


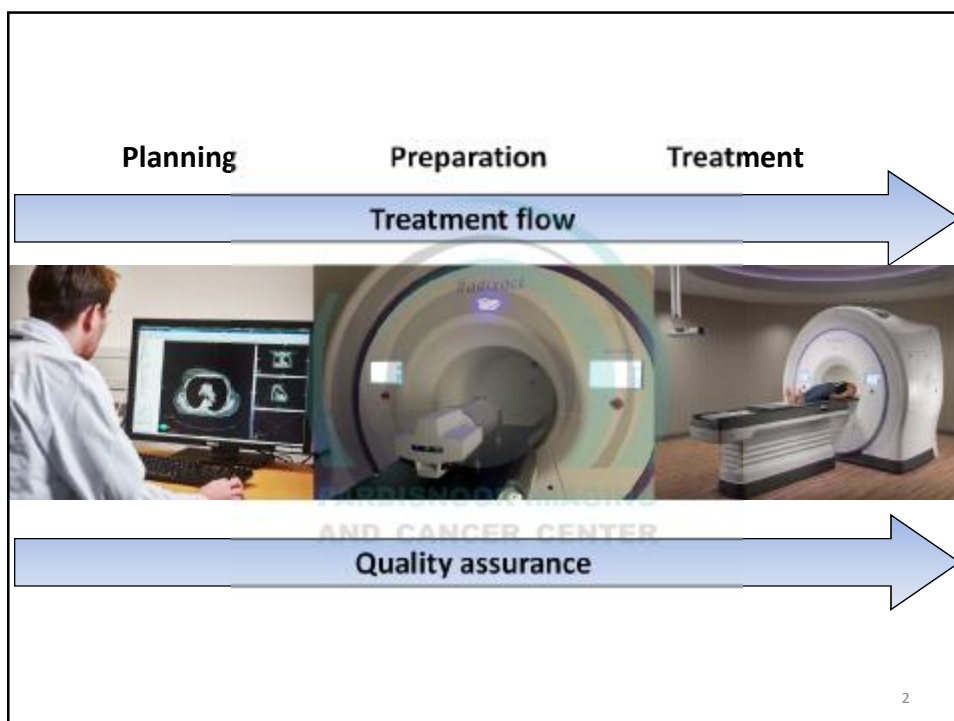
Tomotherapy and Patient QA (Part 1)

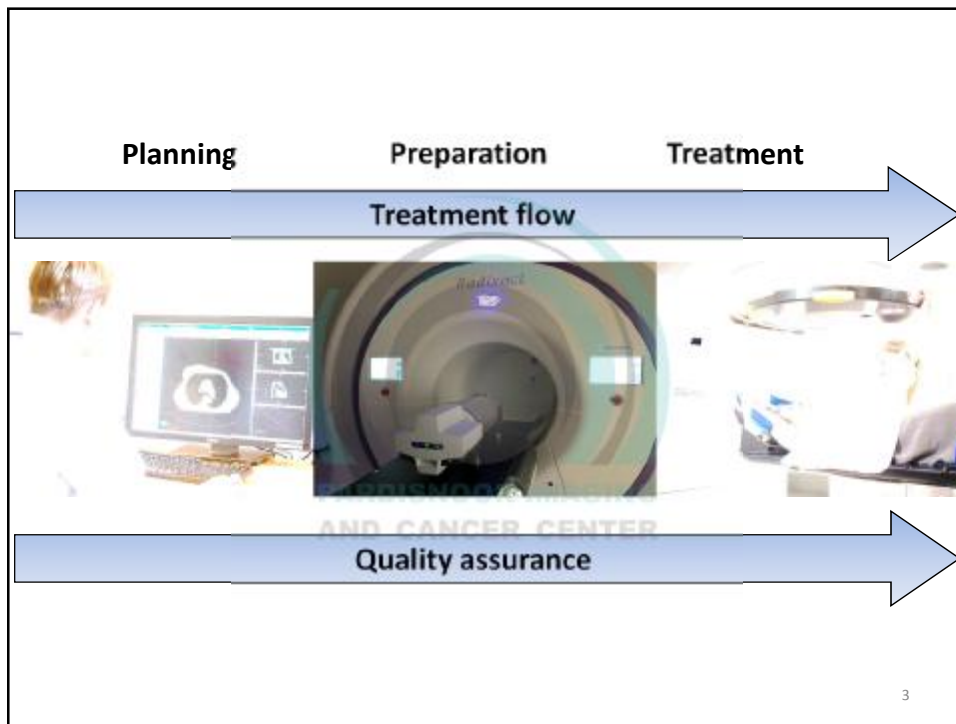


The image displays various components of a tomotherapy system. On the left, there are two smaller images: a white cylindrical device and a blue circular device. Below these is a white and grey mobile unit. On the right is a large, white tomotherapy gantry with a patient table. A watermark for 'PARDISNOOR IMAGING AND CANCER CENTER' is visible in the background.


Aliasghar Rohani
Medical Physicist

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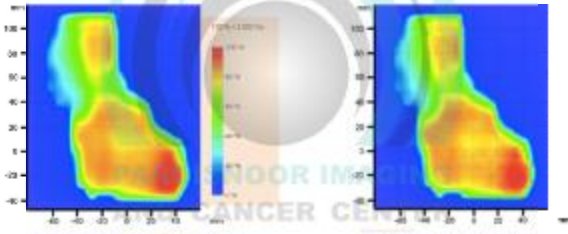




Patient Specific QA




Aim :
Compare the calculated dose ditribution to the measured dose distribution .



Calculated dose distribution Measured dose distribution

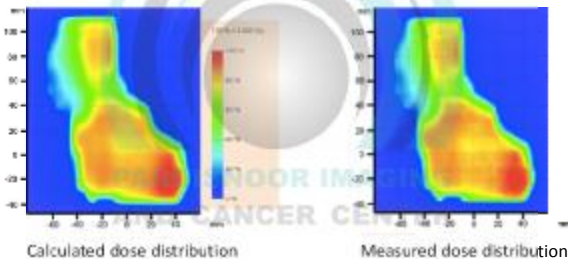
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Patient Specific QA



Aim :

Compare the calculated dose distribution to the measured dose distribution .




- For **individual Patients**
- Before **first treatment session**

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Source of Errors

- Errors in Treatment Planning Systems
- Errors in Treatment Delivery Machine
- Errors in PS-QA Process
- Errors in Calibrations

What should be checked?




PARDISNOOR IMAGING AND CANCER CENTER

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Patient Specific QA

What is the acceptable value to approve the PS-QA?

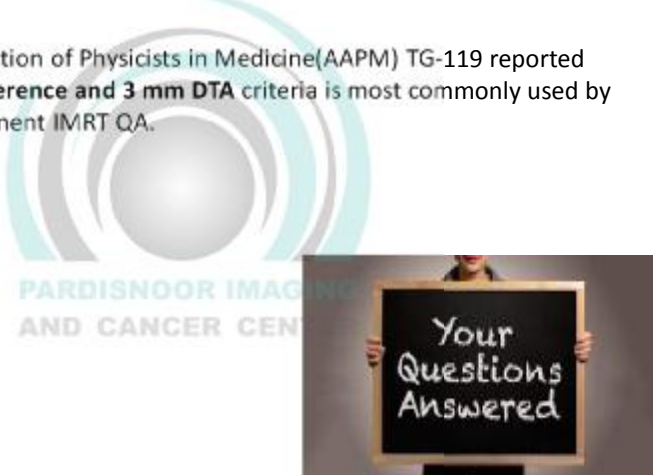


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Patient Specific QA

What is the acceptable value to approve the PS-QA?

- The American Association of Physicists in Medicine(AAPM) TG-119 reported that the **3% dose difference and 3 mm DTA** criteria is most commonly used by physicists in pretreatment IMRT QA.




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Patient Specific QA

What is the acceptable value to approve the PS-QA?

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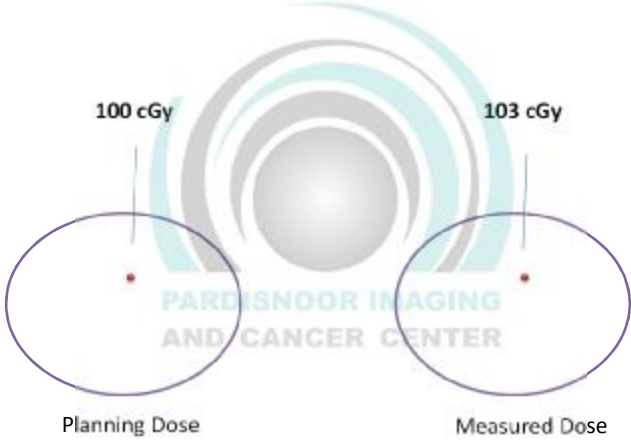
➔ **95- 97% , 3% DD 3mm DTA**



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Dose Deviation

DD represents the Measured and Calculated Dose differences .



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Distance to Agreement

DTA represents the distance between Measured and Calculated Dose.
Van Dyk et al (1993) used the concept of the DTA for QA
Harms et al (1998) : introduce DTA algorithm

The diagram shows two circles representing dose distributions. The left circle is labeled 'Planning Dose' and has a red dot at 100 cGy. The right circle is labeled 'Measured Dose' and has a red dot at 103 cGy. A horizontal line with a red dot at the end is positioned above the circles. The background features a stylized logo with the text 'PARDISNOOR IMAGING AND CANCER CENTER'.

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Distance to Agreement

DTA represents the distance between Measured and Calculated Dose.

The diagram shows two circles representing dose distributions. The left circle is labeled 'Planning Dose' and has a red dot at 100 cGy. The right circle is labeled 'Measured Dose' and has two red dots at 103 cGy and 100 cGy. A horizontal line with a red dot at the end is positioned above the circles. A bracket indicates a 3 mm distance between the 100 cGy dots. The background features a stylized logo with the text 'PARDISNOOR IMAGING AND CANCER CENTER'.

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Gamma Index

This method, first introduced by Low et al (1998).
 This standard method evaluates the coincidence between the calculated and measured dose distributions by utilizing the percent dose difference (DD) and distance to agreement (DTA).

$$\Gamma(\mathbf{r}_R, \mathbf{r}_E) = \sqrt{\frac{\Delta r^2(\mathbf{r}_R, \mathbf{r}_E)}{\delta r^2} + \frac{\Delta D^2(\mathbf{r}_R, \mathbf{r}_E)}{\delta D^2}}$$

$\gamma \leq 1$ Pass
 $\gamma > 1$ Fail

100% passing is ideal but not practical.

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Gamma Index

- Global Gamma Index
- Local Gamma Index

The contrast between the two types is the way the dose difference is calculated.


$$DD = \frac{\text{Measured} - \text{Calculated dose}}{\text{Normalization Value}}$$

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Gamma Index

γ

- **Global Gamma Index**
 - Normalization Value = Max Dose of the Plan
- **Local Gamma Index**
 - $$\frac{103 - 100}{210}$$



PARDISNOOR IMAGING
AND CANCER CENTER

The contrast between the two types is the way the dose difference is calculated.


$$DD = \frac{\text{Measured} - \text{Calculated dose}}{\text{Normalization Value}}$$

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Gamma Index

γ

- **Global Gamma Index**
 - Normalization Value = Max Dose of the Plan
- **Local Gamma Index**
 - Normalization Value = Calculated dose at the currently evaluated pixel
 - $$\frac{103 - 100}{100}$$



PARDISNOOR IMAGING
AND CANCER CENTER

The contrast between the two types is the way the dose difference is calculated.

$$DD = \frac{\text{Measured} - \text{Calculated dose}}{\text{Normalization Value}}$$

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Gamma Index

Dose Thresholding:

The American Association of Physicists in Medicine Task Group 119 instructed institutions to use a low-dose threshold of 10% or a region of interest determined by the jaw setting when they collected gamma analysis quality assurance (QA) data for the planar dose distribution.

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Gamma Index

Ji-Hye Song and et al .2015
performed a gamma analysis

- A total of 30 treatment plans (Brain , H&N and Prostate)
- with various low-dose thresholds in the range of 0% to 15%
- both global and local normalization
- different acceptance criteria (3%/3 mm, 2%/2 mm, and 1%/1 mm)
- e Portal Dosimetry software

For Global Gamma normalization : The %GP decreased as the low-dose threshold increased from 0% to 15%

For Local Gamma normalization : The %GP increased as the low-dose threshold increased from 0% to 15%

Global Gamma


Low dose threshold (%)	Gamma passing rate (%)
0%	~98.0
5%	~97.5
10%	~97.0
15%	~96.5

Local Gamma

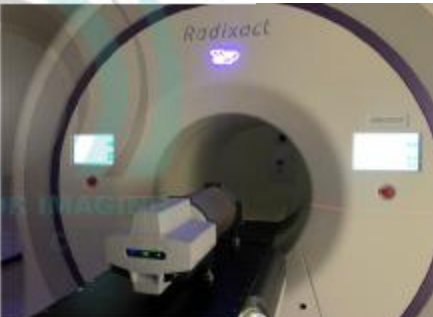
Low dose threshold (%)	Gamma passing rate (%)
0%	~92.0
5%	~95.0
10%	~96.5
15%	~97.0

Tomo Patient Specific QA

Cheese Phantom




Delta4+ Phantom




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Tomo Patient Specific QA (Cheese Phantom)



**Standard Imaging A1SL
"Slimline Miniature Shonka Chamber"**



Collecting Volume:	0.055 cm ³
Nominal Calibration Factor:	60 RHC
Centroid of Collecting Volume:	4.1 mm from lip of chamber
Collector Diameter:	5.0 mm
Outside Diameter of Shell:	6.25 mm
Wall Thickness:	1.1 mm
Shell, Collector, and Guard Material:	A1SL - Sironica Air-Equip. plate: C562



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Tomo Patient Specific QA



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Thank You For Your Attention



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