It's Grays to Me: Understanding Radiation Data

Hiram A. Gay, MD
Department of Radiation Oncology
Washington University in Saint Louis

Alliance Group Meeting, 05/12/2017

Presentation Objectives

- Understand the importance of radiation protocol compliance
- Understand the basic radiation oncology workflow
- Gain insights where to find radiation oncology data requested by Alliance through a sample case

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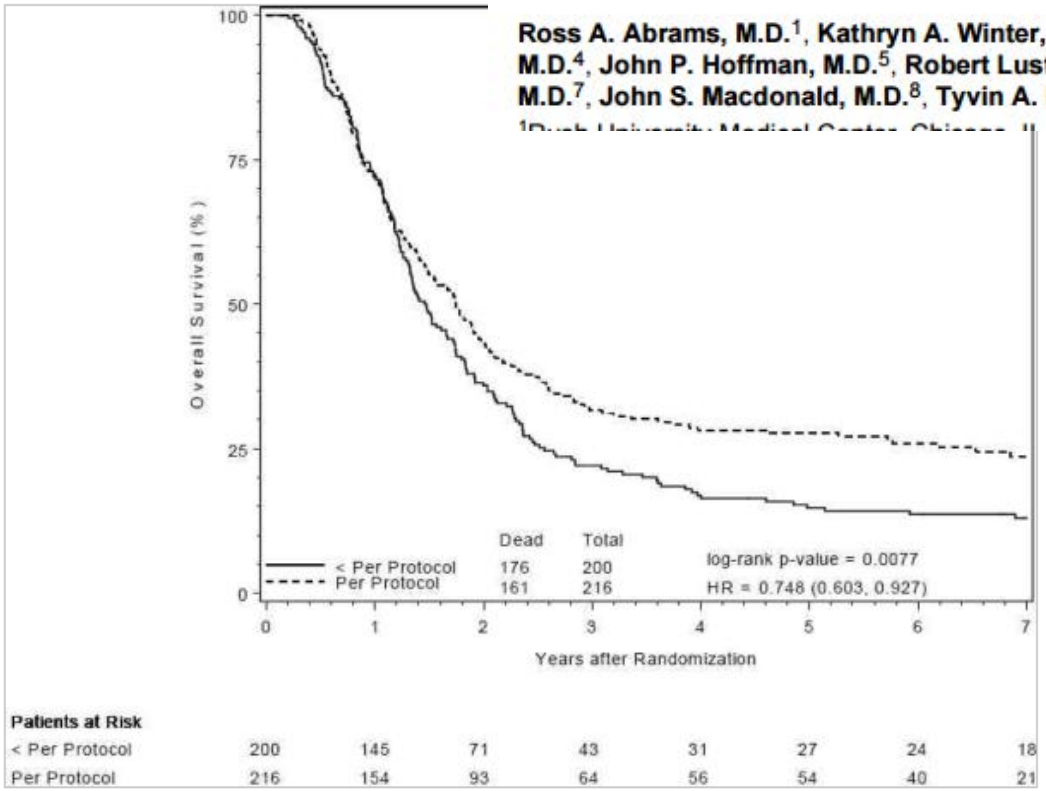
THE IMPORTANCE OF BEING Compliant

Failure to Adhere to Protocol Specified Radiation Therapy Guidelines Was Associated With Decreased Survival in RTOG 9704 - A Phase III Trial of Adjuvant Chemotherapy and Chemoradiotherapy for Patients with Resected Adenocarcinoma of the Pancreas

Ross A. Abrams, M.D.[1], Kathryn A. Winter, M.S.[2], William F. Regine, M.D.[3], Howard Safran, M.D.[4], John P. Hoffman, M.D.[5], Robert Lustig, M.D.[2], Andre A. Konski, M.D.[6], Al B. Benson, M.D.[7], John S. Macdonald, M.D.[8], Tyvin A. Rich, M.D.[9], and Christopher G. Willett, M.D.[10]

[1]Rush University Medical Center, Chicago, IL



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NON-COMPLIANCE Kills Lives

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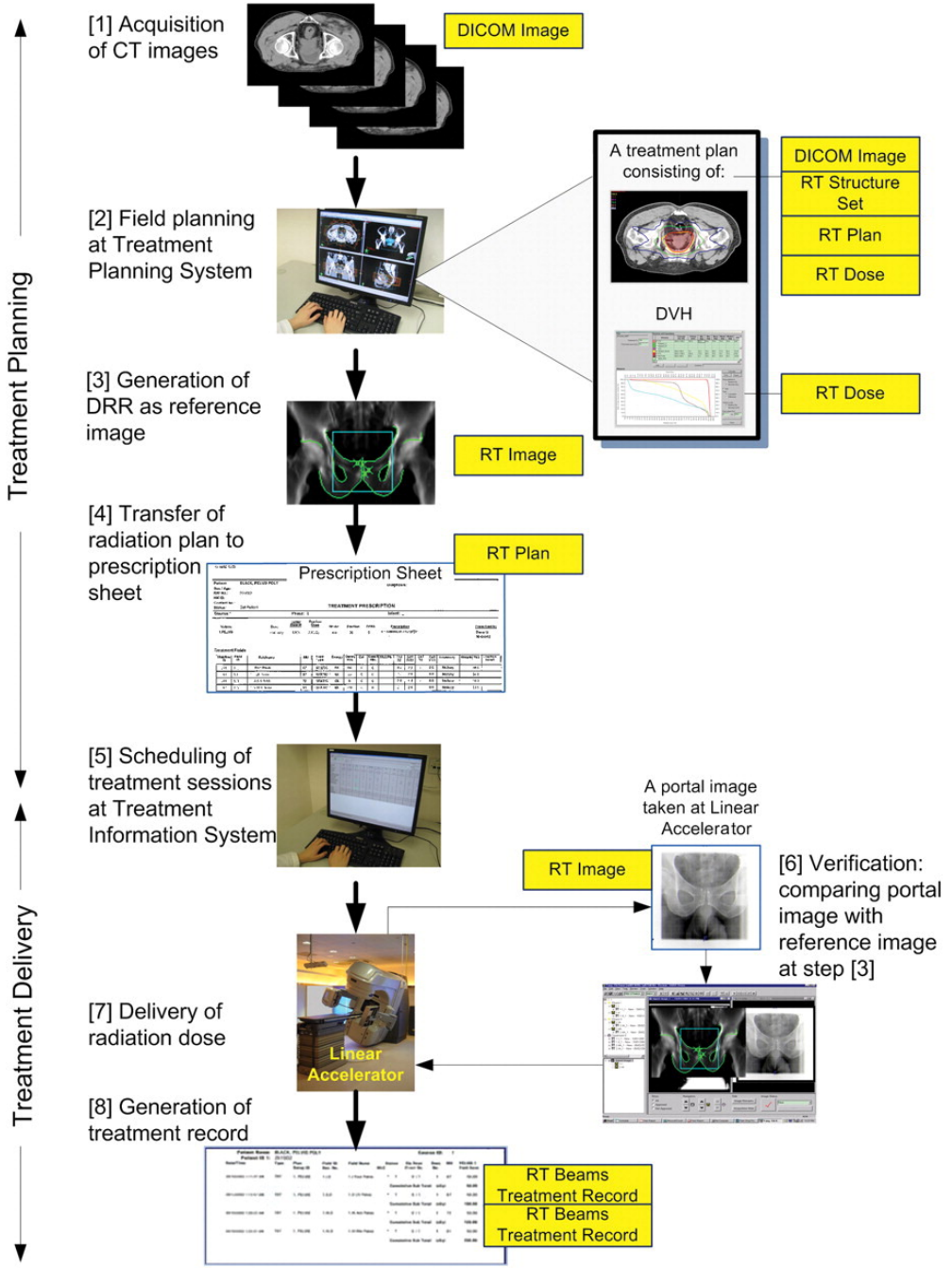
Radiation Oncology Workflow



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ALLIANCE CALGB-30610

Checklist for Submission of Radiation Oncology Quality Assurance Materials

Patient Initials: T,SK Registration #: 136823 RT Start Date: October 28, 2014

Sender's Name: Jason Atkinson Phone #: 314-362-3203

Email: jlatkins@dom.wustl.edu

Radiation Oncologist: Cliff Robinson Email: crobinson@radonc.wustl.edu

Please *enclose a copy of this Checklist* together with the RT materials you submit. All materials must be labeled with the protocol and assigned registration number.

Digital treatment plan, screenshots of other RT data and diagnostic imaging may be submitted via sFTP or on CD. For data sent via sFTP, a notification email should be sent to sFTP@qarc.org with the **protocol # and registration # in the subject line**. Please refer to IROC Rhode Island website for instructions on sending digital data (www.QARC.org).

Data not sent via sFTP may be sent via email to datasubmission@qarc.org with the **protocol # and registration # in the subject line**. Data may also be sent via courier to the address below.

Rapid Review materials must be submitted within the first week of the start of radiotherapy:

DATE SUBMITTED	
3/2/15	Copy of baseline diagnostic CT or PET scan (include reports)
3/2/15	Copy of Treatment Planning CT scan (DicomRT or RTOG format)
3/2/15	Prescription sheet
3/2/15 tx plan	Treatment planning system summary report that includes the MU calcs, beam parameters, calculation algorithm, and volume of interest dose statistics
3/2/15 tx plan	Color Isodose Distributions in axial, sagittal and coronal planes (composite plan) (Only required if Digital RT plan not submitted)
3/2/15 tx plan	Dose volume histograms of PTV, CTV, GTV, Lungs, Heart, Esophagus and Spinal Cord. If IMRT is used, a DVH of unspecified tissue. These will be included with the digital RT plan.
3/2/15	Portal films (or hard copy of real time portal images) of each treatment field
3/2/15 tx plan	DRRs (digitally reconstructed radiographs) of each treatment field
3/2/15 tx plan	Orthogonal Anterior/Posterior and Lateral Films if not part of portals
3/2/15	For thoracic IMRT, motion management description required http://www.qarc.org/forms/IROC_MotionManagementForm.pdf
3/2/15	RT-1 or IMRT Dosimetry Form www.qarc.org/forms/IROC_RT-1DosimetrySummaryForm.pdf

Final Review materials must be submitted within 1 week of the completion of radiation:

3/2/15	Completed RT Daily Treatment Chart, including prescription, daily and cumulative doses
3/2/15	RT-2 Total Dose Record www.qarc.org/forms/IROC_RT2RadiotherapyTotalDoseRecord.pdf
n/a	All revised data if modifications made subsequent to initial data submission

Please contact study CRA by email (alliance@qarc.org) or phone: **(401) 753-7600** for clarification as necessary. Thank you for your ongoing co-operation.

Version date: 12/02/2014

IROC Rhode Island (QARC), Building B, Suite 201, 640 George Washington Highway, Lincoln, RI 02865-4207

ALLIANCE FOR CLINICAL TRIALS IN ONCOLOGY

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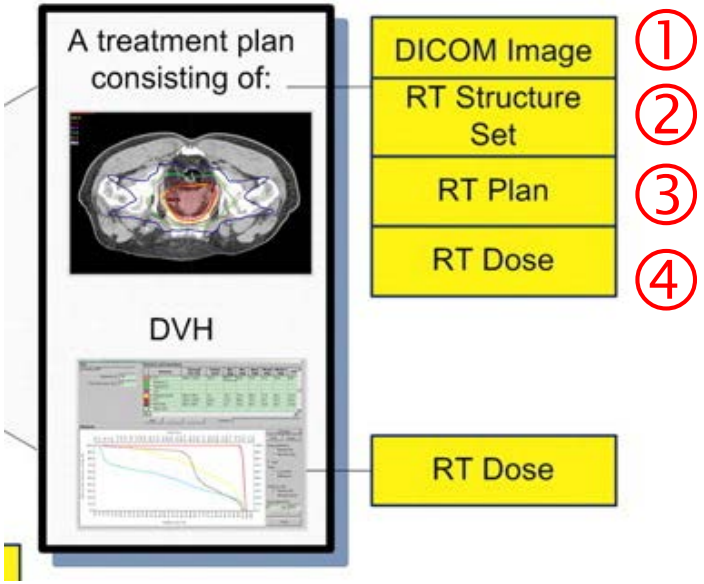
Copy of Treatment Planning CT scan (Dicom-RT or RTOG format)

- Digital Imaging and Communications in Medicine (DICOM) standard is used for the transmission of medical images
  - Radiation therapy is image intensive
    - first specialty incorporated into the DICOM standard after radiology
    - four DICOM-RT objects



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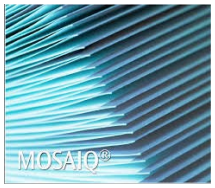
Example illustrated with:

- Mosaiq, record and verify system 

- Pinnacle, treatment planning software PHILIPS Pinnacle³
- ARIA, oncology information system ARIA
- Eclipse, treatment planning system
- WashU MD orders

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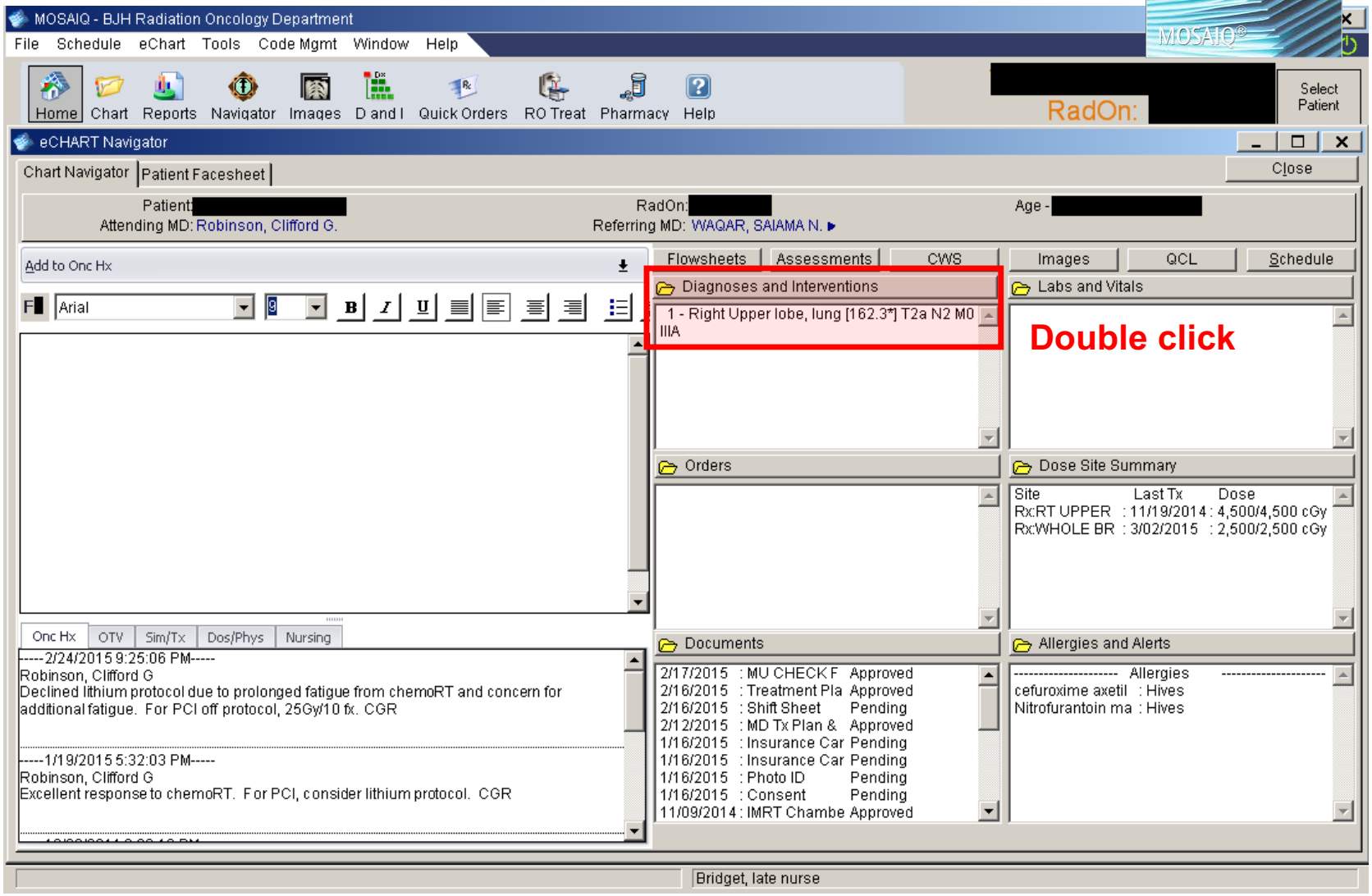
Prescription sheet



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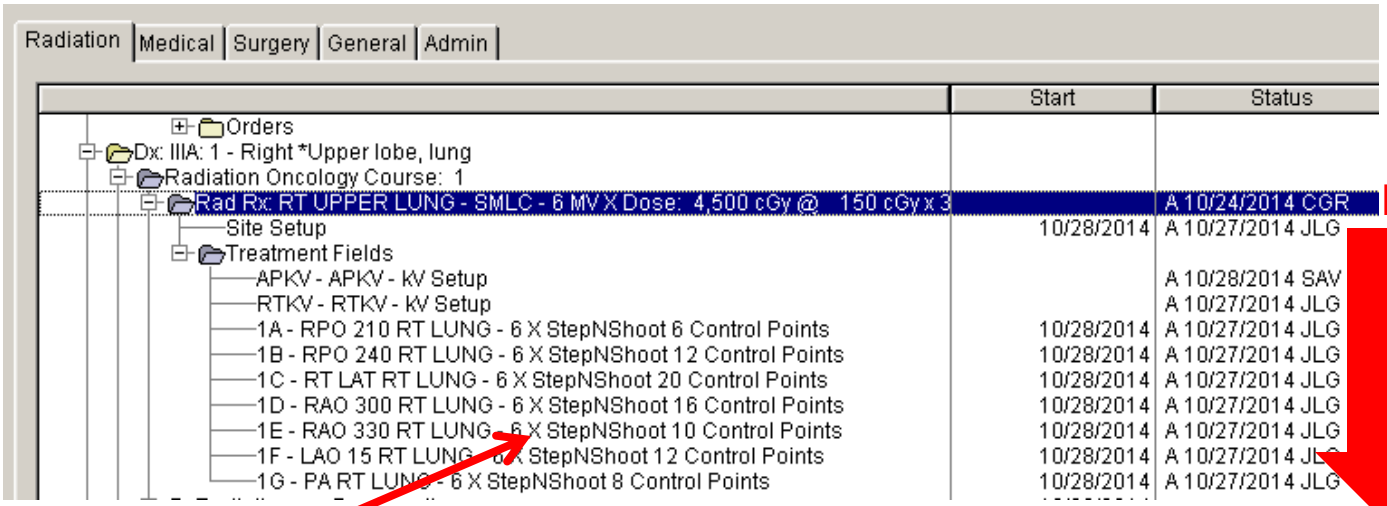
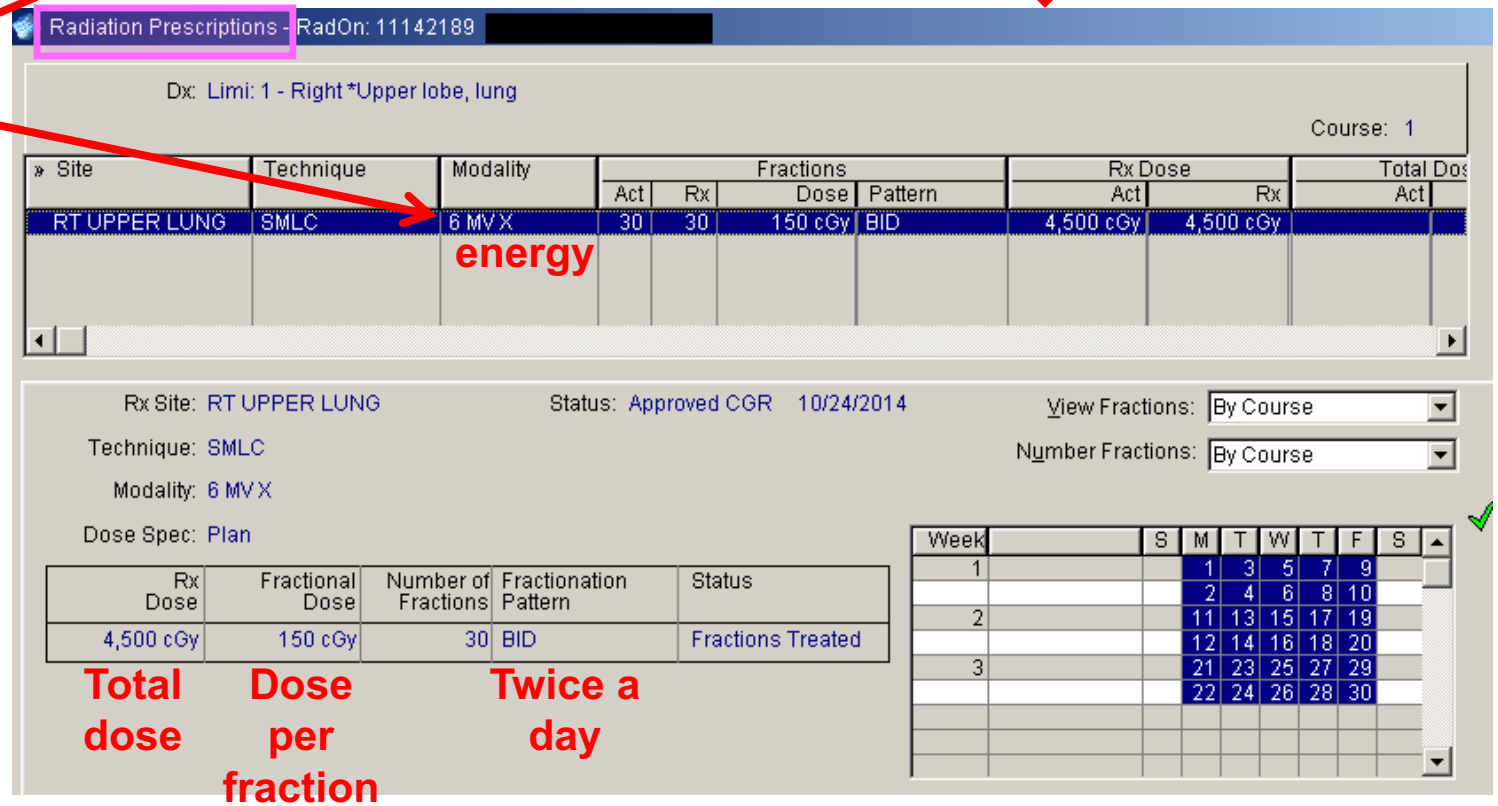
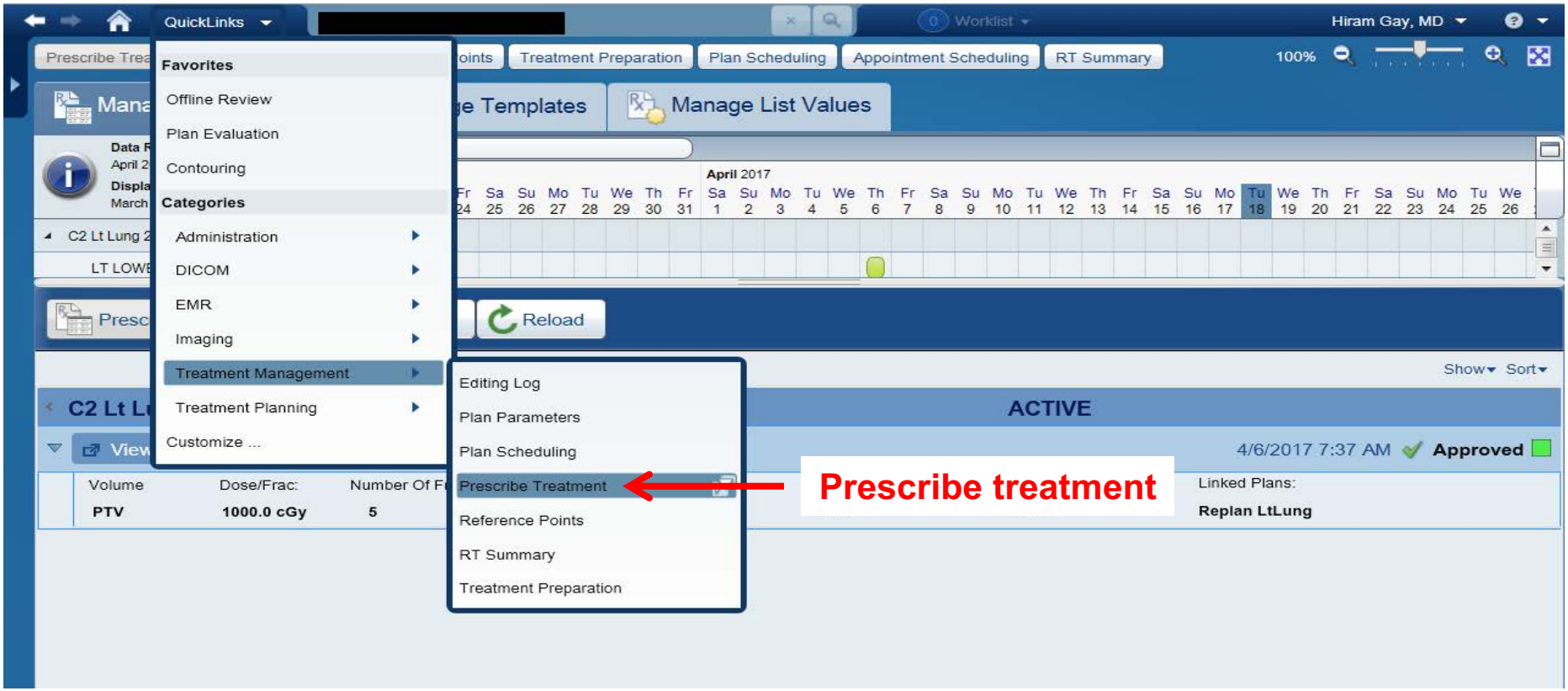
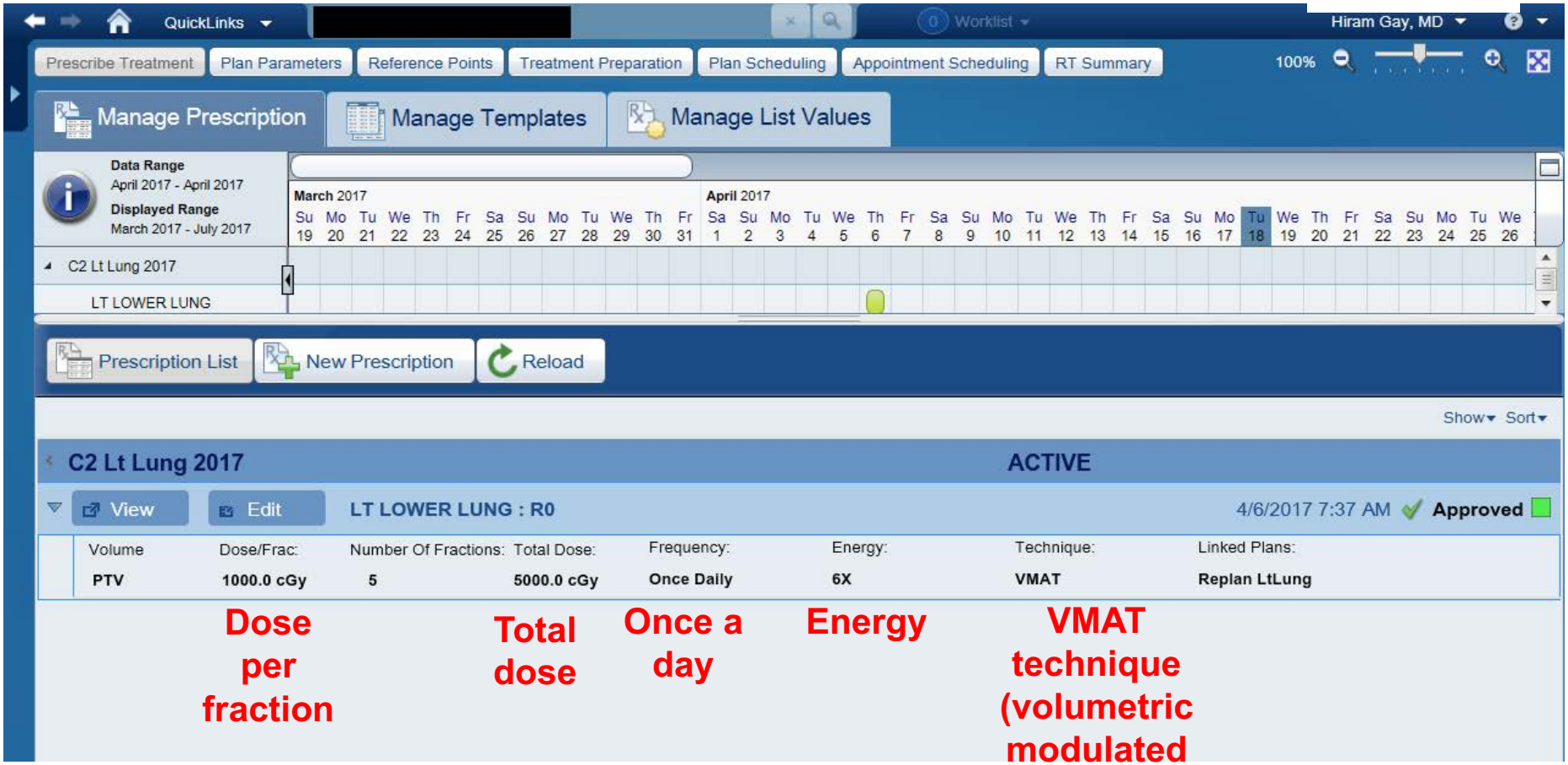


Double click

IMRT




QuickLinks
Worklist
Hiram Gay, MD
Treatment Preparation
Plan Scheduling
Appointment Scheduling
RT Summary
100%
Favorites
Offline Review
Plan Evaluation
Contouring
Categories
Administration
DICOM
EMR
Imaging
Treatment Management
Treatment Planning
Customize ...
Manage List Values
April 2017
Reload
Editing Log
Plan Parameters
Plan Scheduling
Prescribe Treatment
Reference Points
RT Summary
Treatment Preparation
ACTIVE
Show
Sort
4/6/2017 7:37 AM
Approved
Volume
Dose/Frac:
Number Of Fr
PTV
1000.0 cGy
5
Linked Plans:
Replan LtLung
Prescribe treatment



Dose per fraction

Total dose

Once a day

Energy

VMAT technique (volumetric modulated arc therapy, type of IMRT)

Treatment planning system summary report that includes the MU calcs, beam parameters, calculation algorithm, and volume of interest dose statistics

Pinnacle³

Plan Summary Sheet

CALGB 30610
Pt# 136823
T,SK

Beam Setup

Beam	Machine	Energy	Modality	Prescription	Isocenter	SSD (cm) Start / Avg	MU Per Fraction
1A RPO 210 RT ...	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	88.34 / 88.34	**33**
1B RPO 240 RT ...	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	83.51 / 83.51	**40**
1C RT LAT RT L...	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	77.36 / 77.36	**78**
1D RAO 300 RT ...	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	77.23 / 77.23	**54**
1E RAO 330 RT ...	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	83.96 / 83.96	**58**
1F LAO 15 RT L...	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	86.39 / 86.39	**49**
1G PA RT LUNG	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	89.94 / 89.94	**41**
APKV	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	86.87 / 86.87	**0**
RTKV	TR6_VARIX	6MV	Photons	RT LUNG	PREVIE...	77.36 / 77.36	**0**

	Collimators (cm) (Control Pt 1)				Gantry						
Beam	X1	X2	Y2	Y1	Start / Stop	Couch	Coll	Block	Wedge	Bolus	Comp
1A RPO 210 RT L...	2.5	6.5	4.0	7.0	210.0/210.0	0.0	0.0	MLC	None	No	No
1B RPO 240 RT L...	5.0	6.0	4.0	7.0	240.0/240.0	0.0	0.0	MLC	None	No	No
1C RT LAT RT LU...	7.5	4.0	4.0	7.0	270.0/270.0	0.0	0.0	MLC	None	No	No
1D RAO 300 RT L...	8.5	3.0	4.0	6.5	300.0/300.0	0.0	0.0	MLC	None	No	No
1E RAO 330 RT L...	7.5	2.5	4.0	6.5	330.0/330.0	0.0	0.0	MLC	None	No	No
1F LAO 15 RT LU...	6.5	1.5	4.0	6.5	15.0 / 15.0	0.0	0.0	MLC	None	No	No
1G PA RT LUNG	1.5	7.0	4.0	6.5	180.0/180.0	0.0	0.0	MLC	None	No	No
APKV	5.0	5.0	5.0	5.0	0.0 / 0.0	0.0	0.0	No	None	No	No
RTKV	5.0	5.0	5.0	5.0	270.0/270.0	0.0	0.0	No	None	No	No

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Treatment planning system summary report that includes the MU calcs, beam parameters, calculation algorithm, and volume of interest dose statistics

Pinnacle³

	1A RPO 210 RT LUNG	1B RPO 240 RT LUNG	1C RT LAT RT LUNG
Beam Setup			
Machine Name	*TR6_VARIX*	*TR6_VARIX*	*TR6_VARIX*
Machine Version	2011–08–03 17:26:32	2011–08–03 17:26:32	2011–08–03 17:26:32
Energy / Modality	6MV Photons	6MV Photons	6MV Photons
SAD (cm)	100.0	100.0	100.0
Prescription	RT LUNG	RT LUNG	RT LUNG
Isocenter	PREVIEW	PREVIEW	PREVIEW
Beam Geometry			
Couch Angle	0.0	0.0	0.0
Gantry Angle	210.0	240.0	270.
Collimator Angle	0.0	0.0	0.0
SSD (cm)	88.34	83.51	77.36
SSD With Bolus (cm)	---	---	---
Collimators (cm) (Control Pt 1)			
X1 / X2 (Lower)	2.50 / 6.50 (9.00)	5.00 / 6.00 (11.00)	7.50 / 4.00 (11.50)
Y2 / Y1 (upper)	4.00 / 7.00 (11.00)	4.00 / 7.00 (11.00)	4.00 / 7.00 (11.00)
Modifiers			
Wedge Name	None	None	None
Wedge Orientation	---	---	---
Wedge Angle	None	None	None
Blocked/Tray #/MLC(#CP's)	Yes/MLC (3)	Yes/MLC (6)	Yes/MLC (10)
Bolus	None	None	None
Compensator	None	None	None
Opening Density Matrix	None	None	None
Dose			
Dose Engine	Adaptive Convolve	Adaptive Convolve	Adaptive Convolve
Model	All Field Sizes	All Field Sizes	All Field Sizes
Density Correction	Heterogeneous	Heterogeneous	Heterogeneous
Relative Weight (%)	9.22	11.17	33.07
Reference Point	*PREVIEW*	*PREVIEW*	*PREVIEW*
Normalized Dose (ND) at Ref Pt	1.094	0.673	0.276
Collimator Output Factor (OFc)(Last CP)	1.000	1.002	1.003
MLC Transmission Factor (Last CP)	0.018	0.018	0.018
Total Transmission Factor (TTF)	1.000	1.000	1.000
SPD/OAD (cm)	100.00 / 0.00	100.00 / 0.00	100.00 / 0.00
SSD to Ref Pt (cm)	88.34	83.51	77.36
Ref Pt Depth / Eff Depth (cm)	11.66 / 8.27	16.49 / 12.16	22.64 / 19.27
Unblk Equiv Sq (cm / %Blkd)(Last CP)	9.9 / 25.2%	11.0 / 32.7%	11.2 / 38.3%
Meas Ref Point Dose (cGy/MU)	---	---	---
Dose at Ref/Fraction (cGy)	24.2	18.1	14.5
Dose Rate (MU/min)	400	400	400
Number of Fractions	30	30	30
MU/Fraction	**33**	**40**	**78**

MU = monitor units

Adaptive Convolve = Convolution Superposition

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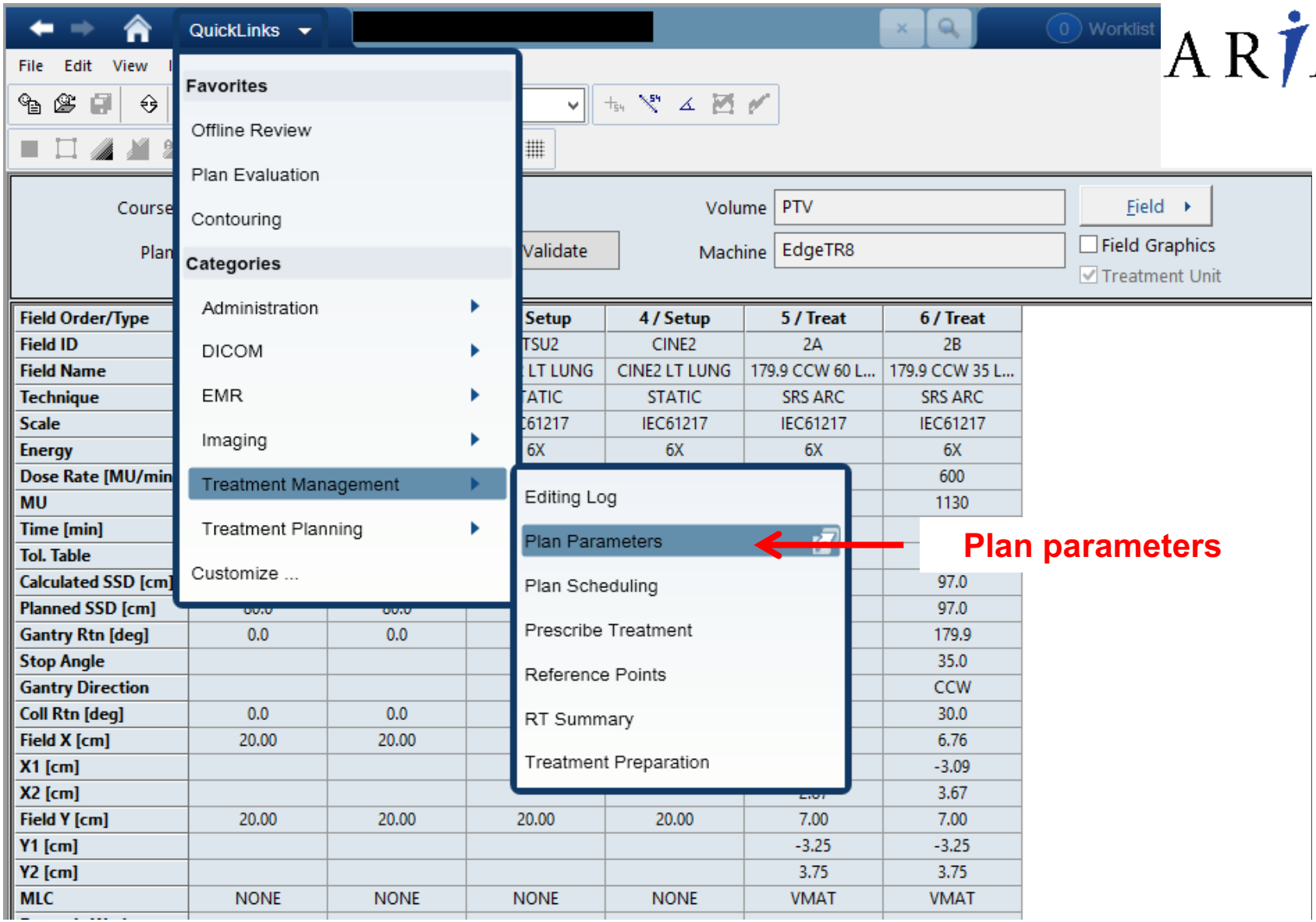

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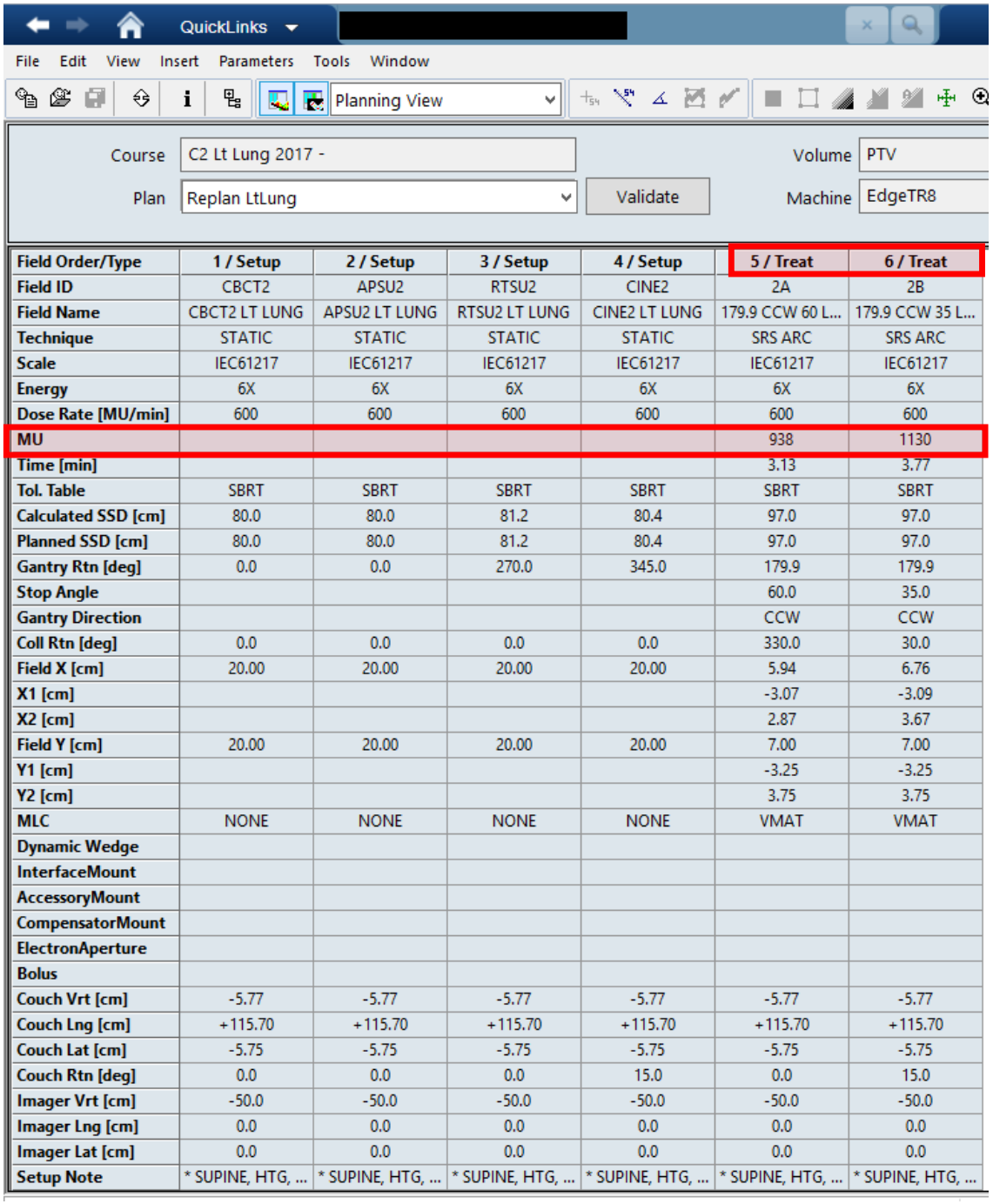

Field Order/Type	1 / Setup	2 / Setup	3 / Setup	4 / Setup	5 / Treat	6 / Treat
Field ID	CBCT2	APSU2	RTSU2	CINE2	2A	2B
Field Name	CBCT2 LT LUNG	APSU2 LT LUNG	RTSU2 LT LUNG	CINE2 LT LUNG	179.9 CCW 60 L...	179.9 CCW 35 L...
Technique	STATIC	STATIC	STATIC	STATIC	SRS ARC	SRS ARC
Scale	IEC61217	IEC61217	IEC61217	IEC61217	IEC61217	IEC61217
Energy	6X	6X	6X	6X	6X	6X
Dose Rate [MU/min]	600	600	600	600	600	600
MU					938	1130
Time [min]					3.13	3.77
Tol. Table	SBRT	SBRT	SBRT	SBRT	SBRT	SBRT
Calculated SSD [cm]	80.0	80.0	81.2	80.4	97.0	97.0
Planned SSD [cm]	80.0	80.0	81.2	80.4	97.0	97.0
Gantry Rtn [deg]	0.0	0.0	270.0	345.0	179.9	179.9
Stop Angle					60.0	35.0
Gantry Direction					CCW	CCW
Coll Rtn [deg]	0.0	0.0	0.0	0.0	330.0	30.0
Field X [cm]	20.00	20.00	20.00	20.00	5.94	6.76
X1 [cm]					-3.07	-3.09
X2 [cm]					2.87	3.67
Field Y [cm]	20.00	20.00	20.00	20.00	7.00	7.00
Y1 [cm]					-3.25	-3.25
Y2 [cm]					3.75	3.75
MLC	NONE	NONE	NONE	NONE	VMAT	VMAT
Dynamic Wedge						
InterfaceMount						
AccessoryMount						
CompensatorMount						
ElectronAperture						
Bolus						
Couch Vrt [cm]	-5.77	-5.77	-5.77	-5.77	-5.77	-5.77
Couch Lng [cm]	+115.70	+115.70	+115.70	+115.70	+115.70	+115.70
Couch Lat [cm]	-5.75	-5.75	-5.75	-5.75	-5.75	-5.75
Couch Rtn [deg]	0.0	0.0	0.0	15.0	0.0	15.0
Imager Vrt [cm]	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0
Imager Lng [cm]	0.0	0.0	0.0	0.0	0.0	0.0
Imager Lat [cm]	0.0	0.0	0.0	0.0	0.0	0.0
Setup Note	* SUPINE, HTG, ...	* SUPINE, HTG, ...	* SUPINE, HTG, ...	* SUPINE, HTG, ...	* SUPINE, HTG, ...	* SUPINE, HTG, ...

Two treatment arcs

MU

ARIA

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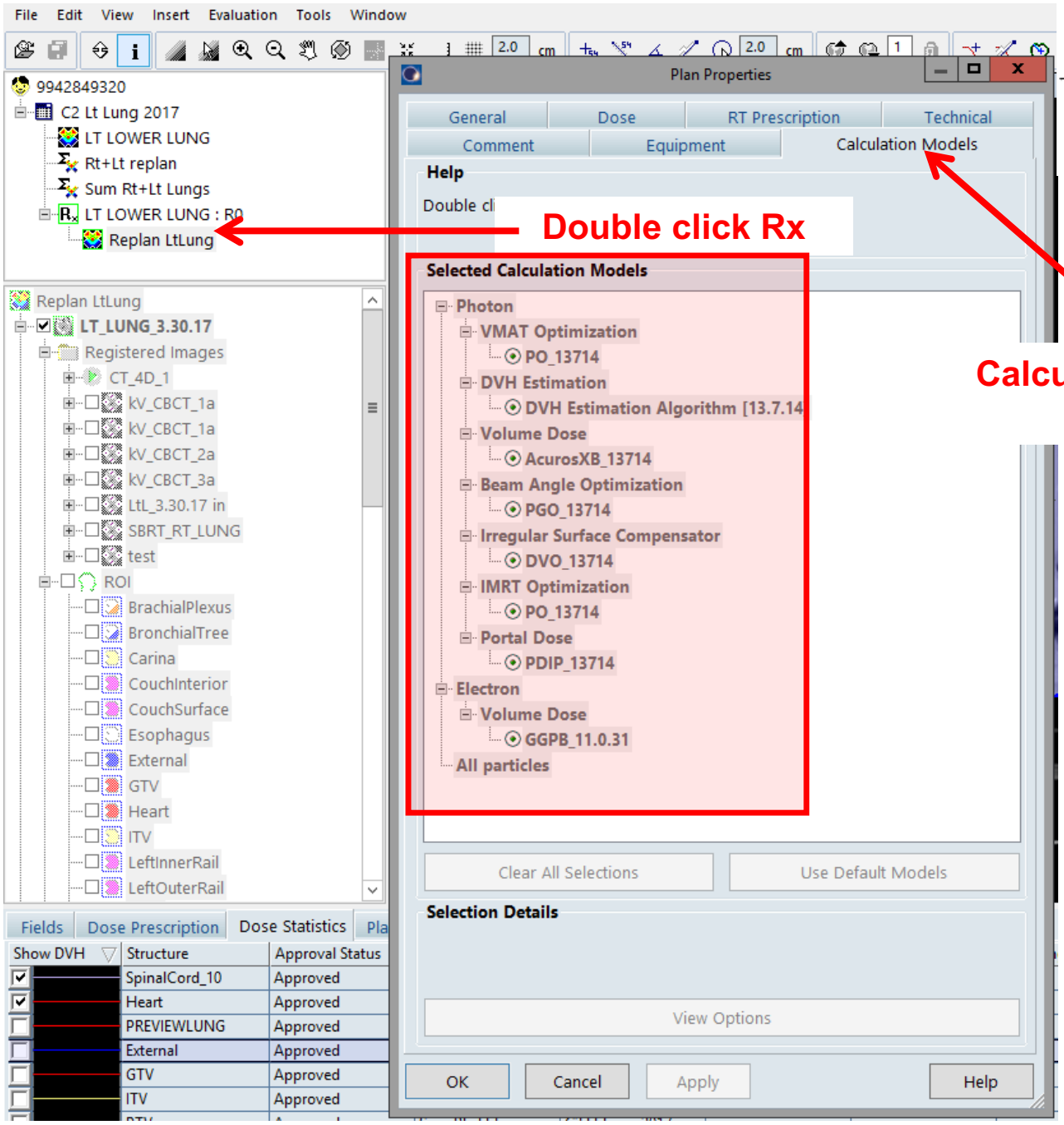
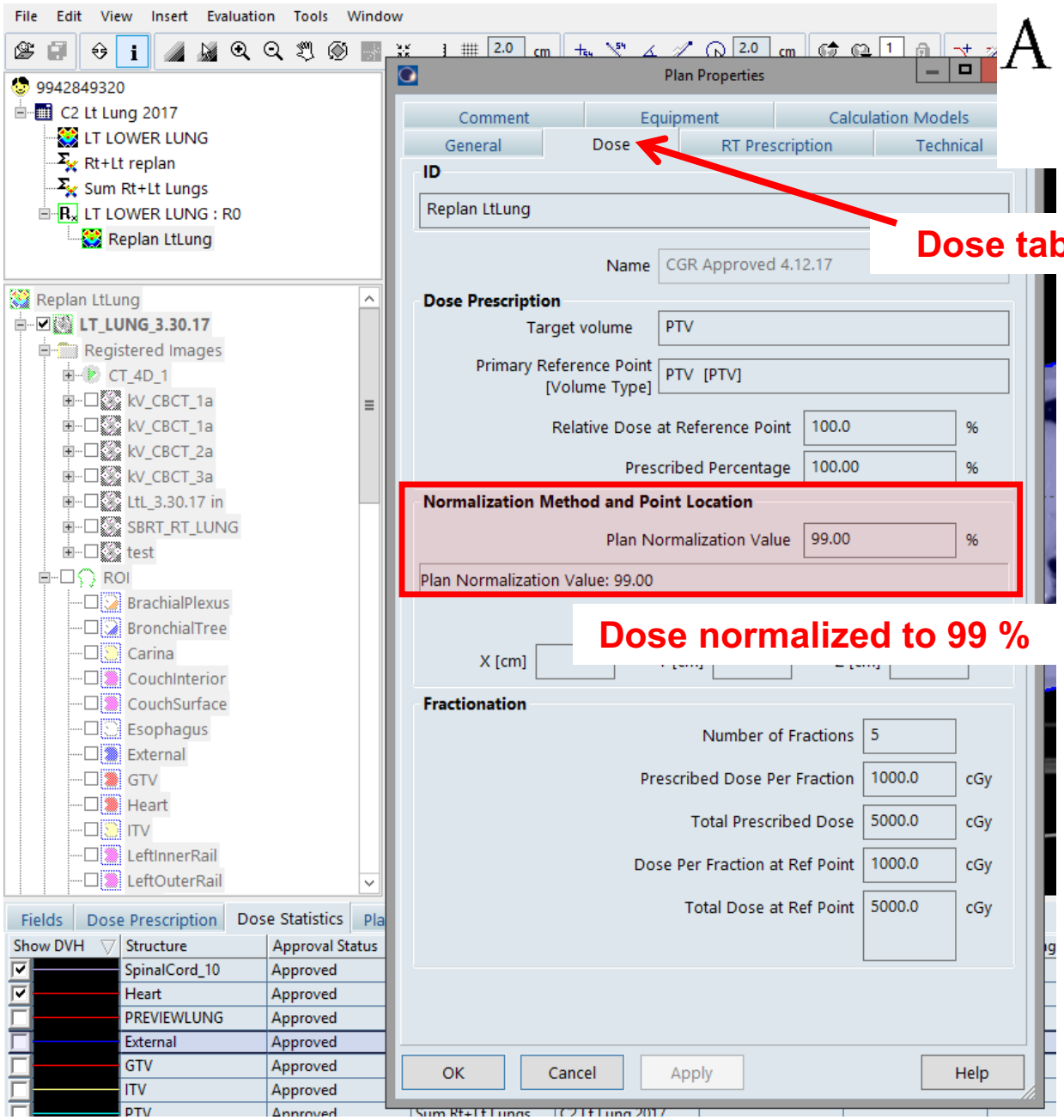
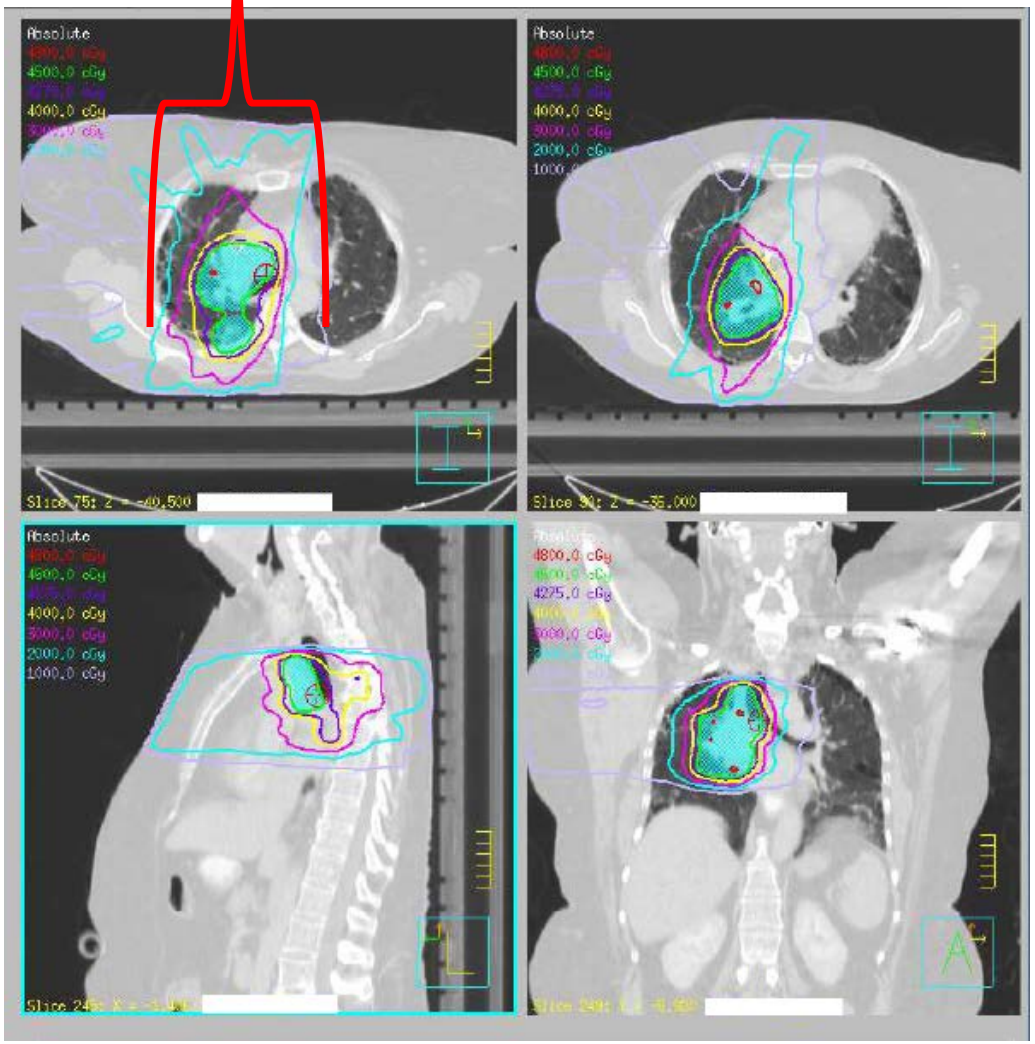

File Edit View Insert Evaluation Tools Window
9942849320
C2 Lt Lung 2017
LT LOWER LUNG
Rt+Lt replan
Sum Rt+Lt Lungs
LT LOWER LUNG : R0
Replan LtLung
Double click Rx
Plan Properties
General
Dose
RT Prescription
Technical
Comment
Equipment
Calculation Models
Help
Double cl
Selected Calculation Models
Photon
VMAT Optimization
PO_13714
DVH Estimation
DVH Estimation Algorithm [13.7.14]
Volume Dose
AcurosXB_13714
Beam Angle Optimization
PGO_13714
Irregular Surface Compensator
DVO_13714
IMRT Optimization
PO_13714
Portal Dose
PDIP_13714
Electron
Volume Dose
GGPB_11.0.31
All particles
Clear All Selections
Use Default Models
Selection Details
View Options
OK
Cancel
Apply
Help
Calculation Models tab
Replan LtLung
LT_LUNG_3.30.17
Registered Images
CT_4D_1
kV_CBCT_1a
kV_CBCT_1a
kV_CBCT_2a
kV_CBCT_3a
LtL_3.30.17 in
SBRT_RT_LUNG
test
ROI
BrachialPlexus
BronchialTree
Carina
CouchInterior
CouchSurface
Esophagus
External
GTV
Heart
ITV
LeftInnerRail
LeftOuterRail
Fields
Dose Prescription
Dose Statistics
Show DVH
Structure
Approval Status
SpinalCord_10 Approved
Heart Approved
PREVIEWLUNG Approved
External Approved
GTV Approved
ITV Approved

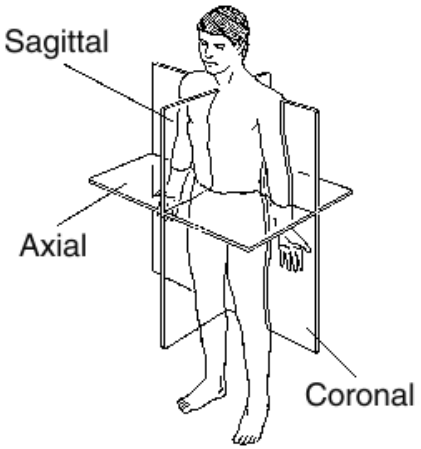

File Edit View Insert Evaluation Tools Window
9942849320
C2 Lt Lung 2017
LT LOWER LUNG
Rt+Lt replan
Sum Rt+Lt Lungs
LT LOWER LUNG : R0
Replan LtLung
Replan LtLung
LT_LUNG_3.30.17
Registered Images
CT_4D_1
kV_CBCT_1a
kV_CBCT_1a
kV_CBCT_2a
kV_CBCT_3a
LtL_3.30.17 in
SBRT_RT_LUNG
test
ROI
BrachialPlexus
BronchialTree
Carina
CouchInterior
CouchSurface
Esophagus
External
GTV
Heart
ITV
LeftInnerRail
LeftOuterRail
Fields
Dose Prescription
Dose Statistics
Show DVH
Structure
Approval Status
SpinalCord_10 Approved
Heart Approved
PREVIEWLUNG Approved
External Approved
GTV Approved
ITV Approved
PTV Approved
Plan Properties
Comment
Equipment
Calculation Models
General
Dose
RT Prescription
Technical
ID
Replan LtLung
Name
CGR Approved 4.12.17
Dose Prescription
Target volume
PTV
Primary Reference Point [Volume Type]
PTV [PTV]
Relative Dose at Reference Point
100.0
%
Prescribed Percentage
100.00
%
Normalization Method and Point Location
Plan Normalization Value
99.00
%
Plan Normalization Value: 99.00
X [cm]
Fractionation
Number of Fractions
5
Prescribed Dose Per Fraction
1000.0
cGy
Total Prescribed Dose
5000.0
cGy
Dose Per Fraction at Ref Point
1000.0
cGy
Total Dose at Ref Point
5000.0
cGy
OK
Cancel
Apply
Help
Dose tab
Dose normalized to 99 %

Color Isodose Distributions in axial, sagittal and coronal planes (composite plan) (Only required if Digital RT plan not submitted)

axial

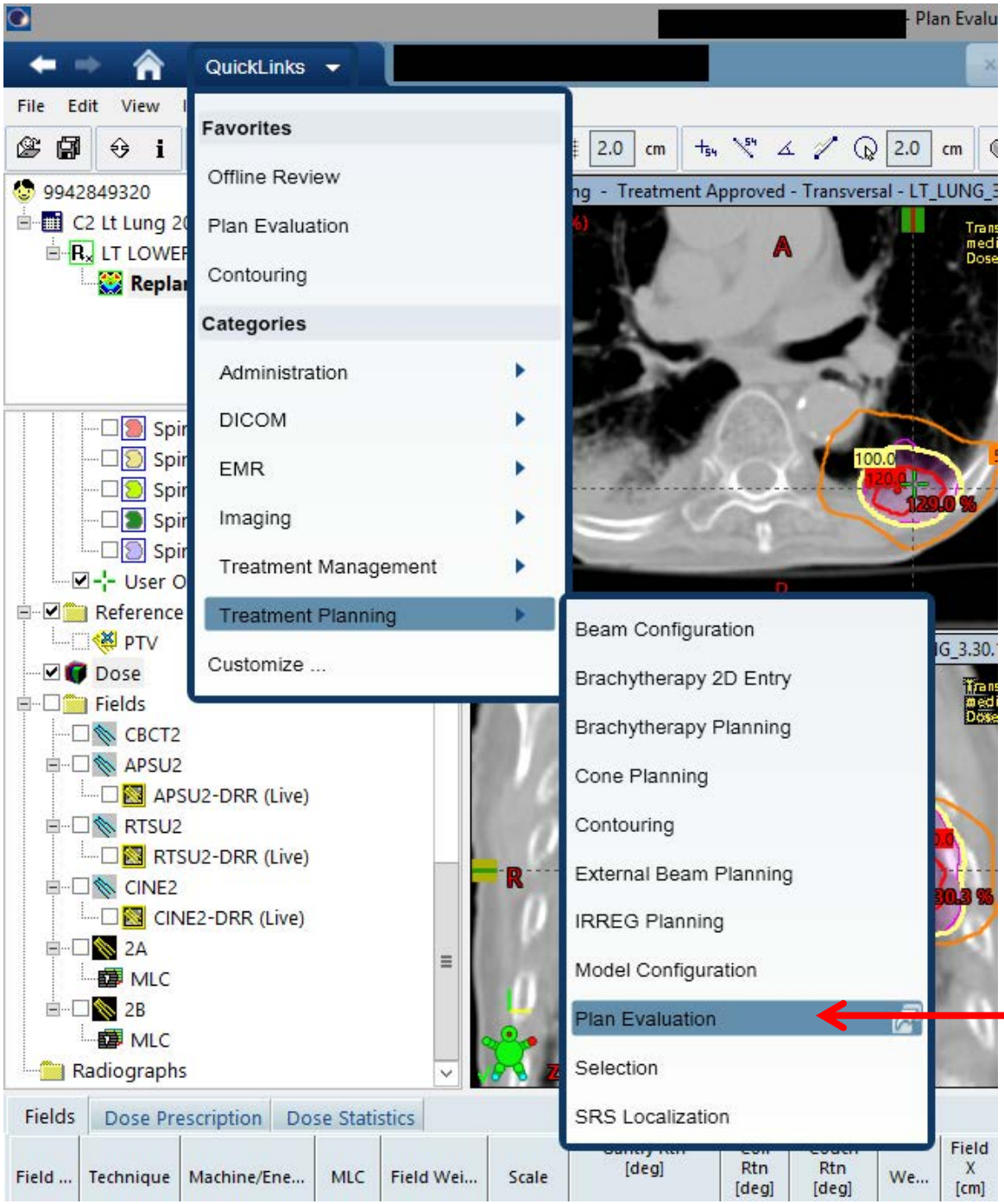


axial

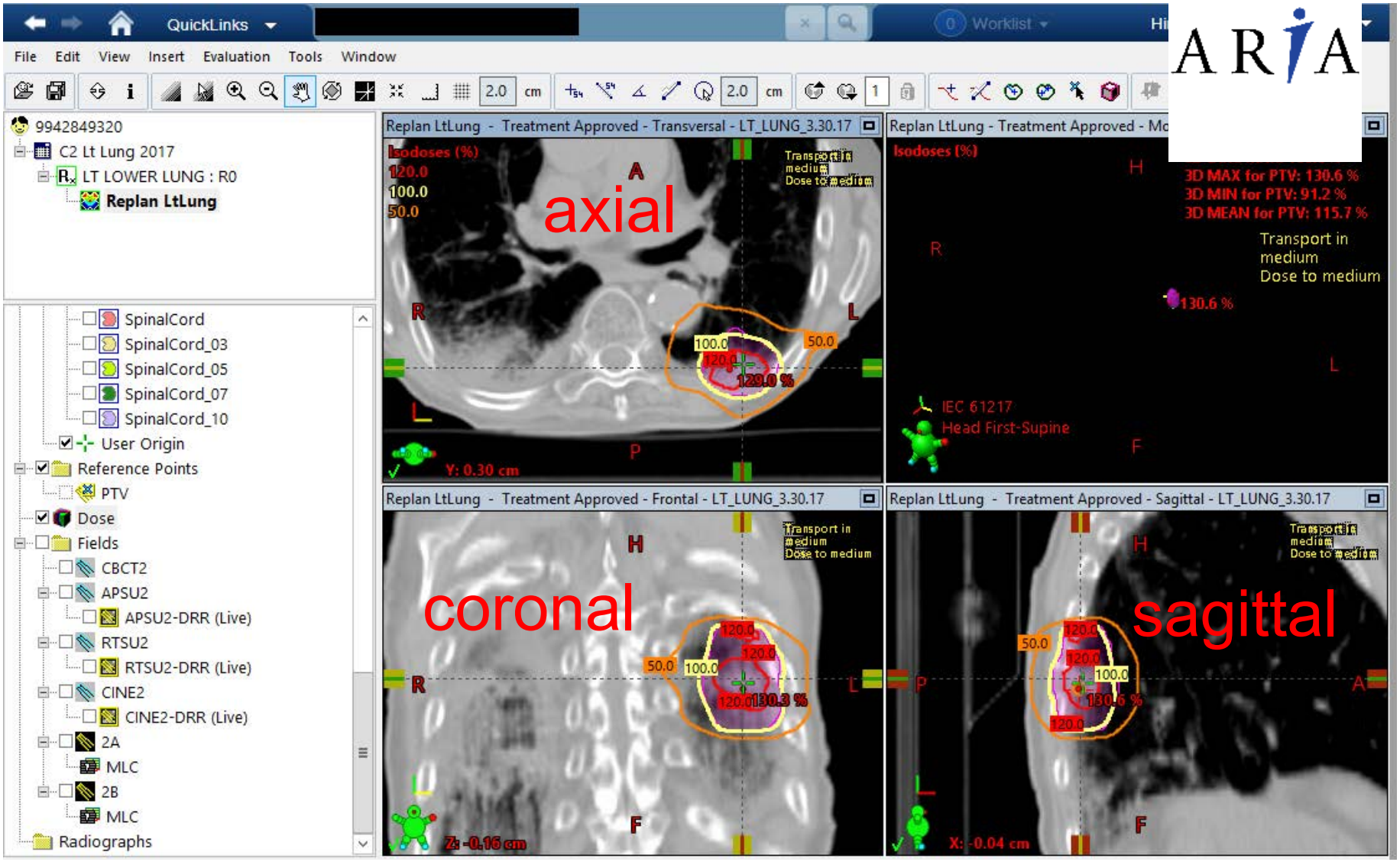


sagittal

coronal



Plan evaluation



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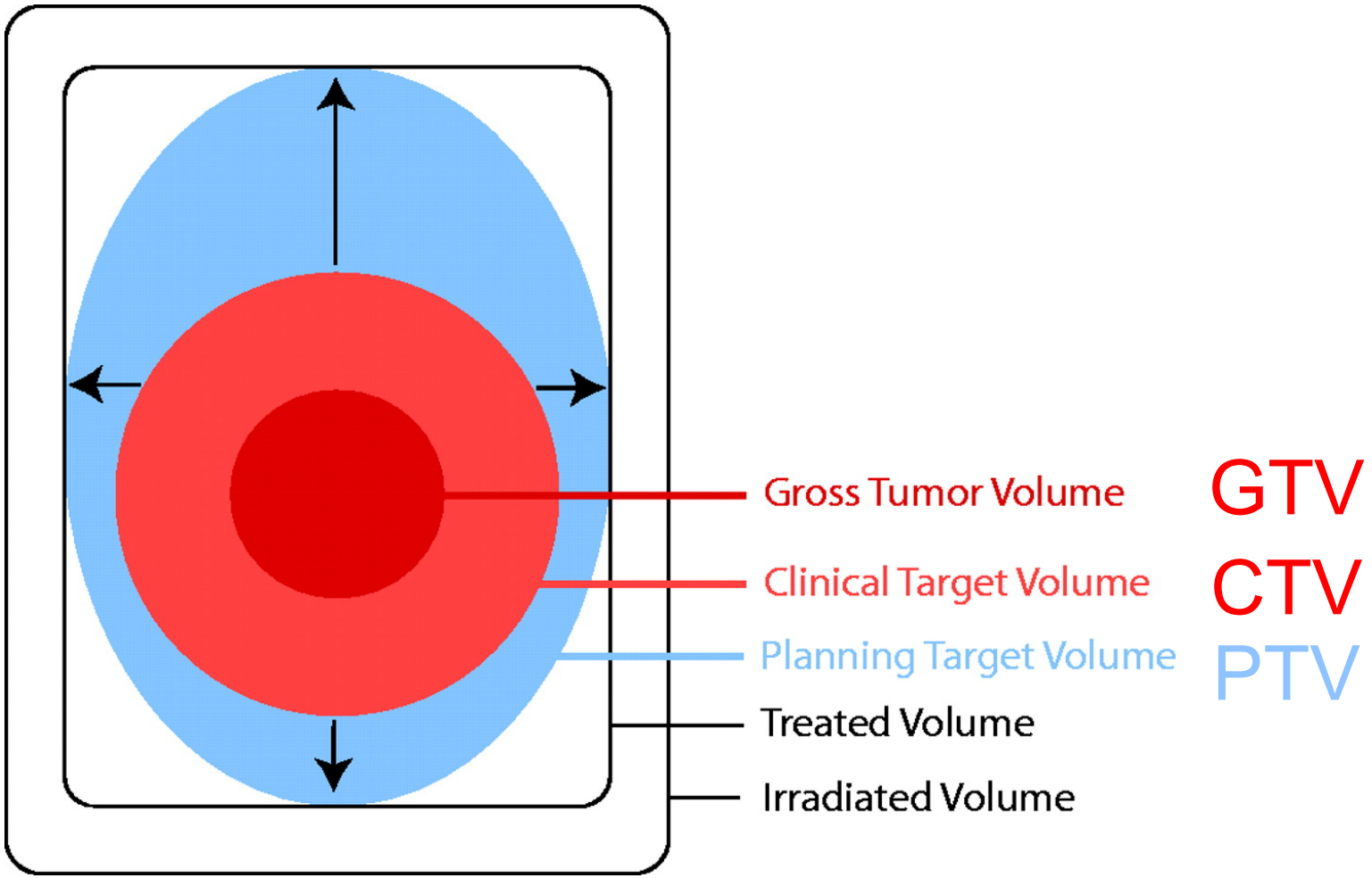
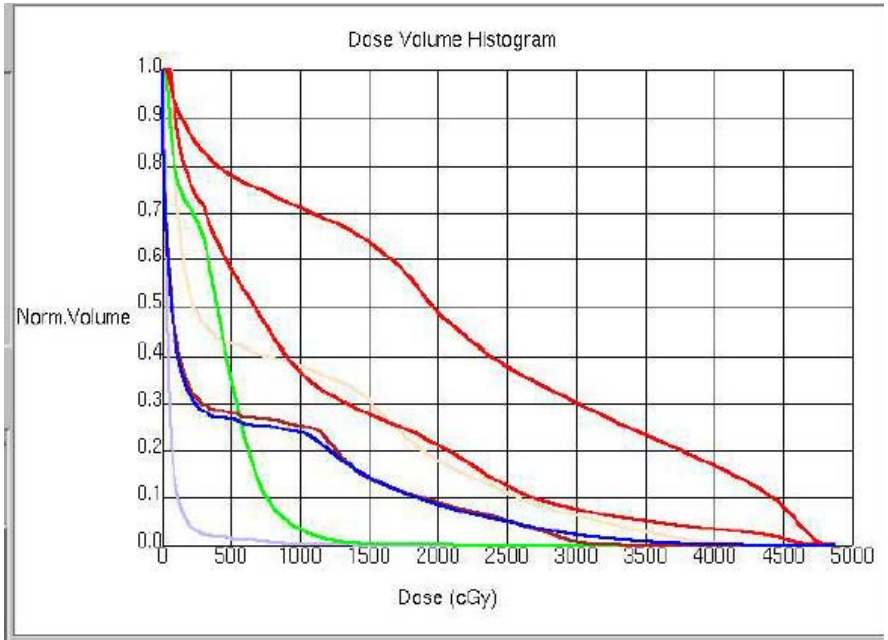
FOR CLINICAL TRIALS IN ONCOLOGY

Dose volume histograms (DVH) of PTV, CTV, GTV, Lungs, Heart, Esophagus and Spinal Cord. If IMRT is used, a DVH of unspecified tissue. These will be included with the digital RT plan.



ALLIANCE
FOR CLINICAL TRIALS IN ONCOLOGY

Dose volume histograms (DVH) of PTV, CTV, GTV, Lungs, Heart, Esophagus and Spinal Cord. If IMRT is used, a DVH of unspecified tissue. These will be included with the digital RT plan.



ROI Statistics

Line Type	ROI	Trial	Min.	Max.	Mean	Std. Dev.
	Esophagus	CGR_APPRVD	59.9	4166.5	920.0	1061.7
	Heart	CGR_APPRVD	47.6	4777.8	1084.0	1108.8
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	Lung_L	CGR_APPRVD	17.6	2114.1	404.9	281.7
	Lung_R	CGR_APPRVD	18.4	4870.6	2110.2	1496.1
	SpinalCord	CGR_APPRVD	0.6	3320.7	522.3	817.6
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PHILIPS

Pinnacle^3

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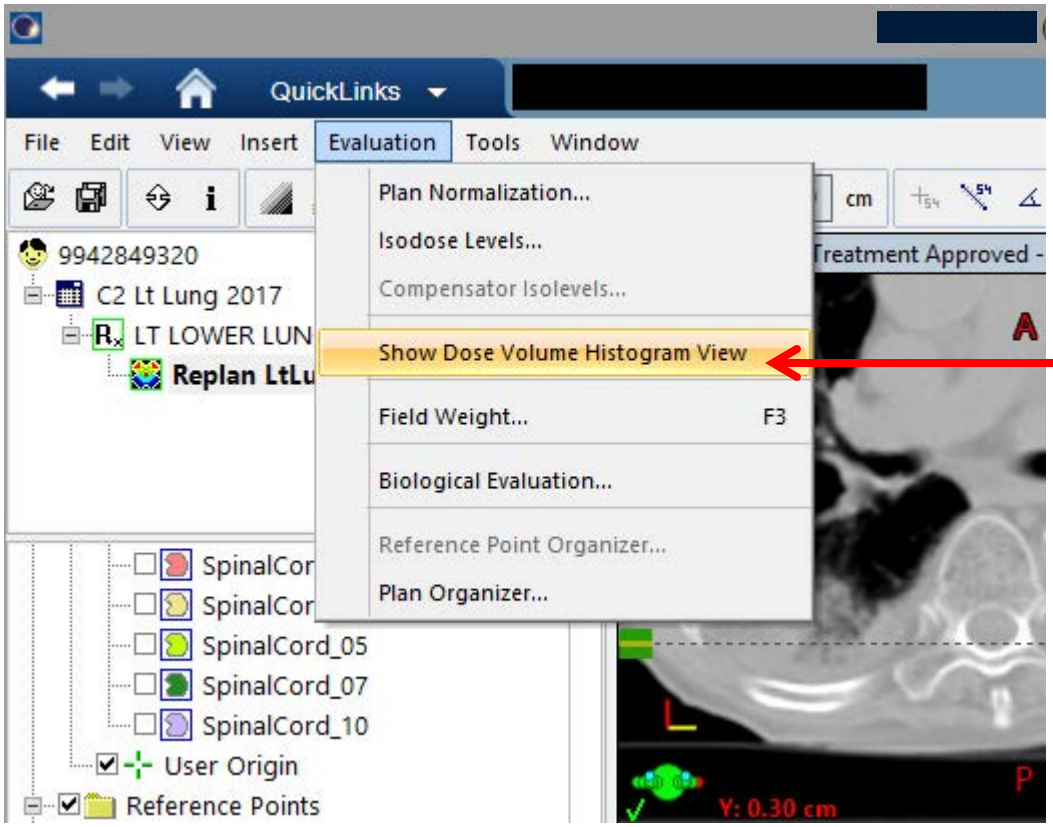
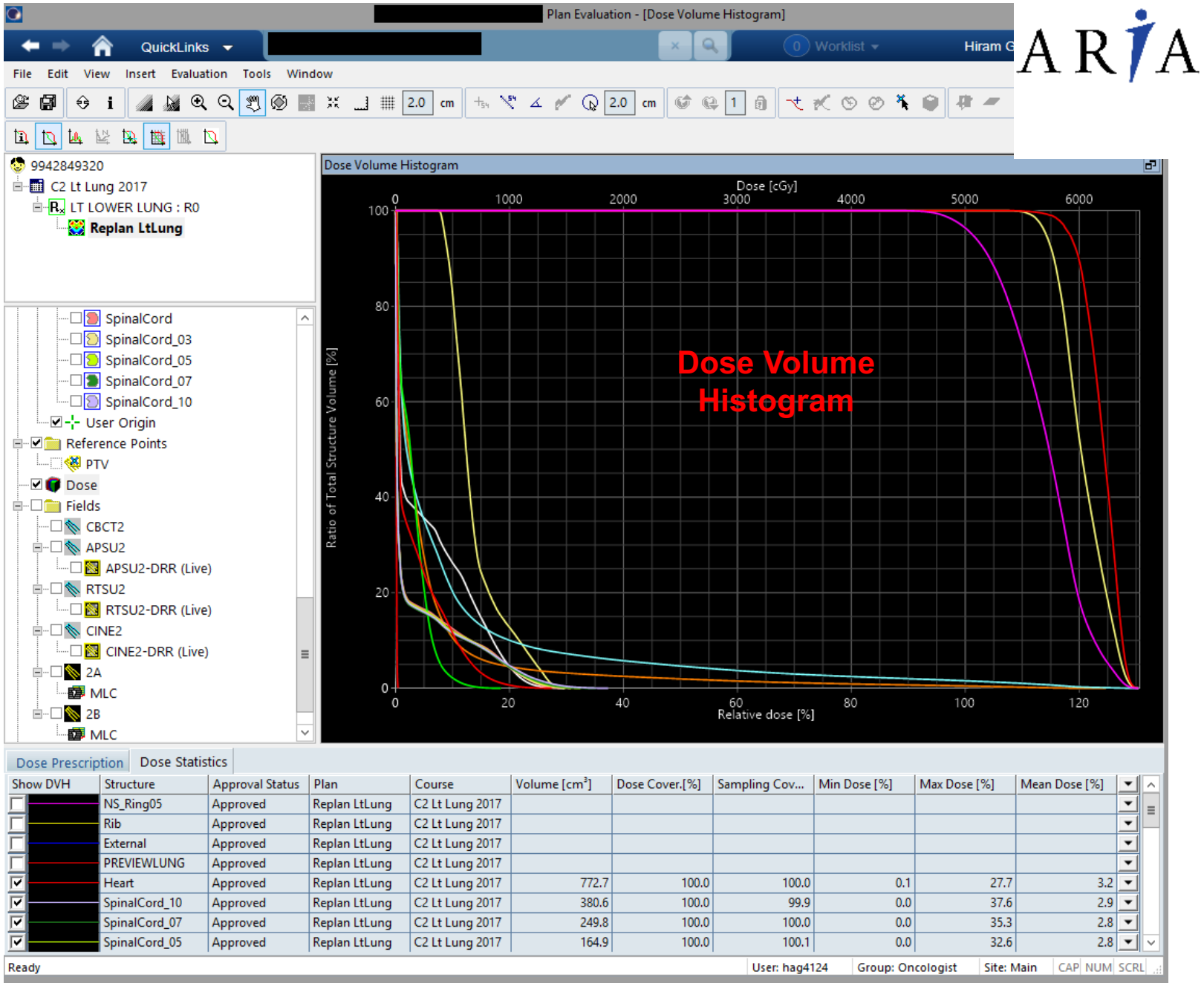


Dose Volume Histogram View



Show DVH	Structure	Approval Status	Plan	Course	Volume [cm³]	Dose Cover.[%]	Sampling Cov...	Min Dose [%]	Max Dose [%]	Mean Dose [%]
☐	NS_Ring05	Approved	Replan LtLung	C2 Lt Lung 2017						
☐	Rib	Approved	Replan LtLung	C2 Lt Lung 2017						
☐	External	Approved	Replan LtLung	C2 Lt Lung 2017						
☐	PREVIEWLUNG	Approved	Replan LtLung	C2 Lt Lung 2017						
☑	Heart	Approved	Replan LtLung	C2 Lt Lung 2017	772.7	100.0	100.0	0.1	27.7	3.2
☑	SpinalCord_10	Approved	Replan LtLung	C2 Lt Lung 2017	380.6	100.0	99.9	0.0	37.6	2.9
☑	SpinalCord_07	Approved	Replan LtLung	C2 Lt Lung 2017	249.8	100.0	100.0	0.0	35.3	2.8
☑	SpinalCord_05	Approved	Replan LtLung	C2 Lt Lung 2017	164.9	100.0	100.1	0.0	32.6	2.8

Portal films (or hard copy of real time portal images) of each treatment field

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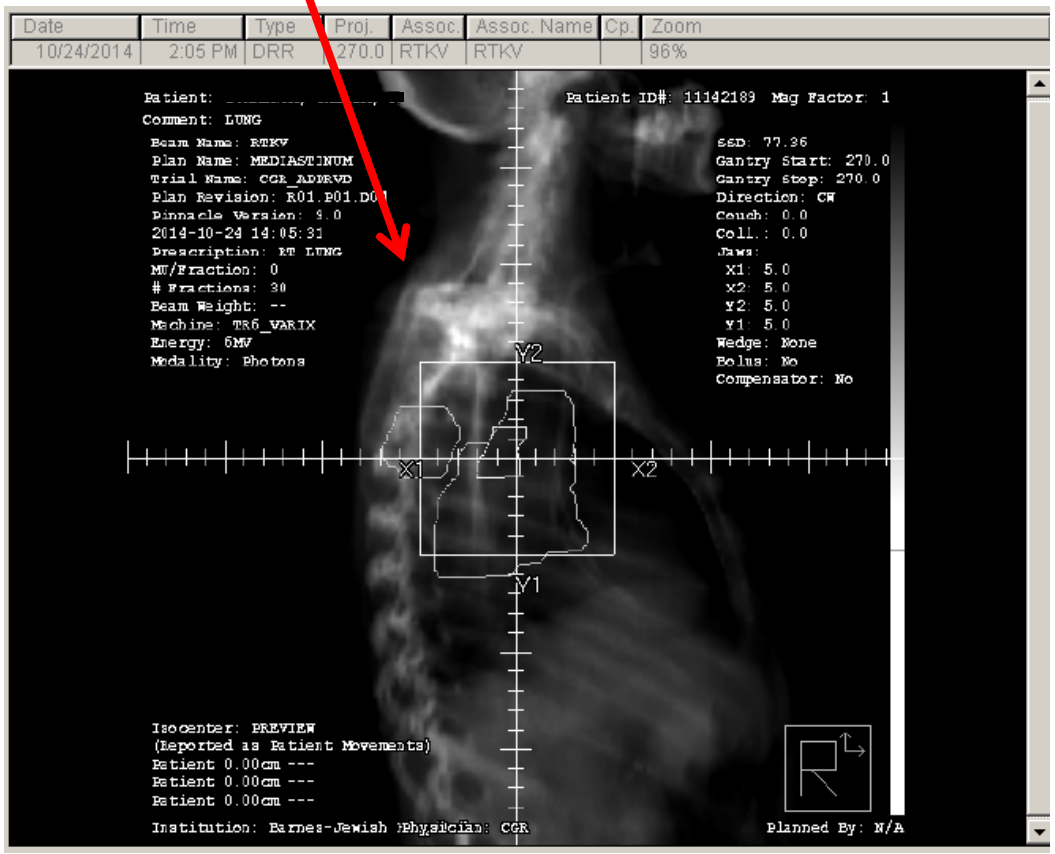
DRRs (digitally reconstructed radiographs) of each treatment field



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Orthogonal Anterior/Posterior and Lateral Films if not part of portals

- For IMRT all you get is one Anterior/Posterior (AP) film (or PA), and one either right (RT) or left (LT) lateral film to document the isocenter.
- For 3D conformal treatments you get a the films above to document the isocenter, and films with the shape of each fields (at least 2). Simplest arrangement would be 2 fields: AP/PA

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A word on motion management

- Refers to different techniques to account for tumor motion and ensure we don’t miss hitting the target
- Very important in organs that move, especially the lung and liver that can move a lot during breathing

ALLIANCE
FOR CLINICAL TRIALS IN ONCOLOGY

A word on motion management

- Some techniques:
  - Tracking the tumor and moving:
    - The beam (Cyberknife)

    - The patient (robotic couch)
    - MLC (multileaf collimator)

    - Monitoring the breathing cycle
    - Gating (turning on and off the beam when tumor moves the least in respiratory cycle)
    - Active breathing control

ALLIANCE
FOR CLINICAL TRIALS IN ONCOLOGY

For thoracic IMRT, motion management description required

IROC
IMAGING AND RADIATION ONCOLOGY CORE
Global Leaders in Clinical Trial Quality Assurance

Motion Management Reporting Form

IROC Rhode Island QA Center (QARC)
Building B, Suite 201
640 George Washington Highway
Lincoln, RI 02865-4207
Phone (401) 753-7600
Fax: (401) 753-7601
www.irori.qarc.org

Coop Group: Alliance | *Protocol #: CALGB30610 | *Registration #.: 136823
PT initials: T,SK | Date of birth: Aug 25, 1958 | Sex: M ____ F ✓
Radiotherapy Dept.: Barnes Jewish Hospital | Radiation Oncologist: Cliff Robinson
Physicist/ Dosimetrist: V. Rodriguez/ A. Lindsey | Phone: 314-362-4633

I. Assessment of Lesion Motion due to Respiration

A. How did you assess motion of the lesion with respiration for this patient?

____ fluoroscopy ✓ 4D CT ____ inspiration/expiration fast-CT scan
____ other: Please describe: _____

B. What was used to assess the motion?

✓ lesion itself
____ anatomic correlates: ___ diaphragm ___ chest wall
____ other: Please specify: _____
____ implanted fiducial markers: How many? ____ What size? ____ mm
____ other: Please specify: _____

C. Maximum tumor excursion in any direction prior to motion management: 0.5 cm

WashU MD orders

Simulation	CT
Planning	IMRT (Preport or Start day 10), 4D Bellows

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FOR CLINICAL TRIALS IN ONCOLOGY

For thoracic IMRT, motion management description required

II. Method used for managing motion of the lesion with respiration?

- ____ free breathing with increased margins for PTV definition
- ____ forced shallow breathing using abdominal compression
- ____ gating of treatment with breathing cycle
  - ____ active breathing control (ABC)
  - ____ self-held breath-hold with respiratory monitoring (e.g., RPM)
  - ____ gating during free breathing using external monitors or implanted fiducials
  - ✓ other: Please describe: MIP
- ____ tracking motion by
  - ____ moving the beam (e.g. Cyberknife)
  - ____ moving the MLC's
  - ____ moving the patient to follow the target

Commercial system, if applicable _____

III. Definition of Margins

Maximum tumor excursion in any direction following motion management: 0.5 cm

PTV Margins: Ant/Post 0.5 mm Rt/Lt 0.5 mm Sup/Inf 0.5 mm

WashU MD orders

Prescription Information

	Description	Total Dose (cGy)	Daily Dose (cGy)	CTV/ITV to PTV Margin (CM)	Block Margin (cm)
PTV1/Initial Field					
PTV		4500	150 BID	?	

ALLIANCE FOR CLINICAL TRIALS IN ONCOLOGY

RT-1 or IMRT Dosimetry Form

Treatment Technique

Check off all that apply: ___ 3D Conformal ___ TomoTherapy ✓ IMRT (SMLC or DMLC)
___ Rotational IMRT ___ Motion Management ___ IGRT
___ Other _____

➢ Note: If Protons are used for treatment, please use the Proton Reporting form instead.

Heterogeneity Calculations: ✓ Yes ___ No Bolus Thickness if used: n/a cm
Treatment Planning System Pinnacle Patient Position supine

➢ ***Must*** Include Treatment Planning System Summary Reports (which includes monitor unit calculations, beam parameters, calculation algorithm and volume of interest dose statistics pages) with data submission.

Protocol Treatment Site	Target Volume Name	Daily Dose (cGy)	Total Number of Fractions	Total Dose (cGy)	Prescription Isodose Surface (e.g. 95%)	Number of Beams	Beam energy (e.g.6X, 6e)
Phase #1	PTV_4500	150	30	4500	96.7%	9	6X
Phase #2							
Phase #3							
Intended Total			30	4500			

WashU MD orders

Patient Position:

Patient Position	Supine
Head Position	Neutral
Arm Position	Above Head
Wire	None
Special Treatment Aid Devices	None
Probe	None

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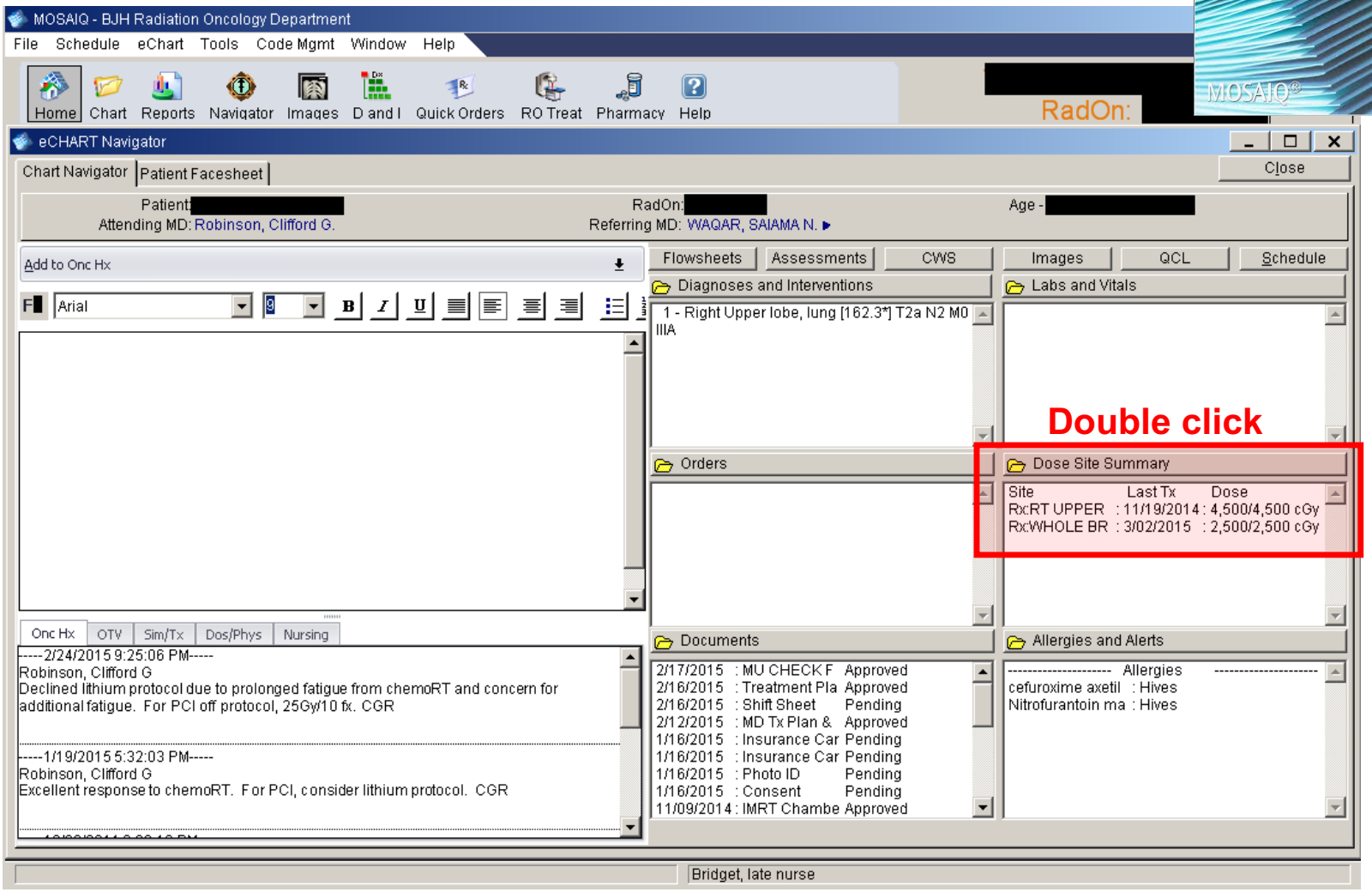
Prescriptions

RT LUNG

Prescribe 150 cGy per fraction to 96.7 % of "PTV" mean dose for 30 fractions.
Actual "PTV" mean dose from all prescriptions/beams is 4646.99 cGy.
9 beams are assigned to this prescription.
PRESCRIPTION EXCEEDS MACHINE LIMITATIONS ++

ALLIANCE FOR CLINICAL TRIALS IN ONCOLOGY

Completed RT Daily Treatment Chart, including prescription, daily and cumulative doses



Completed RT Daily Treatment Chart, including prescription, daily and cumulative doses

Session			Setup / Field								Notes						Sts	By	2:Rx:WHOLE BRAIN				1:Rx:R T LOWER LUNG			
No	Date	Time	ID	Tx	ED	Seq	PI	Meterset	Dose	Machine	T	S	P	F	D	C			Fx	ED	Dly	Cum	Fx	ED	Dly	Cum
2		16:50	7Flds				2PIs			TrueBeamTF		S	P					JMB/JK					2		150 cGy	300 cGy
3	10/29/2014	7:16	7Flds				2PIs			TrueBeamTF		S	P					HML/JLN					3	1	150 cGy	450 cGy
4		14:25	7Flds				2PIs			TR4_TRILOC		S	P					MMA/EB					4	1	150 cGy	600 cGy
5	10/30/2014	7:53	7Flds				2PIs			VARIX_TR6		S	P					PS/RW					5	2	150 cGy	750 cGy
6		15:04	7Flds				2PIs			VARIX_TR6	T	S	P					RW/PS					6	2	150 cGy	900 cGy
7	10/31/2014	7:17	7Flds				2PIs			TR4_TRILOC		S	P					MMA/EB					7	3	150 cGy	1,050 cGy
8		14:13	7Flds				2PIs			TR4_TRILOC		S	P					MMA/KDL					8	3	150 cGy	1,200 cGy
9	11/04/2014	7:19	7Flds				2PIs			VARIX_TR6		S	P					RW/SAV					9	7	150 cGy	1,350 cGy
10		16:15	7Flds				2PIs			VARIX_TR6		S	P										10	7	150 cGy	1,500 cGy
11	11/05/2014	9:08	7Flds				2PIs			TrueBeamTF		S	P					MM/MMA					11	8	150 cGy	1,650 cGy
12		15:39	7Flds				2PIs			TrueBeamTF		S	P					HML/MM					12	8	150 cGy	1,800 cGy
13	11/06/2014	7:16	7Flds				2PIs			VARIX_TR6		S	P					PS/SAV					13	9	150 cGy	1,950 cGy
14		16:41	7Flds				2PIs			VARIX_TR6		S	P					SAV/PS					14	9	150 cGy	2,100 cGy
15	11/07/2014	9:28	7Flds				2PIs			TrueBeamTF		S	P					MMA/AK					15	10	150 cGy	2,250 cGy
16		15:39	7Flds				2PIs			VARIX_TR6		S	P					SAV/EJW					16	10	150 cGy	2,400 cGy
QA	11/09/2014	11:24	7Flds							TrueBeamTF	T	S														
17	11/10/2014	6:50	7Flds				2PIs			VARIX_TR6		S	P					PS/RW					17	13	150 cGy	2,550 cGy
18		15:48	7Flds				2PIs			TR3_TRILOC		S	P					KLL/JLN					18	13	150 cGy	2,700 cGy
19	11/11/2014	6:58	7Flds				2PIs			VARIX_TR6		S	P					JXH/RW					19	14	150 cGy	2,850 cGy
20		15:45	7Flds				2PIs			VARIX_TR6		S	P					SAV/RW					20	14	150 cGy	3,000 cGy
21	11/12/2014	6:53	7Flds				2PIs			VARIX_TR6		S	P					PS/RCM					21	15	150 cGy	3,150 cGy
22		15:34	7Flds				2PIs			VARIX_TR6		S	P					PS/JMB					22	15	150 cGy	3,300 cGy
23	11/13/2014	7:28	7Flds				2PIs			VARIX_TR6		S	P					PS/JXH					23	16	150 cGy	3,450 cGy
24		15:14	7Flds				2PIs			VARIX_TR6		S	P					JXH/PS					24	16	150 cGy	3,600 cGy
25	11/14/2014	7:44	7Flds				2PIs			VARIX_TR6		S	P					PS/JXH					25	17	150 cGy	3,750 cGy
26		16:01	7Flds				2PIs			TrueBeamTF		S	P					JMB/AK					26	17	150 cGy	3,900 cGy
27	11/17/2014	7:02	7Flds				2PIs			VARIX_TR6		S	P					RW/SAV					27	20	150 cGy	4,050 cGy
28		13:09	7Flds				2PIs			VARIX_TR6		S	P					RW/SAV					28	20	150 cGy	4,200 cGy
29	11/18/2014	7:28	7Flds				2PIs			TR3_TRILOC		S	P					JLN/CS					29	21	150 cGy	4,350 cGy
30	11/19/2014	7:01	7Flds				2PIs			TR3_TRILOC		S	P					RMK/JLN					30	22	150 cGy	4,500 cGy

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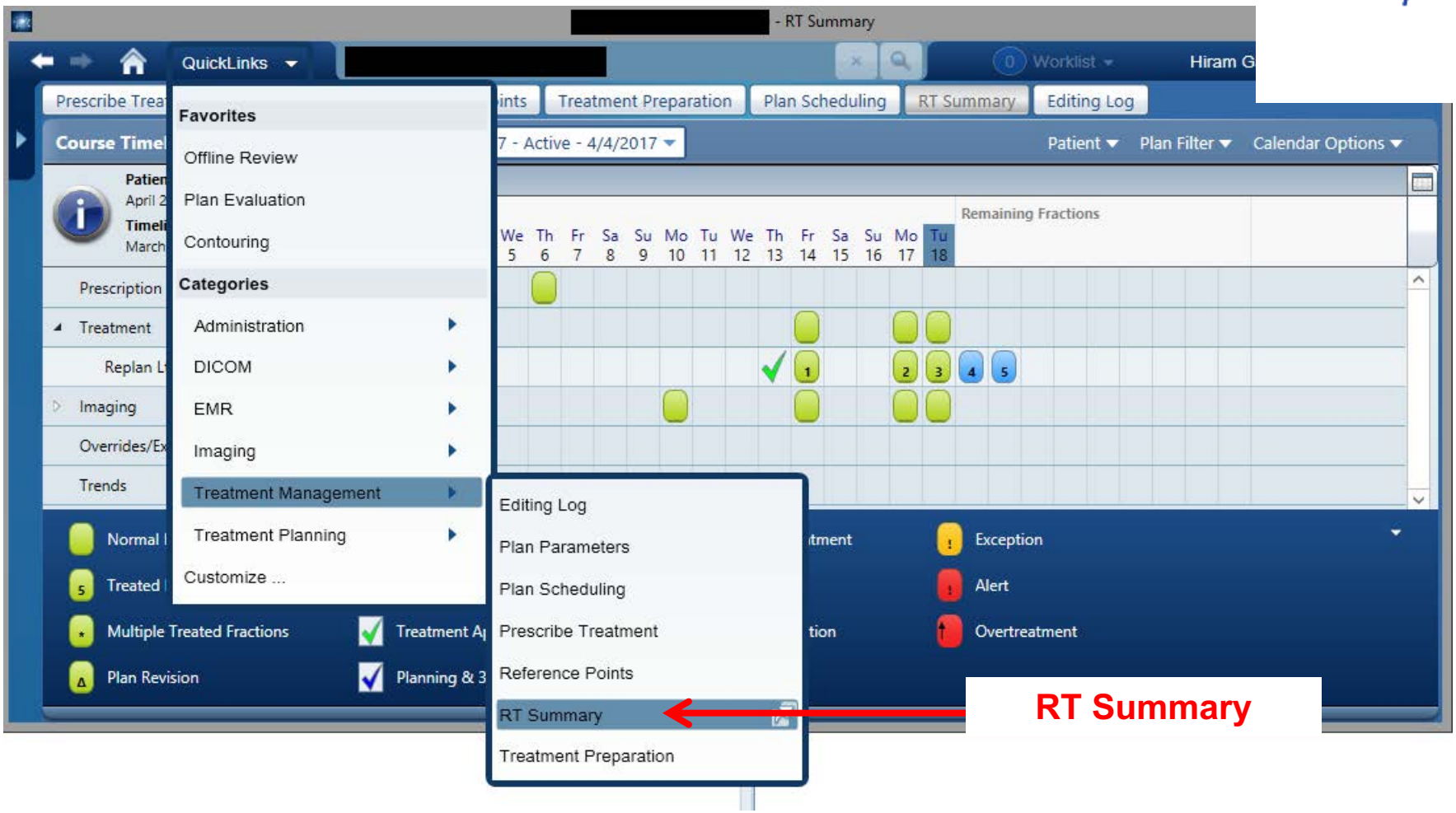
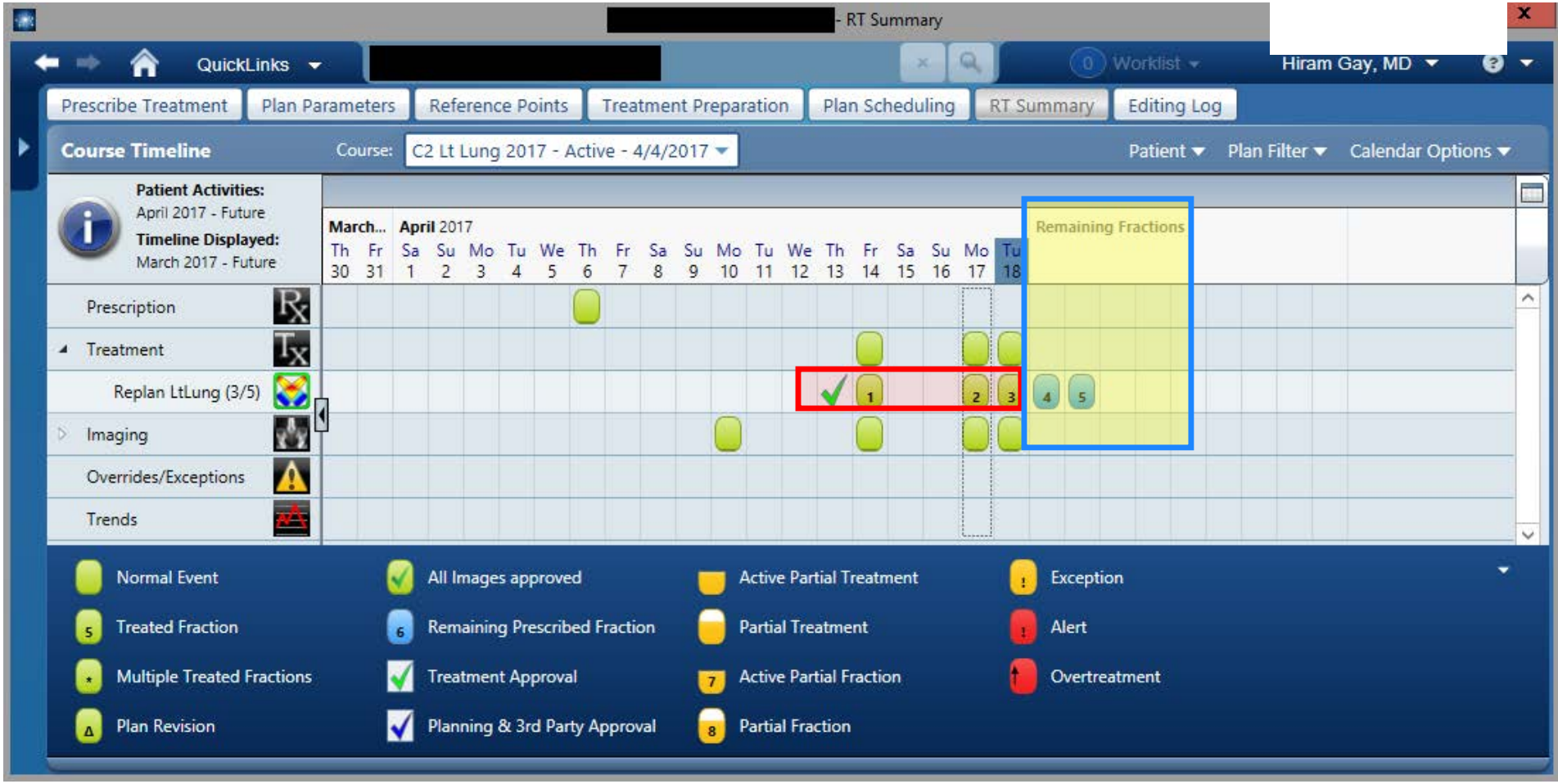
FOR CLINICAL TRIALS IN ONCOLOGY


- RT Summary
QuickLinks
Worklist
Hiram G
Prescribe Trea
Treatment Preparation
Plan Scheduling
RT Summary
Editing Log
Course Timel
7 - Active - 4/4/2017
Patient
Plan Filter
Calendar Options
Remaining Fractions
We Th Fr Sa Su Mo Tu We Th Fr Sa Su Mo Tu
5 6 7 8 9 10 11 12 13 14 15 16 17 18
Prescription
Treatment
Replan L
Imaging
Overrides/Ex
Trends
Favorites
Offline Review
Plan Evaluation
Contouring
Categories
Administration
DICOM
EMR
Imaging
Treatment Management
Treatment Planning
Customize ...
Editing Log
Plan Parameters
Plan Scheduling
Prescribe Treatment
Reference Points
RT Summary
Treatment Preparation
Normal
Treated
Multiple Treated Fractions
Plan Revision
Exception
Alert
Overtreatment
RT Summary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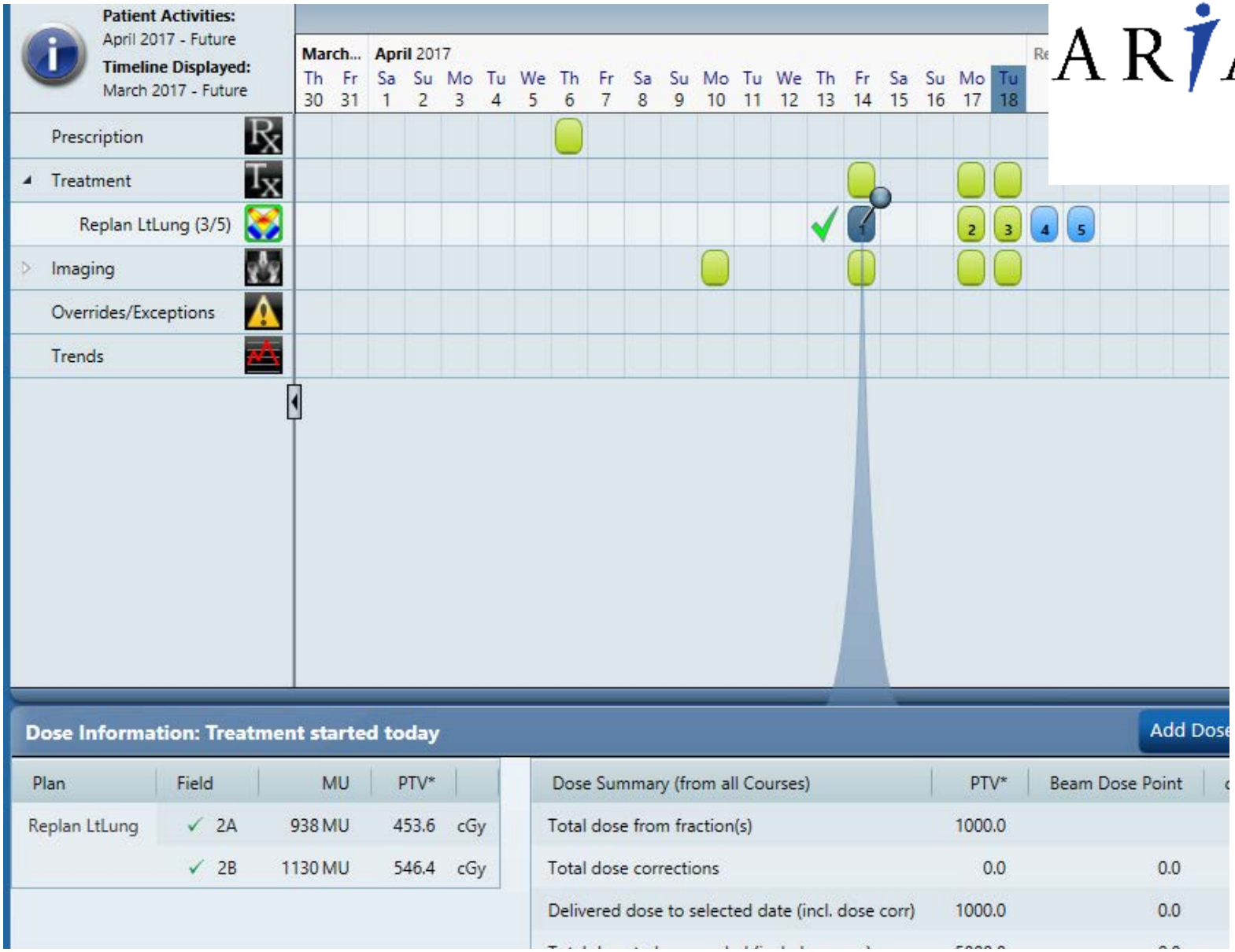
QuickLinks
[redacted]
Worklist
Hiram Gay, MD
Prescribe Treatment
Plan Parameters
Reference Points
Treatment Preparation
Plan Scheduling
RT Summary
Editing Log
Course Timeline
Course: C2 Lt Lung 2017 - Active - 4/4/2017
Patient
Plan Filter
Calendar Options
Patient Activities:
April 2017 - Future
Timeline Displayed:
March 2017 - Future
March... April 2017
Th 30 Fr 31 Sa 1 Su 2 Mo 3 Tu 4 We 5 Th 6 Fr 7 Sa 8 Su 9 Mo 10 Tu 11 We 12 Th 13 Fr 14 Sa 15 Su 16 Mo 17 Tu 18
Remaining Fractions
Prescription
Treatment
Replan LtLung (3/5)
Imaging
Overrides/Exceptions
Trends
Normal Event
All Images approved
Active Partial Treatment
Exception
Treated Fraction
Remaining Prescribed Fraction
Partial Treatment
Alert
Multiple Treated Fractions
Treatment Approval
Active Partial Fraction
Overtreatment
Plan Revision
Planning & 3rd Party Approval
Partial Fraction


Patient Activities:
April 2017 - Future
Timeline Displayed:
March 2017 - Future
March...
April 2017
Th 30
Fr 31
Sa 1
Su 2
Mo 3
Tu 4
We 5
Th 6
Fr 7
Sa 8
Su 9
Mo 10
Tu 11
We 12
Th 13
Fr 14
Sa 15
Su 16
Mo 17
Tu 18
Prescription
Treatment
Replan LtLung (3/5)
Imaging
Overrides/Exceptions
Trends
Dose Information: Treatment started today
Add Dose
Plan
Field
MU
PTV*
Replan LtLung
2A
938 MU
453.6
cGy
2B
1130 MU
546.4
cGy
Dose Summary (from all Courses)
PTV*
Beam Dose Point
Total dose from fraction(s)
1000.0
Total dose corrections
0.0
0.0
Delivered dose to selected date (incl. dose corr)
1000.0
0.0

RT-2 Total Dose Record

List Names Of Target Volumes Corresponding To Those On RT-1 Forms, Record Boost Volumes Separately			
Name of Target Volume (i.e. PTV1, Chest)	PTV4500		
Date of First Treatment to the Target Volume	Oct 28, 2014		
Number of Treatments	30		
Date of Last Treatment	Nov 19, 2014		
Total Dose To Treatment Point (Central Axis)	4500		

Critical Structure		Max Dose	Critical Structure		Max Dose
A.	Spinal Cord	3320.7	D.	Heart	4777.8
B.	Lung_L	2114.1	E.	Esophagus	4168.5
C.	Lung_R	4870.6	F.		

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ROI Statistics

Line Type	ROI	Type	Min.	Max.	Mean	Std. Dev.
	Esophagus	CGR_APPRVD	59.9	4168.5	920.0	1061.7
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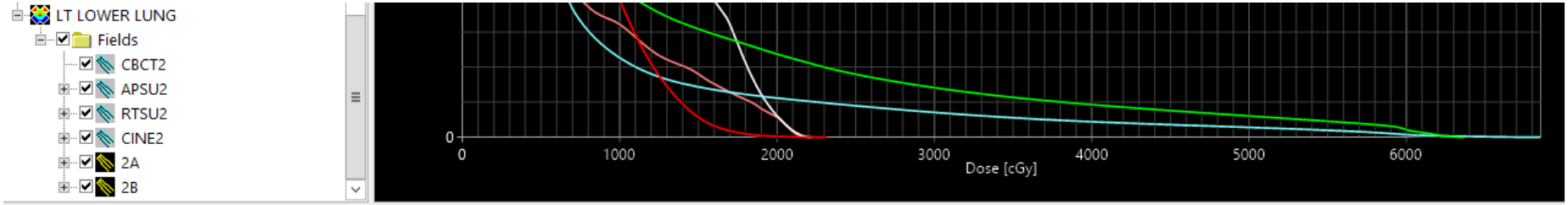

Dose Prescription | Dose Statistics

Show DVH	Structure	Approval Status	Plan	Course	Volume [cm³]	Dose Cover.[%]	Sampling Cover.[%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]
☑	Esophagus	Approved	Sum Rt+Lt Lungs	C2 Lt Lung 2017	31.8	100.0	99.9	22.7	2229.3	672.3
☑	Lung_L	Approved	Sum Rt+Lt Lungs	C2 Lt Lung 2017	1747.8	100.0	100.0	18.9	6853.9	558.7
☑	Lung_R	Approved	Sum Rt+Lt Lungs	C2 Lt Lung 2017	1915.0	100.0	100.0	16.2	6372.0	847.0
☑	SpinalCord	Approved	Sum Rt+Lt Lungs	C2 Lt Lung 2017	38.6	100.0	100.2	0.0	2213.2	345.1
☑	Heart	Approved	Sum Rt+Lt Lungs	C2 Lt Lung 2017	772.7	100.0	100.0	65.0	2323.7	623.9

Max dose

Conclusion

- Radiation therapy (RT) non-compliance kills lives
- The radiation oncology workflow requires and generates a wealth of documentation
- The location of the radiation treatment information that the Alliance requires for a given patient will be unique to the specific clinic, but in general is found in one of more of the following:
  - Treatment planning software (TPS) or documents
    - Pinnacle (Philips)
    - Eclipse (Varian)
  - RT record and verify software:
    - Mosaiq (Elekta)
    - ARIA (Varian)
  - RT paper chart

ALLIANCE
FOR CLINICAL TRIALS IN ONCOLOGY