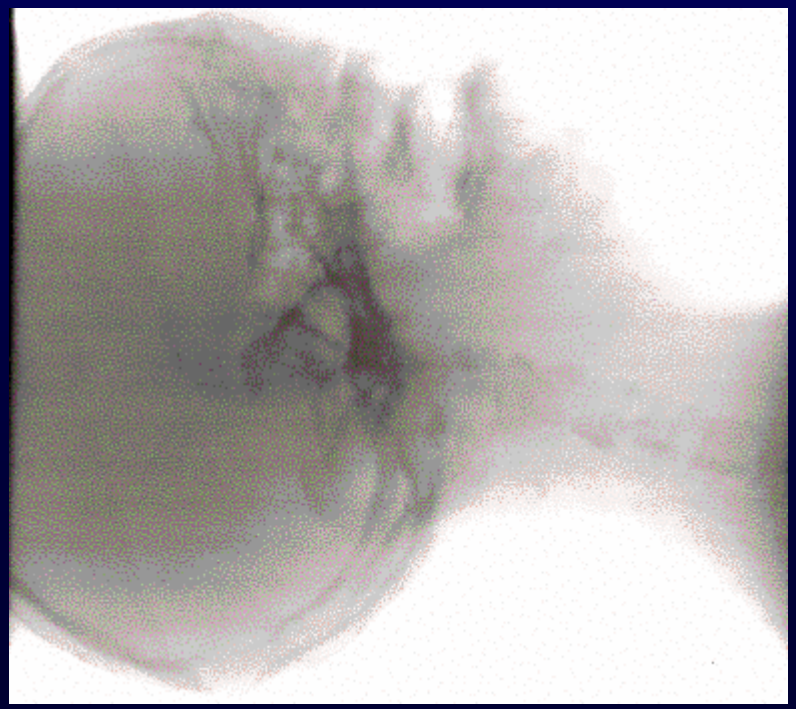
The problem gets bigger ...

- Co-registration (fusion) of MR and PET images with CT scans becoming more common



The problem gets bigger ...

- Plans with geometric and dose data become far too complex to print out and re-type
- Port films (or equivalent evidence) need to be transferred to the central patient record



The problem gets bigger ...

- Beam shaping devices increase plan complexity

Common DICOM RT objects ...

- RT Plan
- RT Structure Set
- RT Image
- RT Dose
- RT Treatment Record and Treatment Summary
- Use of DICOM image sets

Typical workflow ...

CT Study

RT Plan

RT Plan, RT Image
&
RT Structure Set

RT Image

RT Treatment Record

Central Electronic Medical Record

What has changed?

- Still need medical images
  - … but these are larger and of different types
- Still need to identify target areas
  - … made easier by some software tools
- Still need to define a plan
  - … but these plans are far more complex
- Still need to deliver the treatment
  - … and to store the verification images and record of treatment deliveries ...

Integrating the Healthcare Enterprise

- DICOM is no guarantee of connectivity
  - No policing of conformance statements
  - Conformance statements are only the start
  - Still practical issues exist
  - Optional modules and optional attributes
- IHE-RO is an initiative to improve information sharing through standards such as DICOM and HL-7
  - It addresses gaps, options and conflicting interpretations
  - IHE specifies precise interconnectivity requirements
  - IHE provides test tools and a detailed testing process
  - IHE enables greater confidence in interoperability

How has DICOM helped Radiotherapy ...

- The benefits of DICOM RT extensions are
  - Improved patient throughput
  - Improved clinical outcomes
  - Easier development for vendors
  - Less chance of transmission errors for critical data
  - Users have power in tenders by requiring DICOM
- DICOM has enabled advanced clinical techniques to become a practical reality worldwide

In summary …

- DICOM in RT is still being extended:
  - Treatment Course object
  - RT Worklist
  - RT Query Retrieve extensions
  - Image Guided Radiotherapy
  - All will be backward compatible
- Life without DICOM-RT is no longer really conceivable

And finally …

… thank you