Accelerating the Future:
Designing a Robust and Affordable Radiation Therapy Treatment System for Challenging Environments

Radiation Therapy Treatment Techniques and Treatment Planning Systems

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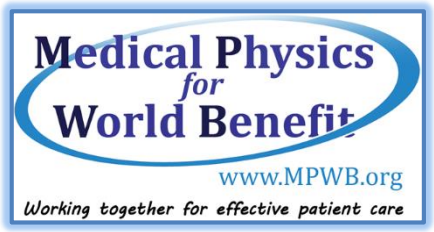

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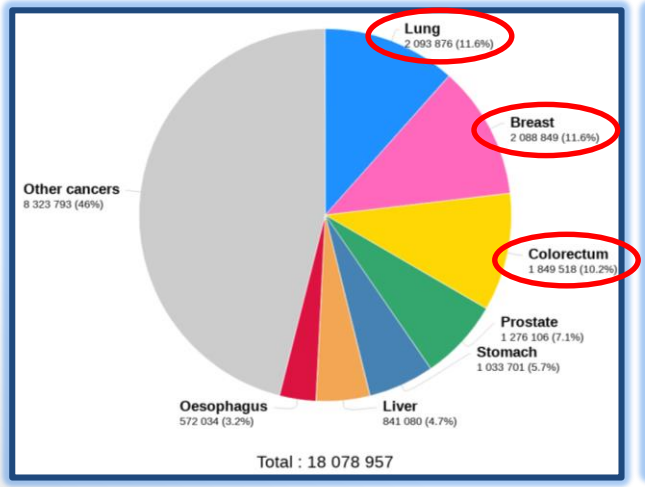
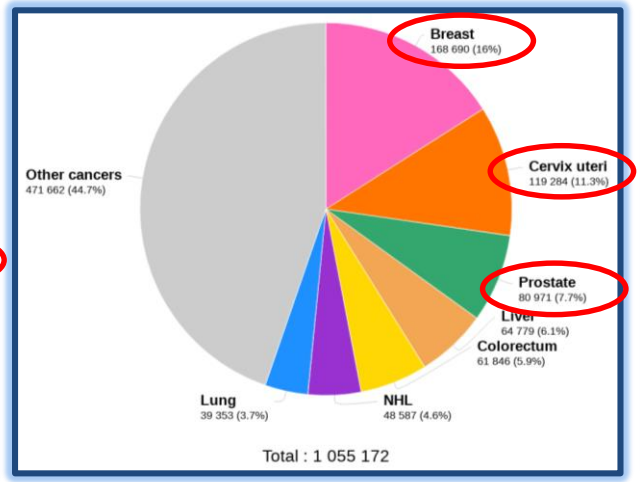
Cancer Incidence 2018

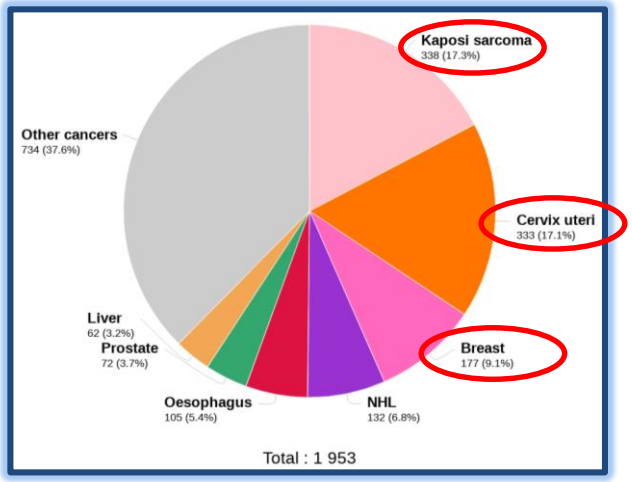
World



Africa



Botswana



Data Source: GLOBOCAN 2018

Frequency of different cancers varies around the globe

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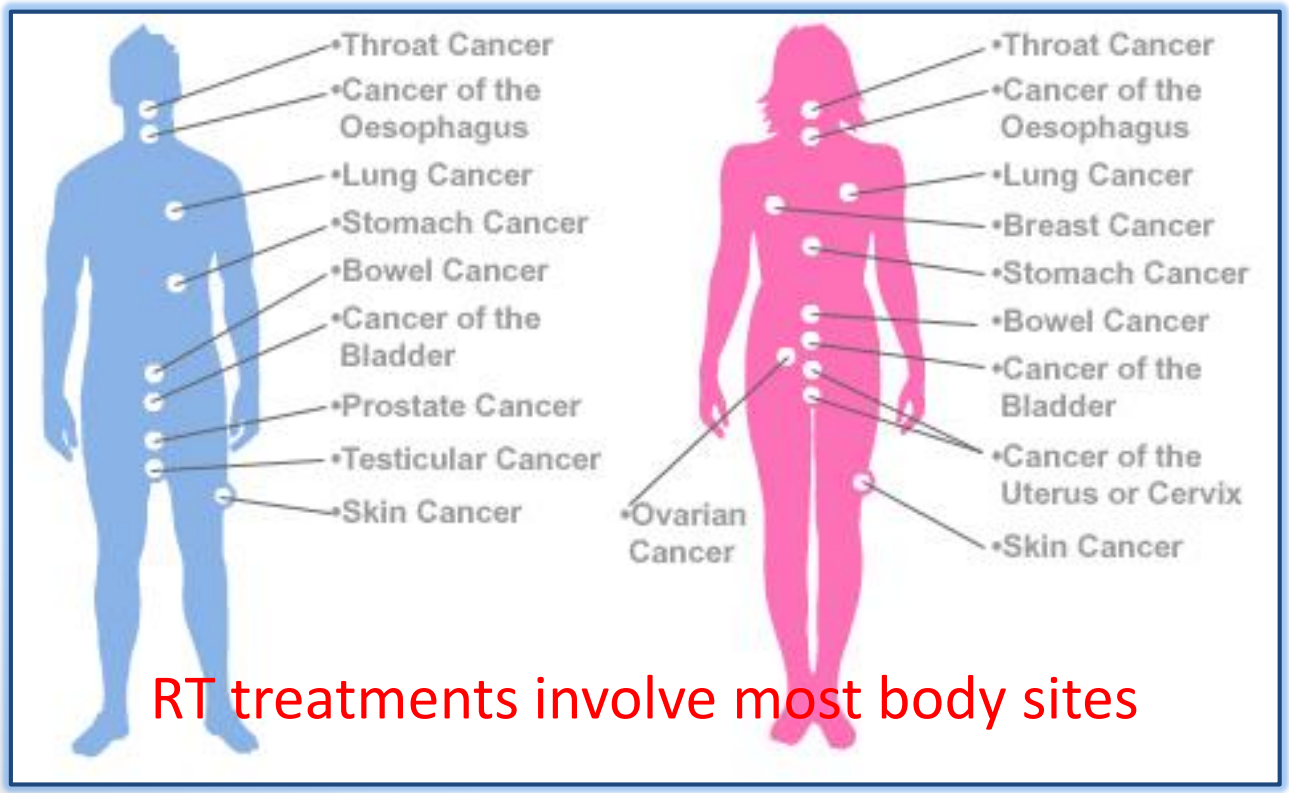
Cancer: Clinical Sites



From: http://2.bp.blogspot.com/-J2GpKl2IRdc/Ta4IKpAyqWI/AAAAAAAAAMs/lhveE-NfmkI/s1600/Types+of+Cancer.jpg

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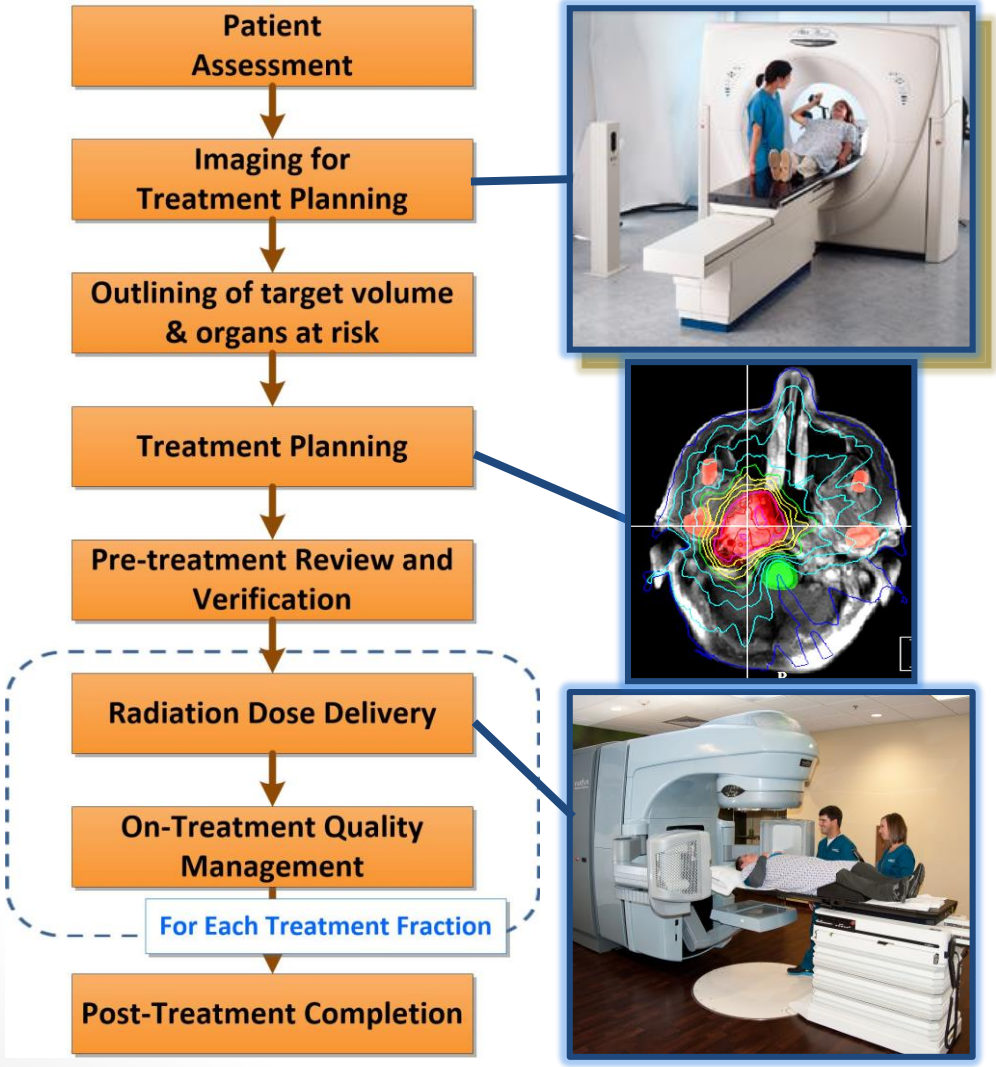
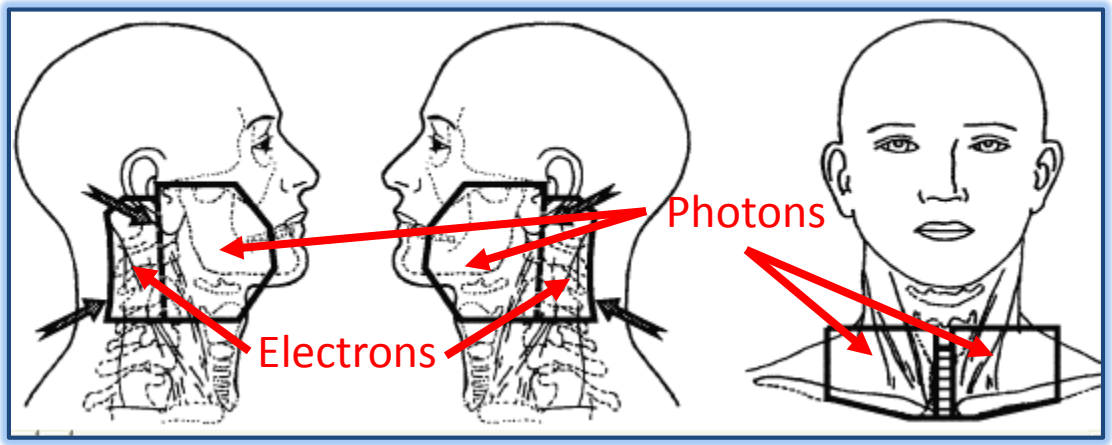
Steps in Radiation Treatment Process

- Multiple steps
- Complex



Treatment Techniques: Head & Neck Cancers

Patient immobilization for reproducible set-ups



http://www.aboutcancer.com/neck_simulation_images.gif

https://www.valleymed.org/uploadedImages/valleymedorg/Our_Services/Cancer_Treatment_and_Support/Cancer_Services/Radiation_Oncology/head%20and%20neck%20setupa1.jpg?n=8095&n=8095

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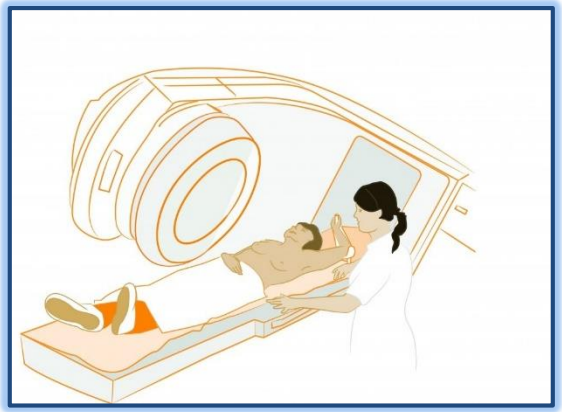
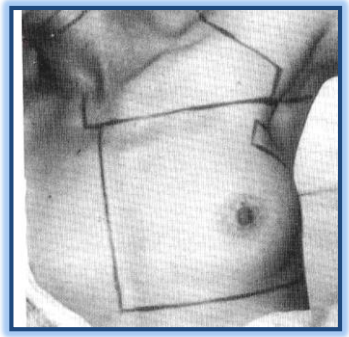
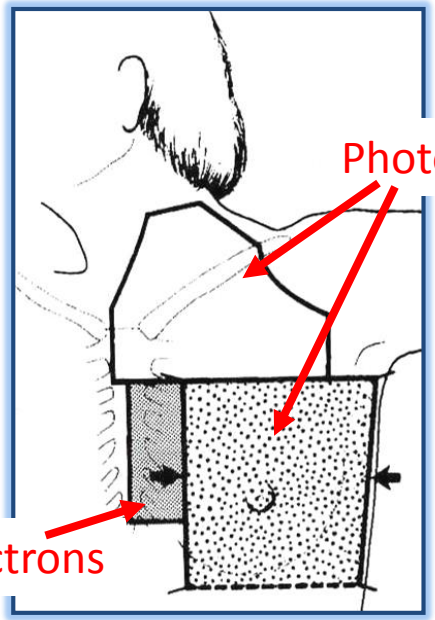
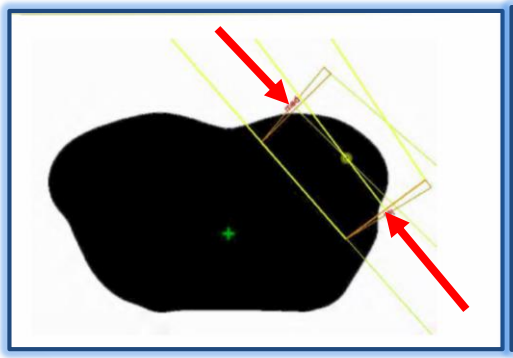
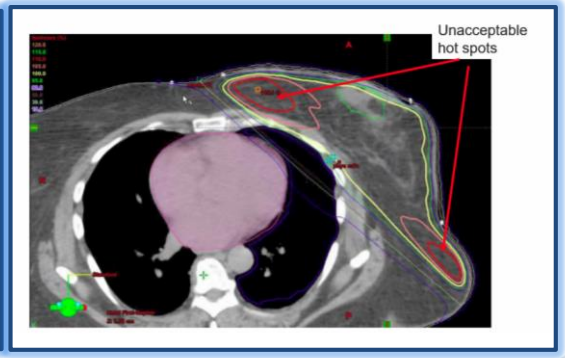
Breast Techniques











https://www.breastcancercare.org.uk/information-support/facing-breast-cancer/going-through-breast-cancer-treatment/radiotherapy-primary#what is radiotherapy

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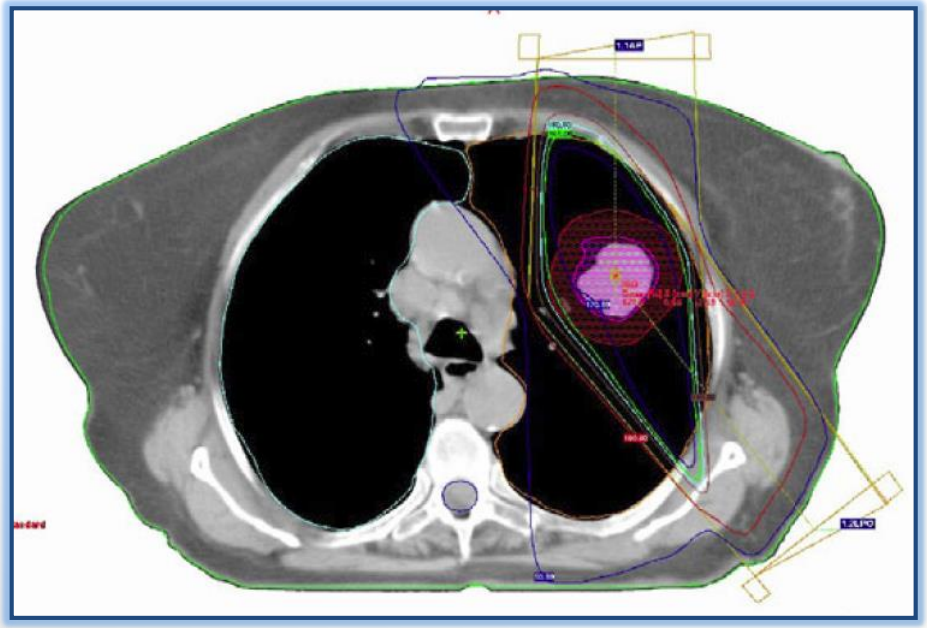
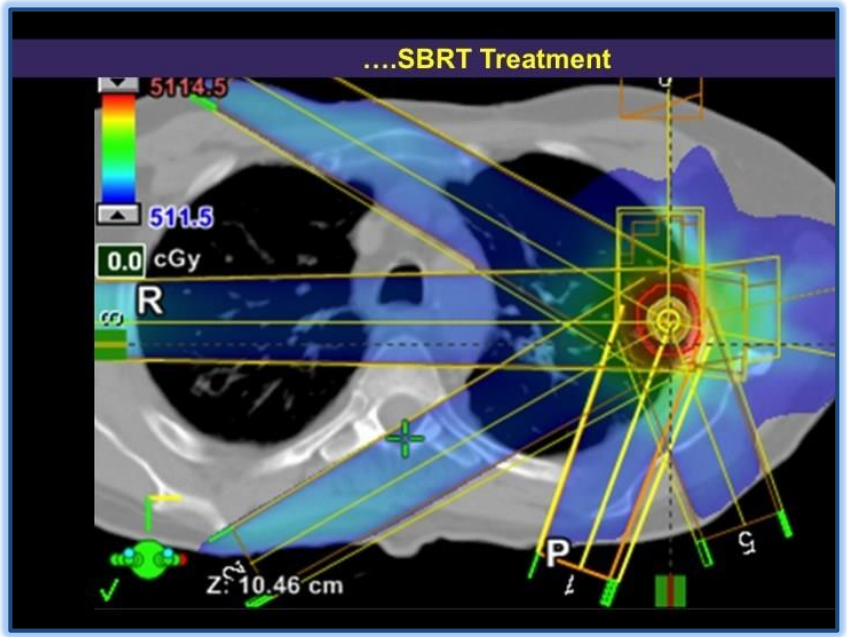
Lung Cancer

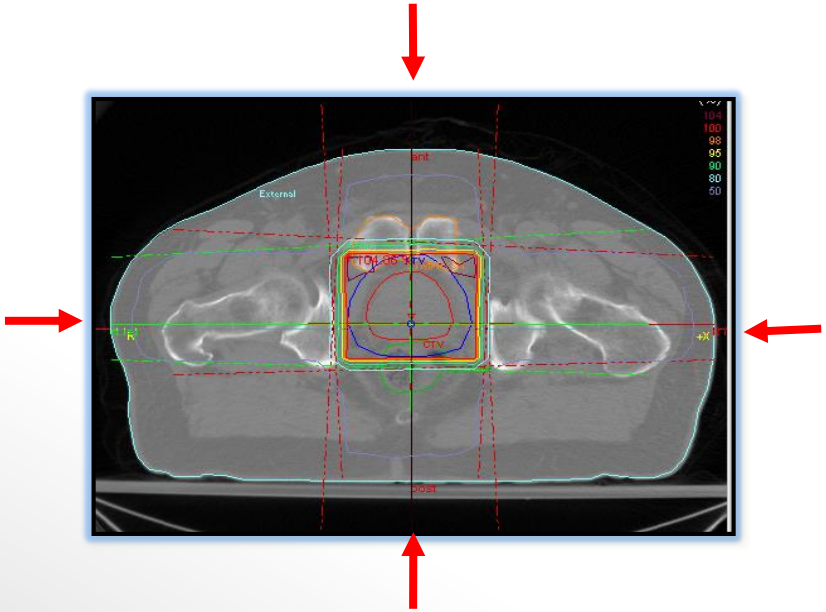


Conventional 2-field technique



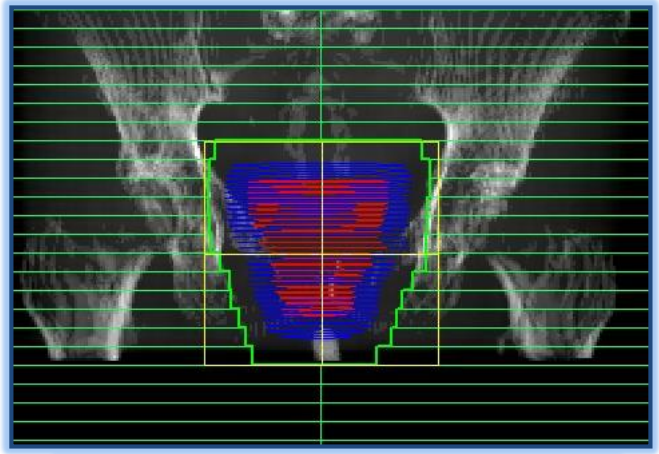
Stereotactic Body Radiotherapy (SBRT)

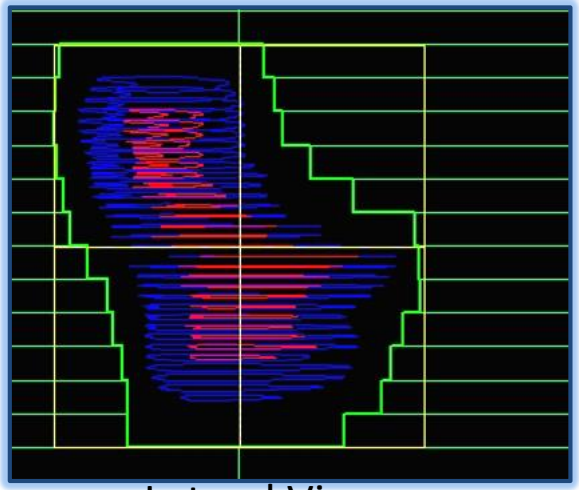
Prostate Cancer



Conventional treatment
4-field box

Anterior-Posterior View

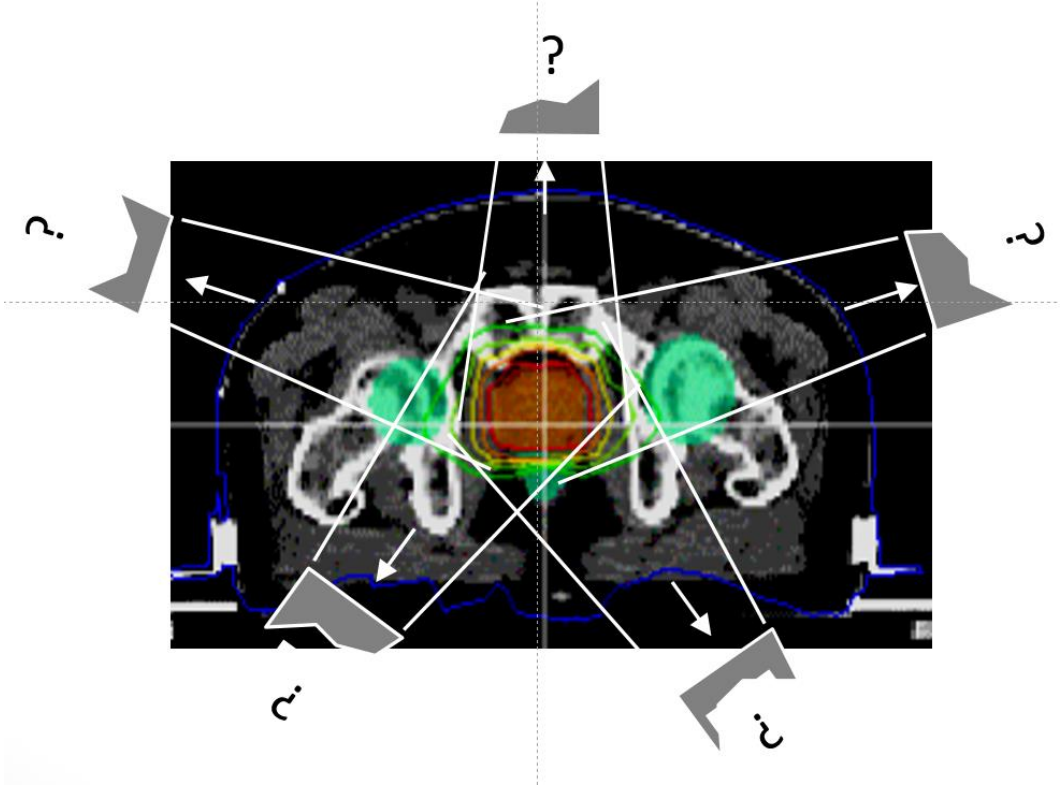




Lateral View

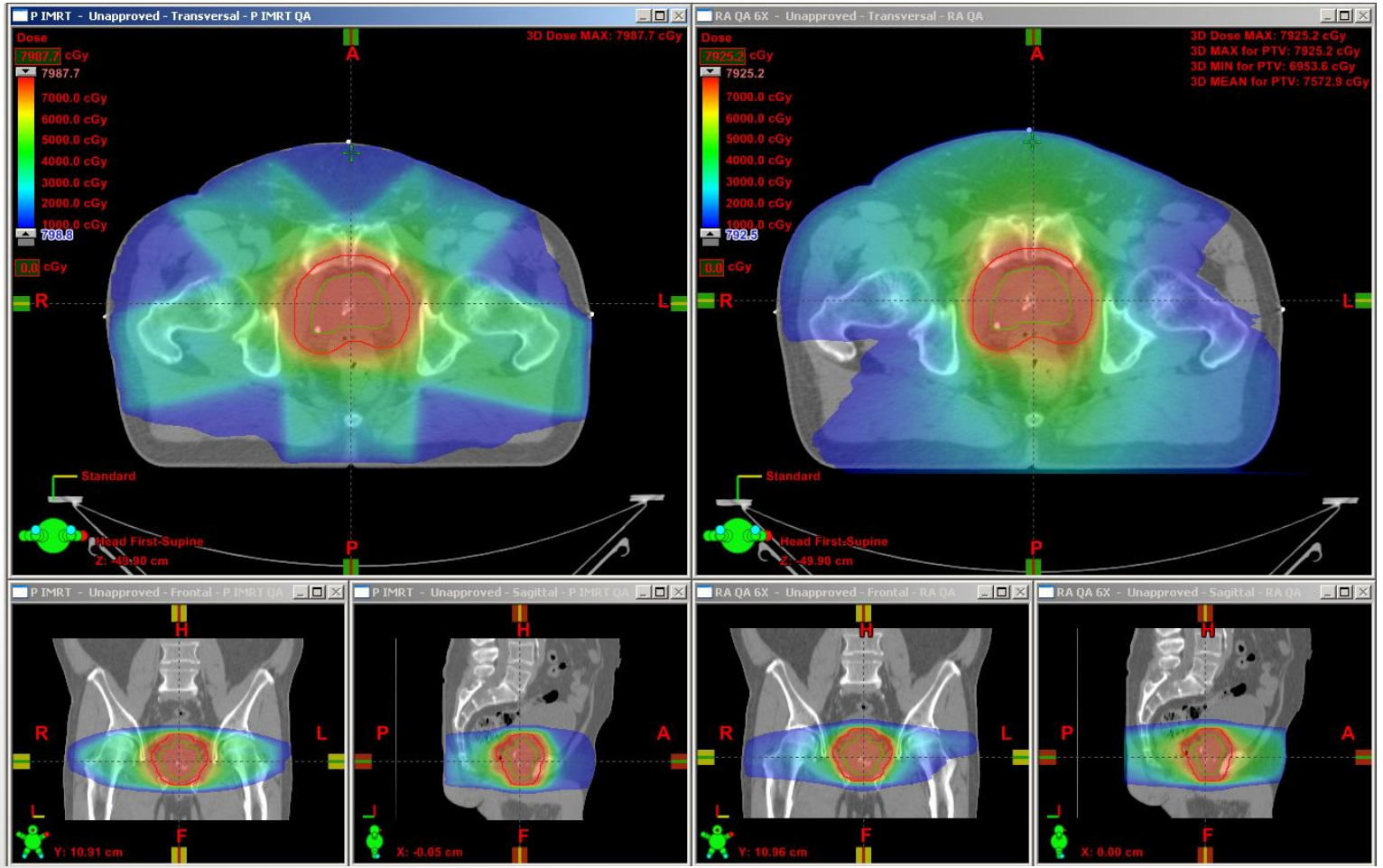
Intensity Modulated Radiation Therapy (IMRT)

- Define objectives
- Use inverse planning
- Determine beam intensities



5-Field S&S IMRT

Single 360° RA



Components of Modern TPS

- Hardware
  - CPU
  - High resolution graphics
  - Mass storage (hard disc)
  - CD/DVD
  - Keyboard & mouse
  - Printer
  - Backup storage facility
  - Network connections

Elekta Xio

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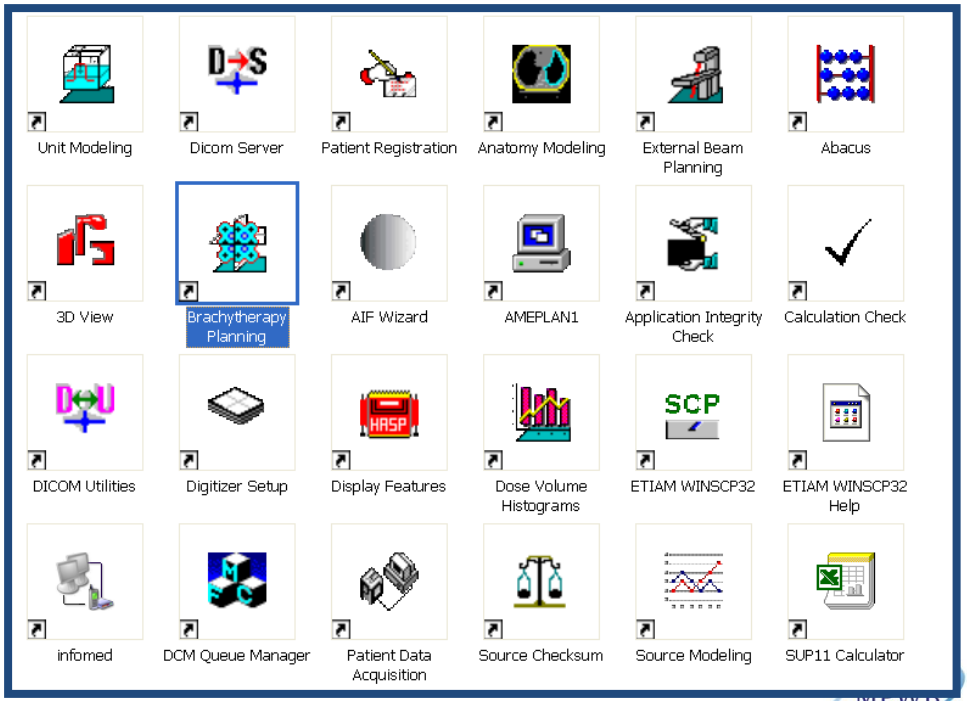
Components of 3-D TPS

- Software
- Input routines
- Anatomy modeling
- Beam geometry (virtual simulation)
- Dose calculations
- Dose volume histograms/evaluation tools
- Digitally reconstructed radiographs
- Output [hardcopies, network, web connection (RTOG)]

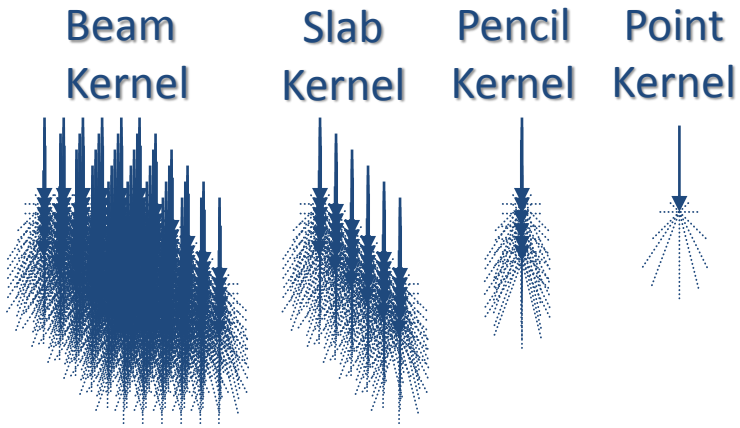
TPP Nucletron



https://n7.alamy.com/zooms/82cdbbb3db54491bbafe48cb70aed145/dosimetrist-calculating-dosimetry-for-radiation-therapy-of-head-and-e5rh3d.jpg

Calculation Methodologies

- Methods
  - Pencil beam
  - Convolution/superposition
  - Boltzmann transport
  - Monte Carlo
  - Radiobiological models
- Issues to consider
  - Accuracy
  - Speed of calculation
  - User friendly
  - Ease of commissioning and QA
  - Options
  - Price



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National/International Protocols

- IAEA TRS-430, 2004

Figure 2

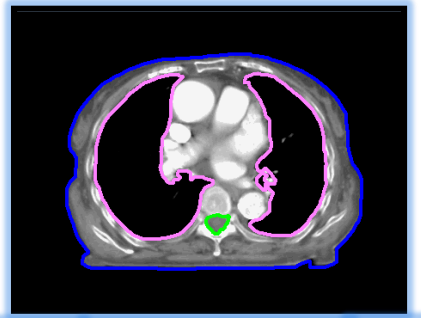
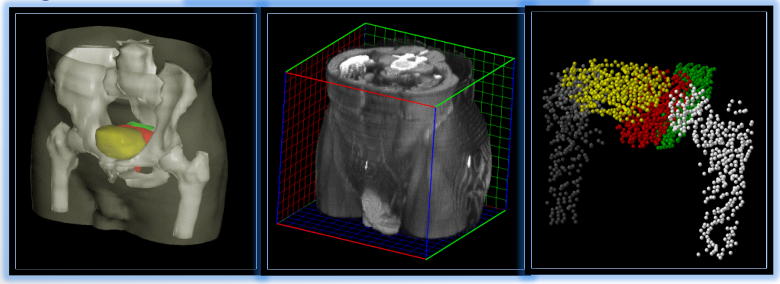
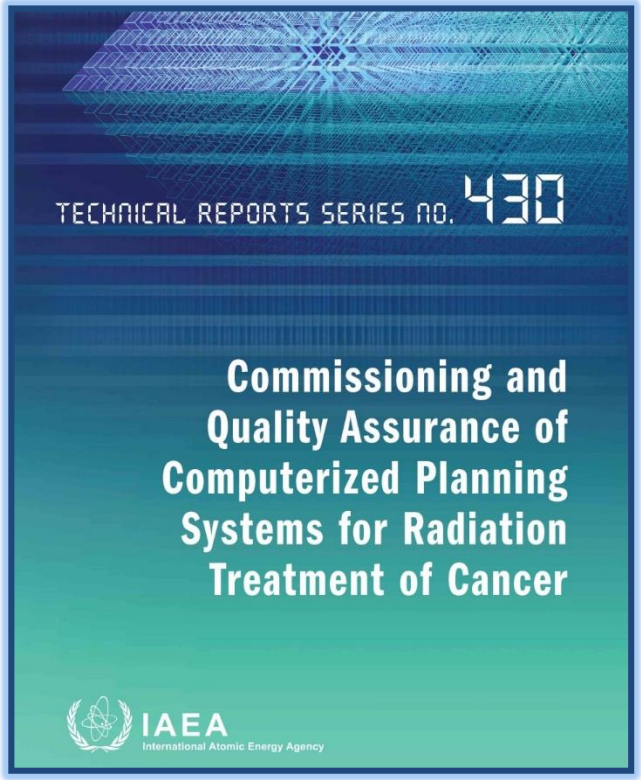


Figure 3





300 pages

Available in pdf format from:
http://www-pub.iaea.org/MTCD/publications/PDF/TRS430_web.pdf

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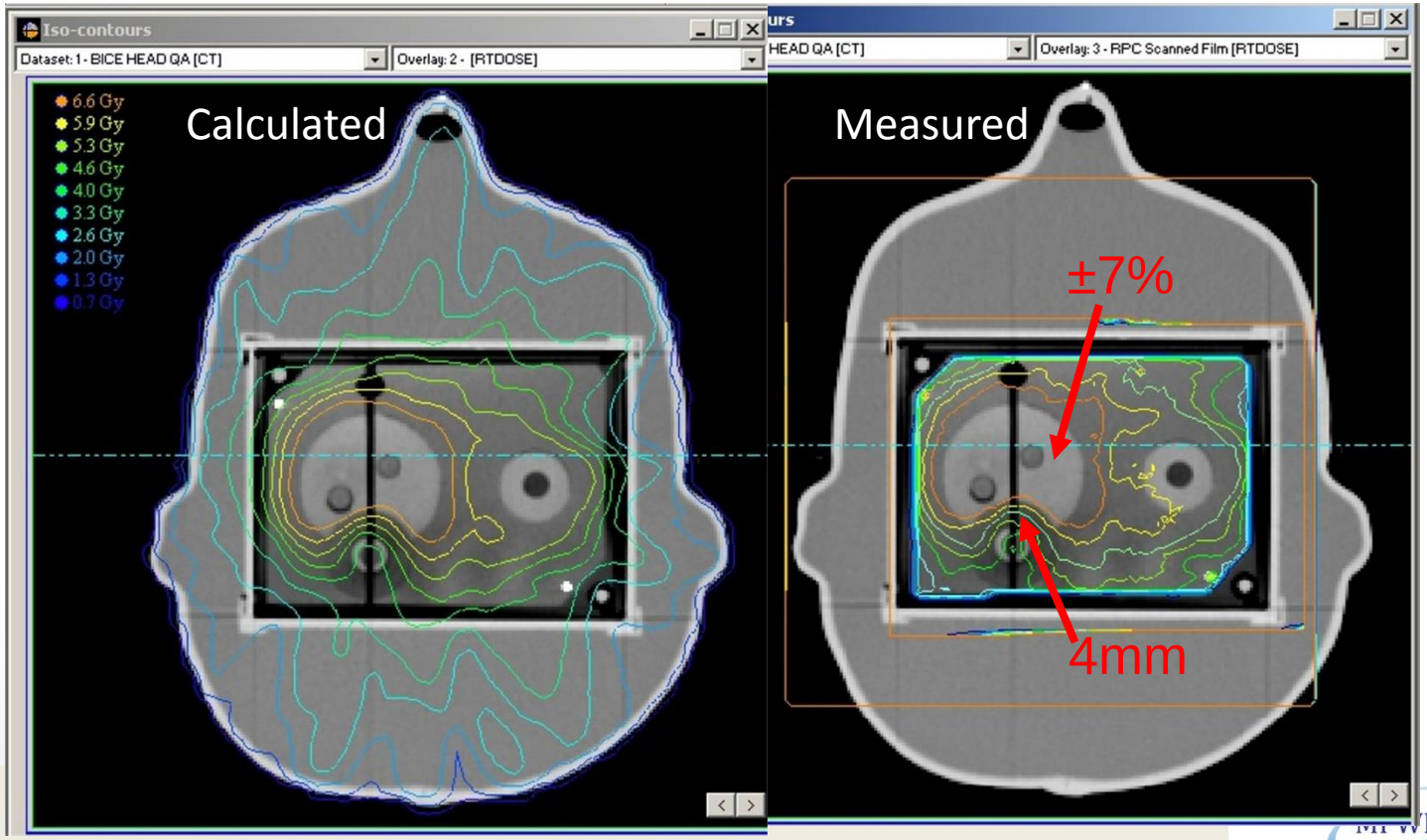
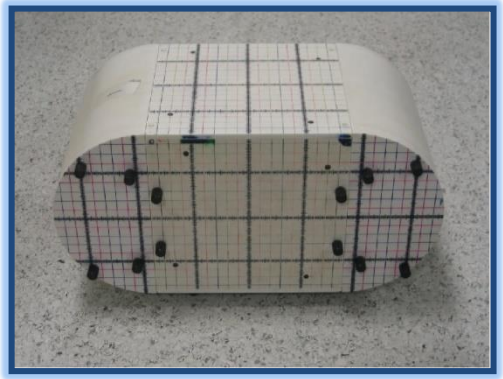
Auditing Accuracy for IMRT, IROC



Various Phantoms… for Commissioning/QA/QC

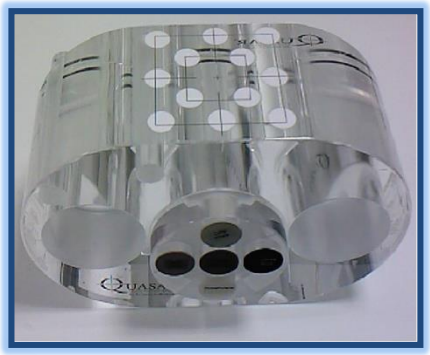
Gammex RMI



Euromechanics Medical GmbH

Standard Imaging Inc.

CIRS Inc.



Modus Medical Devices Inc.

Med-Tec

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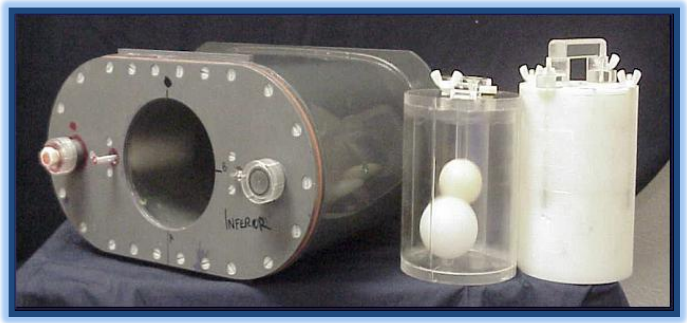
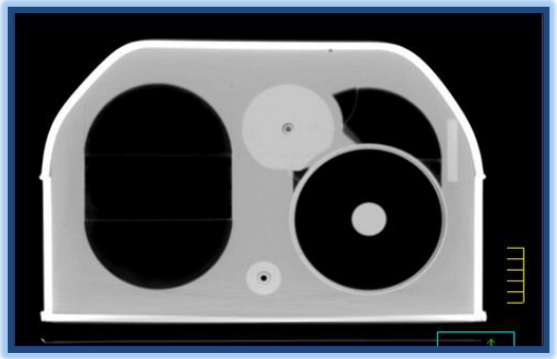
IROC Audit Phantoms



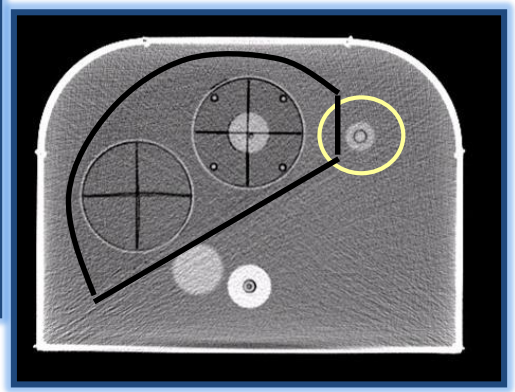
Pelvis (10)



Thorax (15)

H&N IMRT (31)

SRS Head (4)



Liver (2)

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Summary

- Incidence of different cancers varies around the world
- Radiation therapy techniques cover the entire body
  - Each site requiring its own details
- While different techniques have some commonality
  - They are developed uniquely for each department
- Treatment planning systems are at the core of the treatment planning process
  - Treatment planning requires imaging
  - Clinical implementation requires commissioning, verification and QA procedures

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