

Radiation Therapy in Oncology

Colin Winfield

Elekta Limited

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

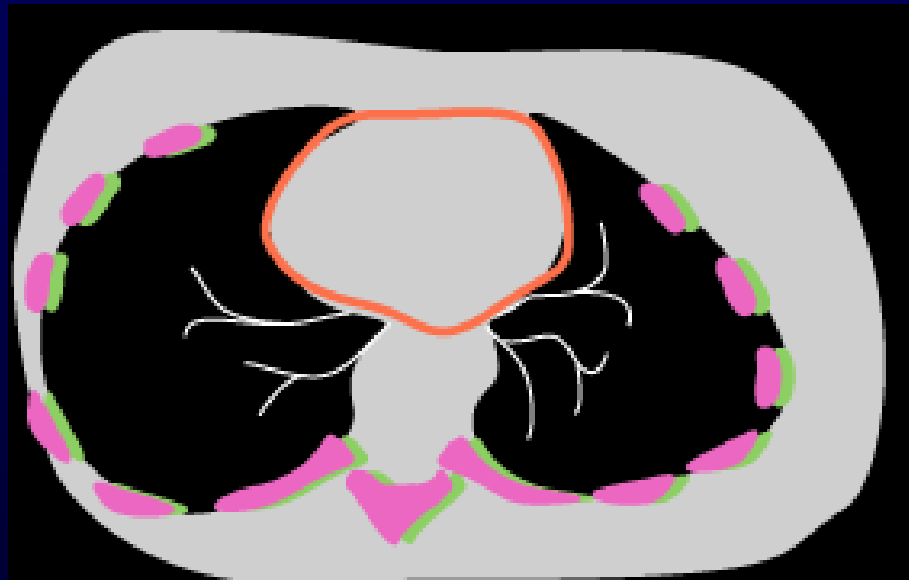


The clinical aim of Radiotherapy ...

- 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

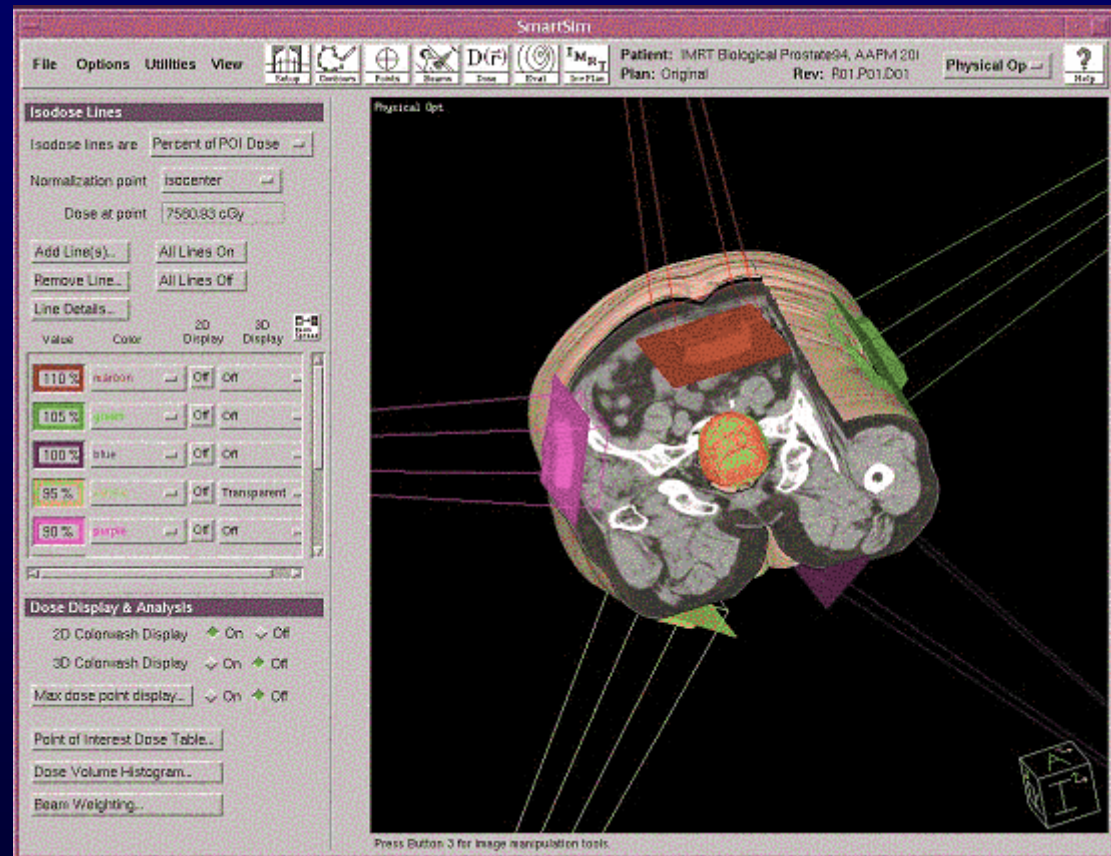
Basically ...

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



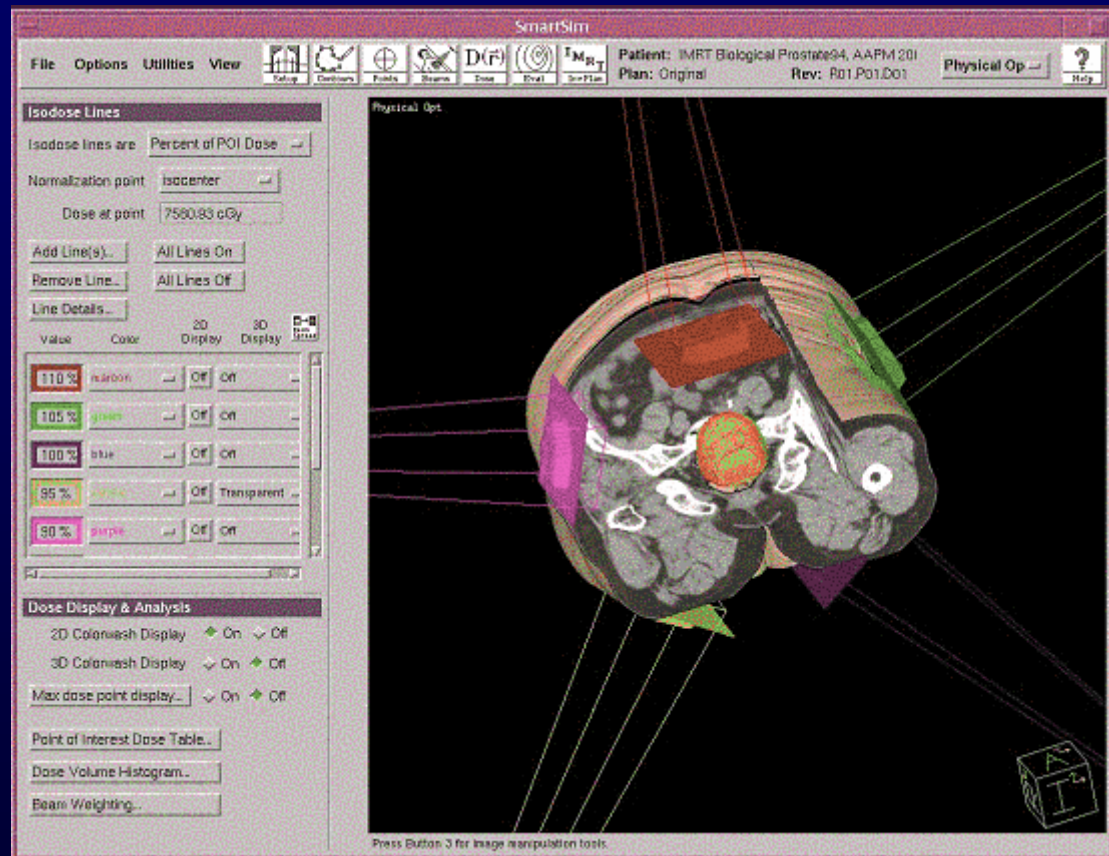
Basically ...

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



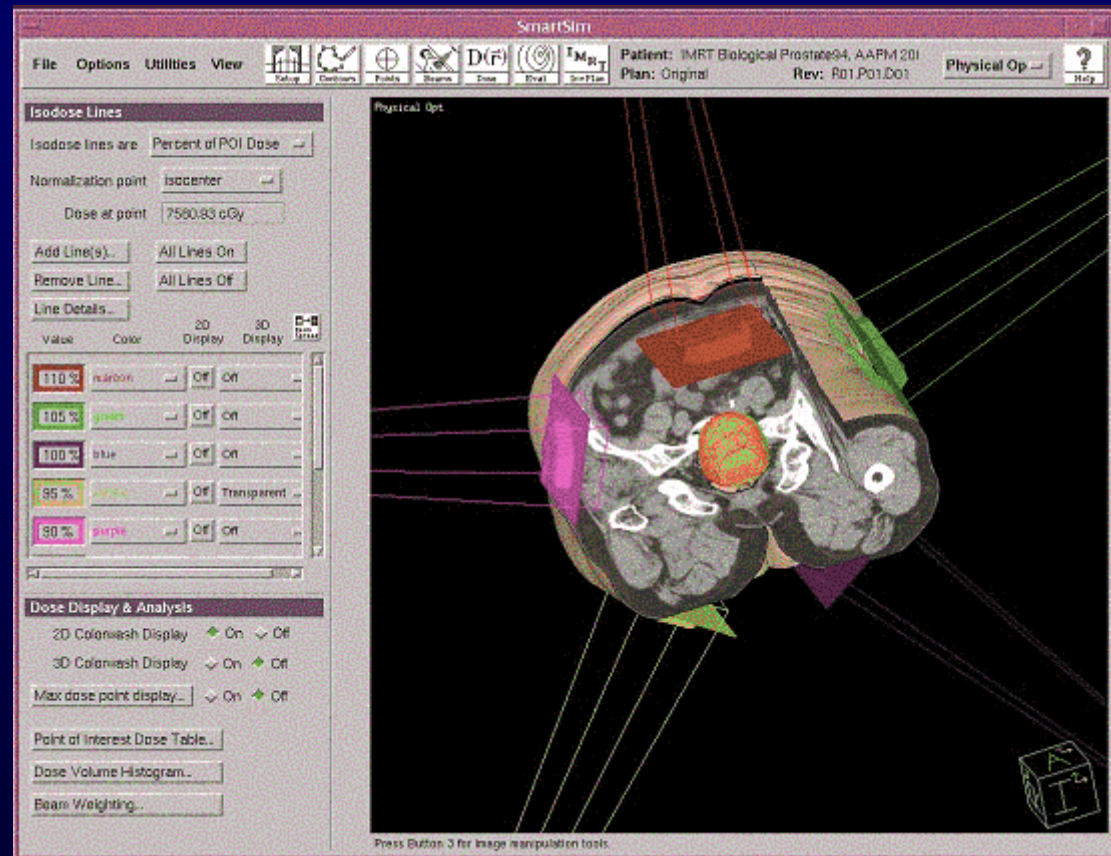
Basically ...

- 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



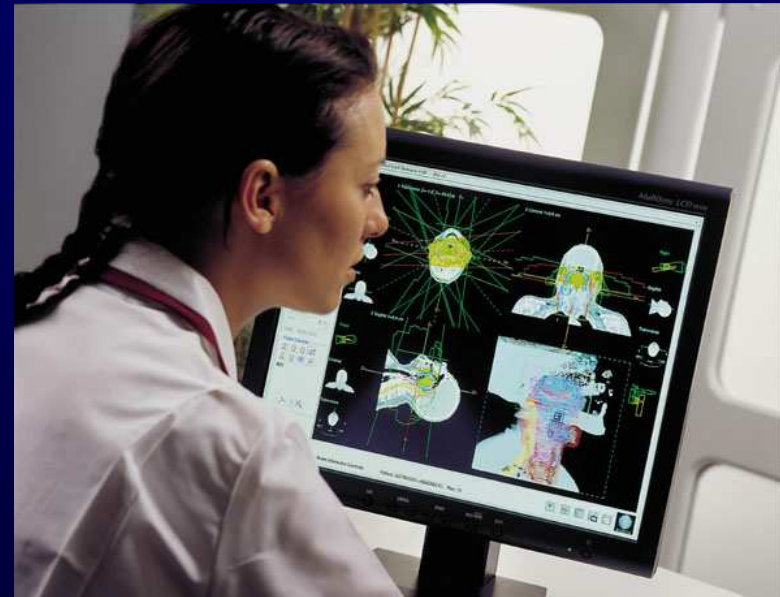
Originally ...

- 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



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



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

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

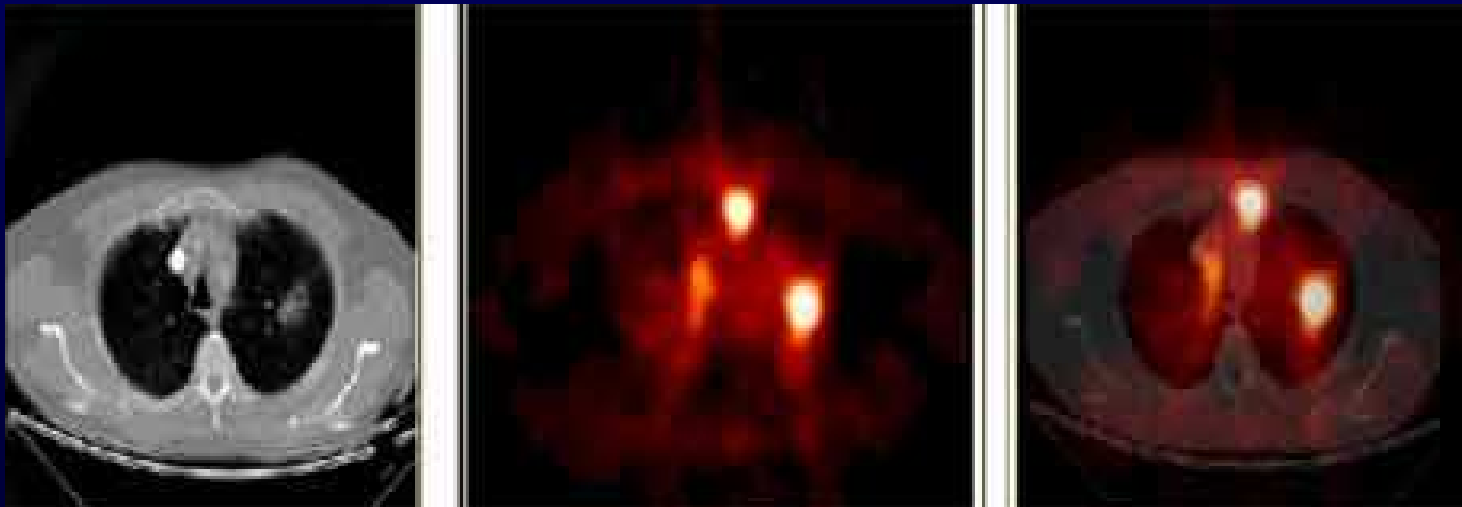


The problem gets bigger ...

- 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

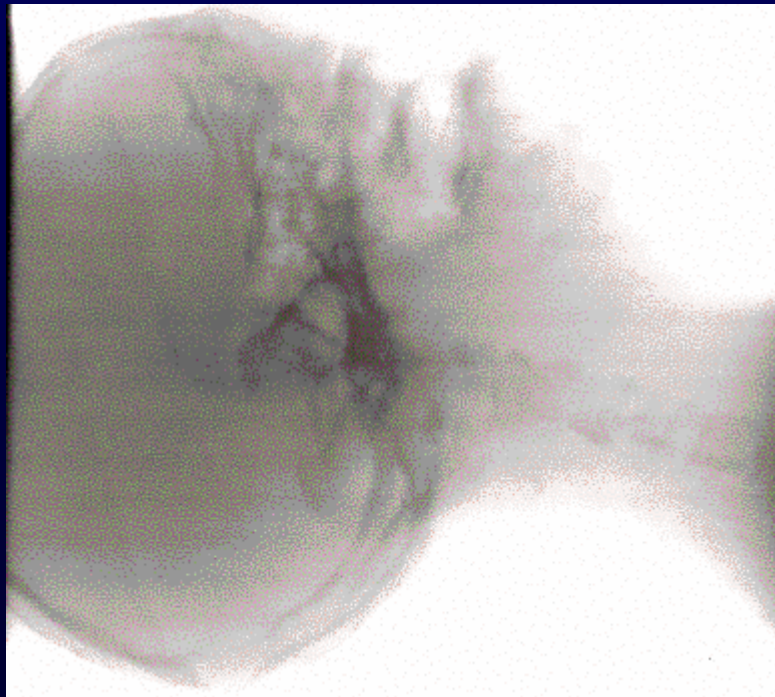
The problem gets bigger ...

- 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 ...

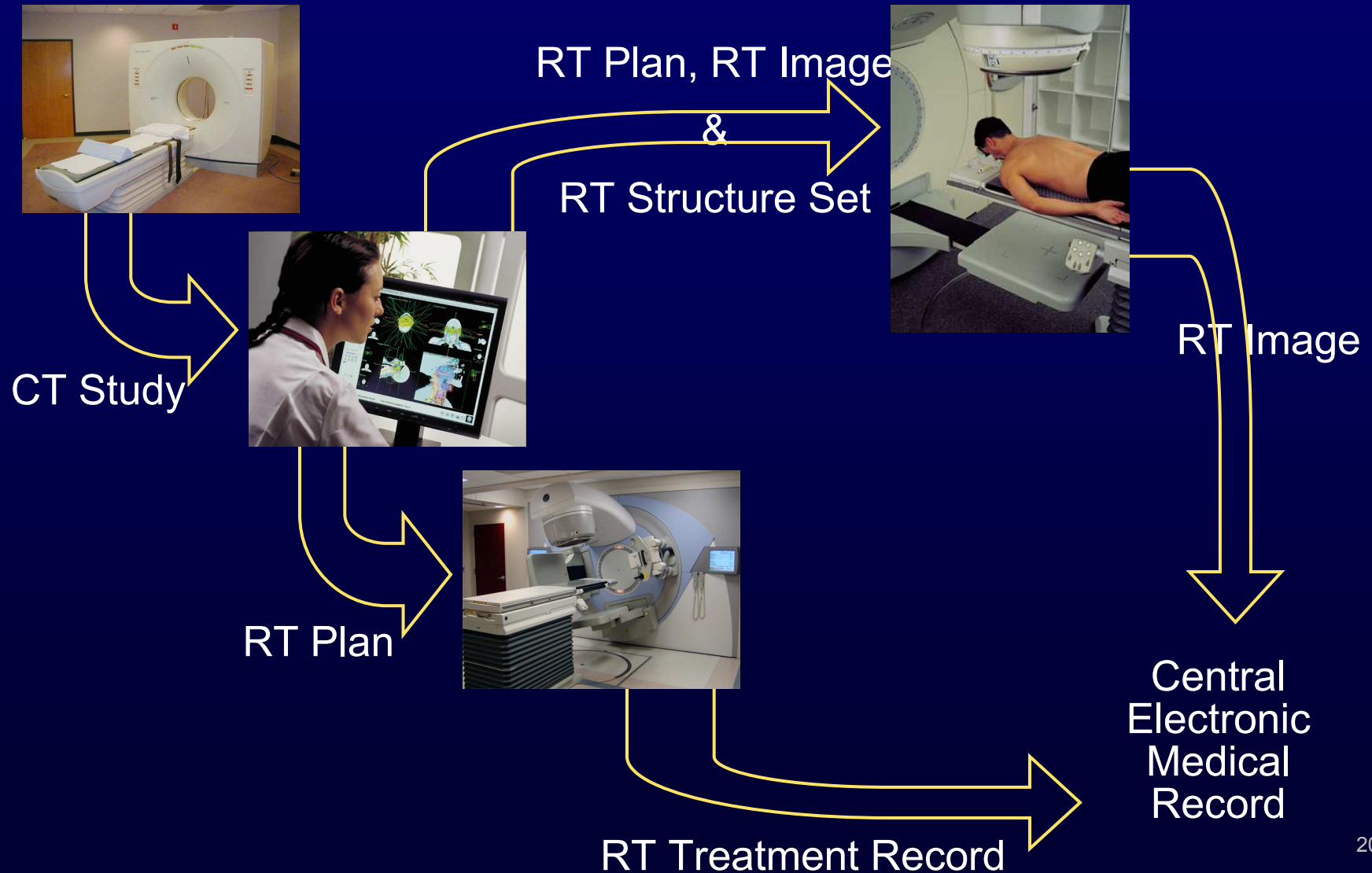
- Beam shaping devices increase plan complexity



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 ...



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