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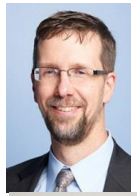
MILLER SCHOOL of MEDICINE

Risk assessment for Physics Plan Review – Update from TG275

Perry Johnson, et al.

March 19, 2017

Task Group Members



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  - Scripps Proton Therapy Center

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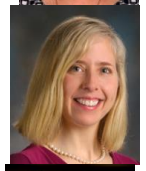

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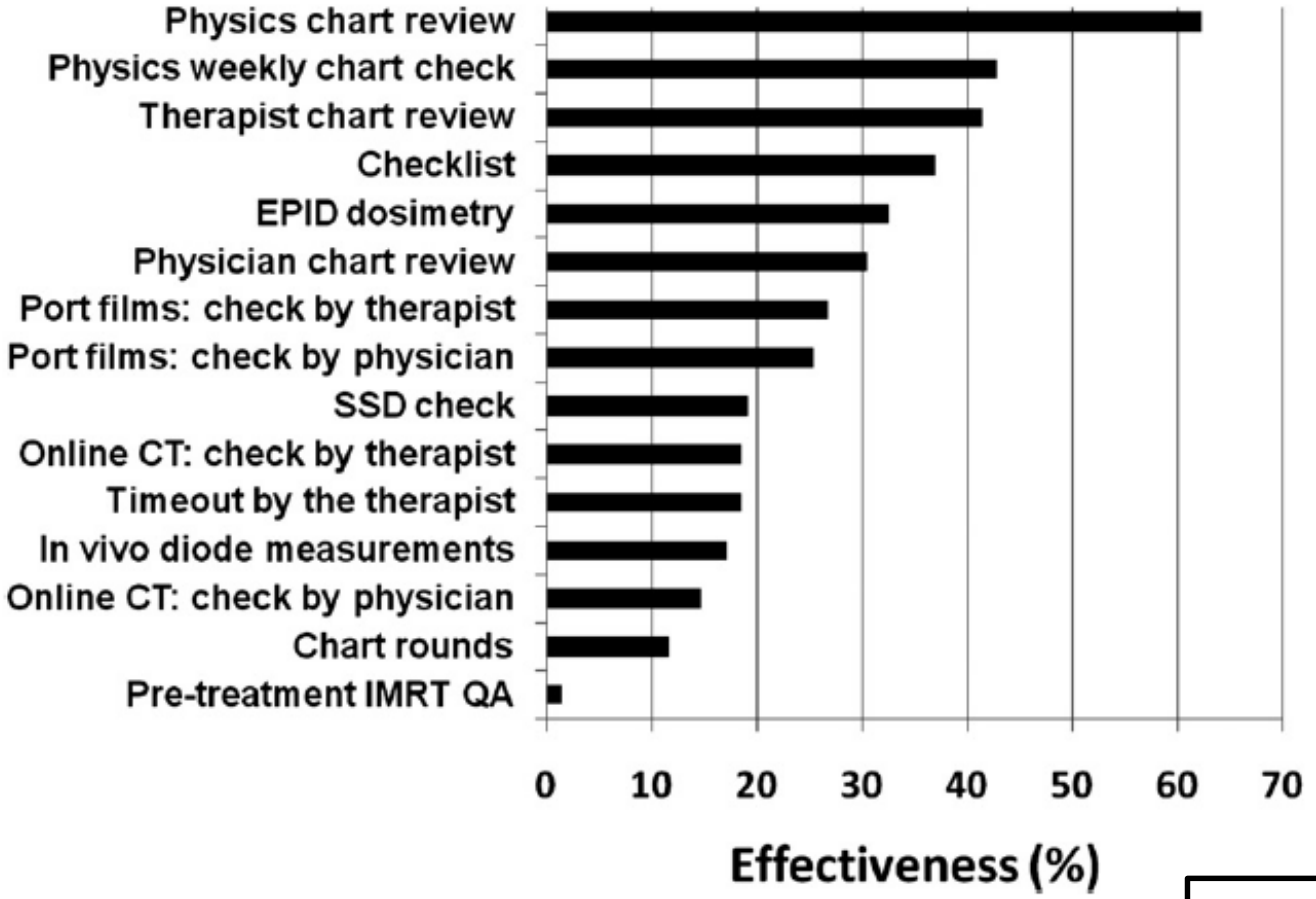
Why is this important?



Quality Control Quantification (QCQ): A Tool to Measure the Value of Quality Control Checks in Radiation Oncology

Eric C. Ford, PhD,* Stephanie Terezakis, MD,* Annette Souranis,* Kendra Harris, MD,* Hiram Gay, MD,† and Sasa Mutic, PhD†

Int J Radiation Oncol Biol Phys, Vol. 84, No. 3, pp. e263–e269, 2012

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Why is this important?

Society level recommendations

- ACR technical standard for the performance of radiation oncology physics for external beam therapy
- ACR-ASTRO practice parameter for radiation oncology
- AAPM Task groups – 11, 40, 59

Continuing medical physics consultation

- Billing code – CPT 77336
- Assessment of treatment parameters, QA of dose delivery, and review of patient documentation reported per week of therapy.

Why is this important?

Task Group 40

- Procedure for checking of technical parameters.
  - Daily dose, total dose, and fractionation scheme.
  - Machine, mode, and energy.
  - Fields parameters, algorithm, etc.
- Is prescription “reasonable”?
- Request, i.e. special physics consult, in-vivo dosimetry, etc.
- Proper documentation
- **“Consistency from rx to plan to sim sheet to MU calculation to daily record.”**

Addressing the knowledge gap

1. Review existing data and recommendations
2. Survey information on current practices
3. Provide risk-based recommendations
4. Provide recommendations to software vendors

Guidelines – the basics

ACR technical standards

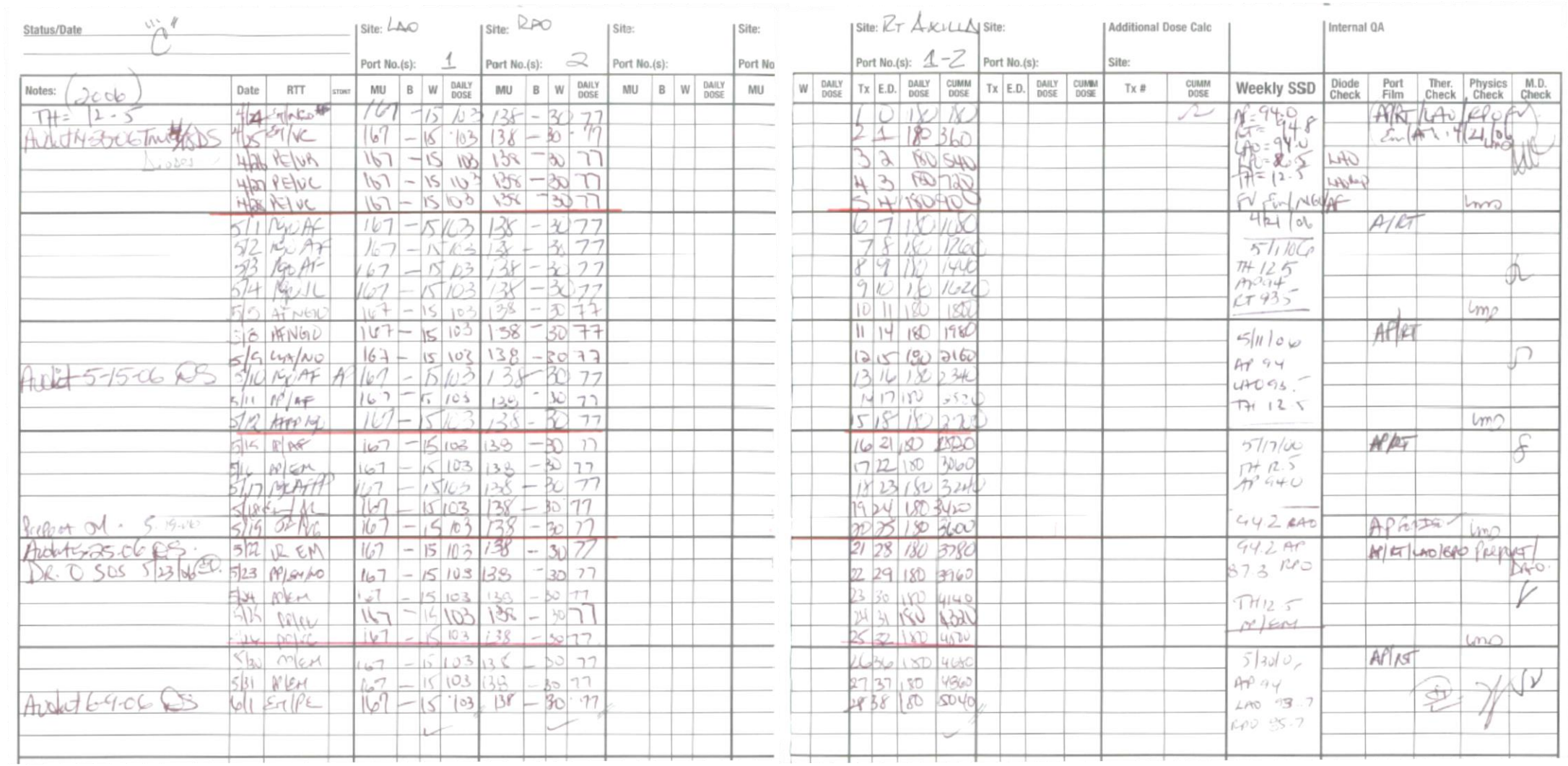
- Medical physicist must develop a chart review protocol.
- Should review new or modified treatments.
- Assess accuracy of information as well as completeness and clarity of record.
- Physics chart review must be conducted at least weekly.
- EOT check must be performed within 1 week of EOT.

Aspects of chart/plan review

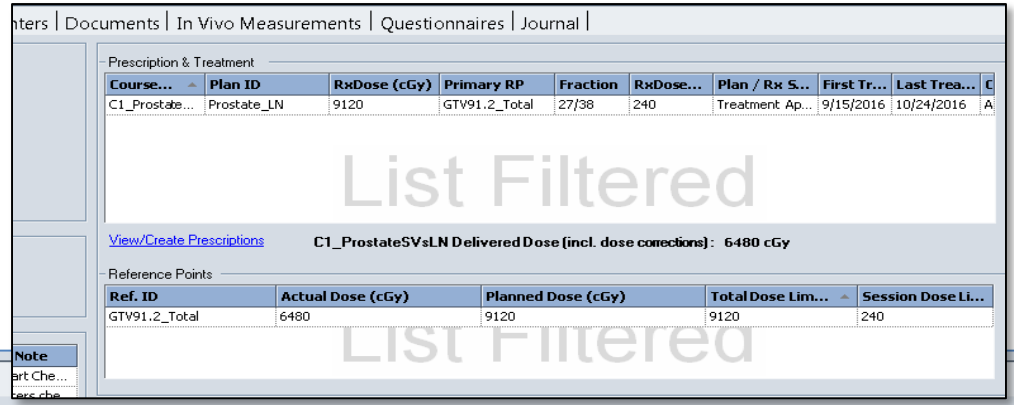
1. Technical parameters
   - Dose grid, density overrides, couch tolerance table, isocenter consistency, etc.
2. Data transfer/plan consistency
   - Agreement from RX to TPS to R&V to delivery
3. Documentation/communication
   - Setup photos/instructions, document approvals, special requests, etc.
4. Plan quality
   - Target coverage, DVH parameters, etc.
5. Clinical decision making
   - Contouring, image registration, treatment approach, etc.

1) Native to current systems 2) Custom solutions 3) Vendor solutions

How do we check “charts”?



EMR and treatment management software



Summary | Treatment History | Encounters | Documents | In Vivo Measurements | Questionnaires | Journal

☐ Show All Treatments ☐ Hide Completed Plans

☐ Hide Completed Courses ☐ Hide Retired Plans

Chart QA Note | Graph | QA'd

DateTime	Resource	Course ID	Plan ID	Field ID	Field Type	Fraction Number	MU	Energy	Treatment Ti...	Elapsed Days	Dose Rate	Gantry Rtn	Coll Rtn	Coll	Coll Y1	Coll Y2	Col	Coll X1	Coll X2	Couch Vrt	Couch Lng	Couch Lat	Couch Rtn	Pitch
1/24/2017 5:06:41 PM	**Linac A1**	**C1**	**ENT50Gy**	**1_ARC1**	**Planned**		**225**	**6X**	**1.86**		**600**	**181**	**5**		**-9.3**	**9.5**		**-7.5**	**7.5**	**-13.3**	**66.6**	**-1.5**	**0**	
2/22/2017 2:43:19 PM	Linac A1	C1	ENT50Gy	1_ARC1	TRT	21	225	6X	1.22	28	600	181	5		-9.3	9.5		-7.5	7.5	-13.3	66.7	-0.8	1.7	
2/23/2017 9:38:19 AM	Linac A1	C1	ENT50Gy	1_ARC1	TRT	22	225	6X	1.22	29	600	181	5		-9.3	9.5		-7.5	7.5	-13.3	66.2	-0.8	0	
2/24/2017 9:44:14 AM	Linac A1	C1	ENT50Gy	1_ARC1	TRT	23	225	6X	1.22	30	600	181	5		-9.3	9.5		-7.5	7.5	-13.1	66	-0.5	1.3	
2/27/2017 9:22:51 AM	Linac A1	C1	ENT50Gy	1_ARC1	TRT	24	225	6X	1.2	33	600	181	5		-9.3	9.5		-7.5	7.5	-12.7	67.2	-0.4	1.3	
2/28/2017 9:39:14 AM	Linac A1	C1	ENT50Gy	1_ARC1	TRT	25	225	6X	1.22	34	600	181	5		-9.3	9.5		-7.5	7.5	-13	66.7	0	1.7	
1/24/2017 5:06:41 PM	**Linac A1**	**C1**	**ENT50Gy**	**2_ARC2**	**Planned**		**223**	**6X**	**1.86**		**600**	**179**	**355**		**-9.3**	**9.5**		**-7.5**	**7.5**	**-13.3**	**66.6**	**-1.5**	**0**	
2/22/2017 2:44:55 PM	Linac A1	C1	ENT50Gy	2_ARC2	TRT	21	223	6X	1.2	28	600	179	355		-9.3	9.5		-7.5	7.5	-13.3	66.7	-0.8	1.7	
2/23/2017 9:39:54 AM	Linac A1	C1	ENT50Gy	2_ARC2	TRT	22	223	6X	1.22	29	600	179	355		-9.3	9.5		-7.5	7.5	-13.3	66.2	-0.8	0	
2/24/2017 9:45:51 AM	Linac A1	C1	ENT50Gy	2_ARC2	TRT	23	223	6X	1.22	30	600	179	355		-9.3	9.5		-7.5	7.5	-13.1	66	-0.5	1.3	
2/27/2017 9:24:27 AM	Linac A1	C1	ENT50Gy	2_ARC2	TRT	24	223	6X	1.2	33	600	179	354.9		-9.3	9.5		-7.5	7.5	-12.7	67.2	-0.4	1.3	
2/28/2017 9:40:50 AM	Linac A1	C1	ENT50Gy	2_ARC2	TRT	25	223	6X	1.2	34	600	179	354.9		-9.3	9.5		-7.5	7.5	-13	66.7	0	1.7	
1/24/2017 5:06:41 PM	**Linac A1**	**C1**	**ENT50Gy**	**3_ARC3**	**Planned**		**205**	**6X**	**1.86**		**600**	**181**	**90**		**-12**	**12**		**-9**	**9**	**-13.3**	**66.6**	**-1.5**	**0**	
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2/23/2017 9:41:55 AM	Linac A1	C1	ENT50Gy	3_ARC3	TRT	22	205	6X	1.22	29	600	181	90		-12	12		-9	9	-13.3	66.2	-0.8	0	
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2/28/2017 9:42:50 AM	Linac A1	C1	ENT50Gy	3_ARC3	TRT	25	205	6X	1.22	34	600	181	90		-12	12		-9	9	-13	66.7	0	1.7	

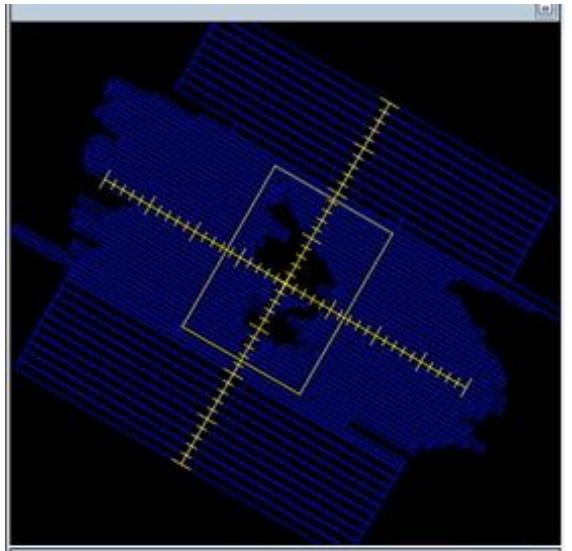
EMR and treatment management software

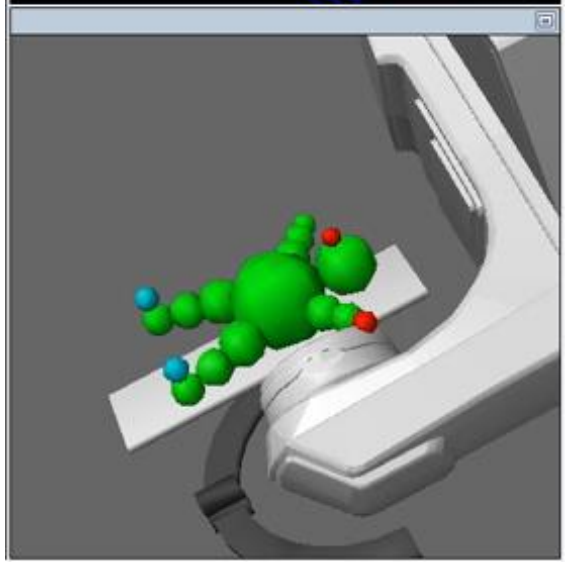
Summary | Treatment History | Encounters | Documents | In Vivo Measurements | Questionnaires | Journal

☑ Show All Treatments ☐ Hide Completed Plans
☐ Hide Completed Courses ☐ Hide Retired Plans

Chart QA Note | Graph | QA'd

D	Field ID	Field Type	Fraction Number	MU	Energy	Treatment Time	Elapsed Days	Dose Rate	Gantry Rtn	Coll Rtn	Coll Y	Coll Y1	Coll Y2	Coll X	Coll X1	Coll X2	Couch Vrt	Couch Lng	Couch Lat	Couch Rtn	Pitch Angle	W
eck_Mediast	**1 ARC1**	**Planned**		**270**	**6X**	**1.49**		**600**	**179**	**330**		**-9.2**	**10.7**		**-6.5**	**6.5**	**-11.5**	**120.8**	**-0.1**	**0**		
Neck_Mediast	1 ARC1	TRT	1	270.1	6X	0.45	0	600	179	330		-8.3	9.3		-6.5	6.5	-12.3	123	-1.2	2	1.2166999578476	
Neck_Mediast	1 ARC1	TRT	2	270.1	6X	0.45	1	600	179	330		-8.3	9.3		-6.5	6.5	-13.6	122.7	-1.7	2.1	0.606800019741...	
Neck_Mediast	1 ARC1	TRT	3	270.1	6X	0.45	2	600	179	330		-8.3	9.3		-6.5	6.5	-10.4	123.2	-1.9	2.1	2.041100025177	
Neck_Mediast	1 ARC1	TRT	4	270.1	6X	0.45	3	599	179	330		-8.3	9.3		-6.5	6.5	-17.1	121.9	-1.3	1.8	359.069885253906	
Neck_Mediast	1 ARC1	TRT	5	270.1	6X	0.45	4	600	179	330		-8.3	9.3		-6.5	6.5	-15.2	122.1	-1	0	359.999694824219	
Neck_Mediast	1 ARC1	TRT	6	270.1	6X	0.45	7	600	179	330		-8.3	9.3		-6.5	6.5	-13.1	122.5	-1.5	1.5	0.973299980163...	
Neck_Mediast	1 ARC1	TRT	7	270.1	6X	0.45	8	600	179	330		-8.3	9.3		-6.5	6.5	-13.5	122.2	-2	2.3	0.789900004863...	
Neck_Mediast	1 ARC1	TRT	8	270.1	6X	0.45	9	600	179	330		-8.3	9.3		-6.5	6.5	-10.5	123	-1.9	2.5	2.10689997673035	
Neck_Mediast	1 ARC1	TRT	9	270.1	6X	0.45	10	600	179	330		-8.3	9.3		-6.5	6.5	-15	122.3	-1.7	0.1	359.997711181641	
Neck_Mediast	1 ARC1	TRT	10	270.1	6X	0.45	11	599	179	330		-8.3	9.3		-6.5	6.5	-11.4	122.4	-1.6	358.8	1.73800003528595	
Neck_Mediast	1 ARC1	TRT	11	270.1	6X	0.45	14	600	179	330		-8.3	9.3		-6.5	6.5	-12.3	122.2	-1.4	359.3	1.30569994449615	
Neck_Mediast	1 ARC1	TRT	12	270.1	6X	0.45	15	600	179	330		-8.3	9.3		-6.5	6.5	-8.7	123.1	-1.5	0.6	2.82399988174438	
Neck_Mediast	1 ARC1	TRT	13	270.1	6X	0.45	16	600	179	330		-8.3	9.3		-6.5	6.5	-8.9	123	-2	1.5	2.84990000724792	
Neck_Mediast	1 ARC1	TRT	14	270.1	6X	0.45	17	600	179	330		-8.3	9.3		-6.5	6.5	-10.8	122.7	-0.9	0.7	1.98989999294281	
Neck_Mediast	1 ARC1	TRT	15	270.1	6X	0.45	18	599	179	330		-8.3	9.3		-6.5	6.5	-12.1	122.7	-1.8	0.7	1.28470003604889	
Neck_Mediast	Instant_Double_E	PIMG	1	1.5	6X	0	0	644	179	330		-8.3	9.3		-6.5	6.5	-12.3	123	-1.2	2	1.2166999578476	
Neck_Mediast	Instant_Double_E	PIMG	1	1.5	6X	0	0	654	179	330		-11.7	11.7		-8.2	8.2	-12.3	123	-1.2	2	1.2166999578476	
eck_Mediast	**2 ARC2**	**Planned**		**263**	**6X**	**1.49**		**600**	**181**	**30**		**-9.6**	**11.2**		**-6.5**	**6.5**	**-11.5**	**120.8**	**-0.1**	**0**		
Neck_Mediast	2 ARC2	TRT	1	263.4	6X	0.44	0	600	181	30		-9.3	11.2		-6.5	6.4	-12.3	123	-1.2	2	1.2166999578476	
Neck_Mediast	2 ARC2	TRT	2	263.4	6X	0.44	1	600	181	30		-9.3	11.2		-6.5	6.4	-13.6	122.7	-1.7	2.1	0.606800019741...	
Neck_Mediast	2 ARC2	TRT	3	263.4	6X	0.44	2	600	181	30		-9.3	11.2		-6.5	6.4	-10.4	123.2	-1.9	2.1	2.041100025177	
Neck_Mediast	2 ARC2	TRT	4	263.4	6X	0.44	3	600	181	30		-9.3	11.2		-6.5	6.4	-17.1	121.9	-1.3	1.8	359.069885253906	
Neck_Mediast	2 ARC2	TRT	5	263.4	6X	0.44	4	600	181	30		-9.3	11.2		-6.5	6.4	-15.2	122.1	-1	0	359.999694824219	
Neck_Mediast	2 ARC2	TRT	6	263.4	6X	0.44	7	600	181	30		-9.3	11.2		-6.5	6.4	-13.1	122.5	-1.5	1.5	0.973299980163...	
Neck_Mediast	2 ARC2	TRT	7	263.4	6X	0.44	8	600	181	30		-9.3	11.2		-6.5	6.4	-13.5	122.2	-2	2.3	0.789900004863...	
Neck_Mediast	2 ARC2	TRT	8	263.4	6X	0.44	9	600	181	30		-9.3	11.2		-6.5	6.4	-10.5	123	-1.9	2.5	2.10689997673035	
Neck_Mediast	2 ARC2	TRT	9	263.4	6X	0.44	10	600	181	30		-9.3	11.2		-6.5	6.4	-15	122.3	-1.7	0.1	359.997711181641	
Neck_Mediast	2 ARC2	TRT	10	263.4	6X	0.44	11	600	181	30		-9.3	11.2		-6.5	6.4	-11.4	122.4	-1.6	358.8	1.73800003528595	
Neck_Mediast	2 ARC2	TRT	11	263.4	6X	0.44	14	600	181	30		-9.3	11.2		-6.5	6.4	-12.3	122.2	-1.4	359.3	1.30599999427795	
Neck_Mediast	2 ARC2	TRT	12	263.4	6X	0.44	15	600	181	30		-9.3	11.2		-6.5	6.4	-8.7	123.1	-1.5	0.6	2.82399988174438	
Neck_Mediast	2 ARC2	TRT	13	263.4	6X	0.44	16	600	181	30		-9.3	11.2		-6.5	6.4	-8.9	123	-2	1.5	2.84990000724792	
Neck_Mediast	2 ARC2	TRT	14	263.4	6X	0.44	17	600	181	30		-9.3	11.2		-6.5	6.4	-10.8	122.7	-0.9	0.7	1.98989999294281	
Neck_Mediast	2 ARC2	TRT	15	263.4	6X	0.44	18	600	181	30		-9.3	11.2		-6.5	6.4	-12.1	122.7	-1.8	0.7	1.28470003604889	
eck_Mediast	**ANT SETUP1**	**Planned**			**6X**			**600**	**0**	**0**		**-9.6**	**11.2**		**-6.5**	**6.5**	**-11.5**	**120.8**	**-0.1**	**0**		
Neck_Mediast	Setup_MV_Ima...	PIMG	1	1.5	6X	0	0	648	0	360		-14.2	14.2		-14.2	14.2	-12.3	123	-1.2	2	1.2166999578476	





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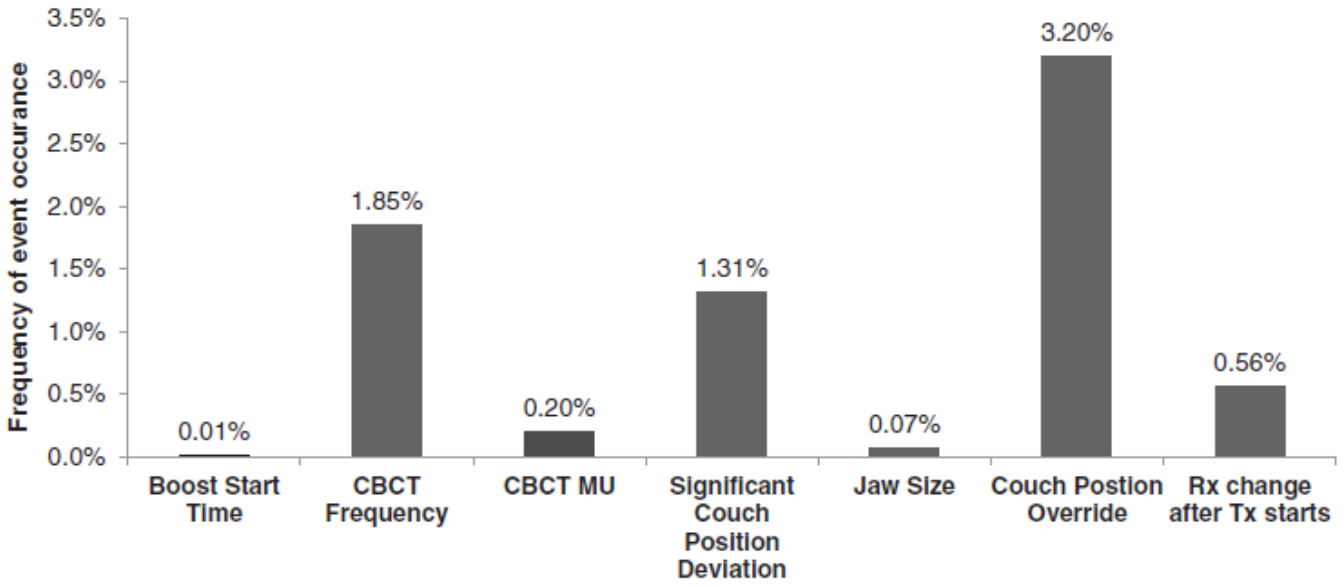
Custom automation (CATERS – Univ. of Iowa)

A computer aided treatment event recognition system in radiation therapy

Junyi Xia, Christopher Mart, and John Bayouth

Citation: Medical Physics **41**, 011713 (2014); doi: 10.1118/1.4852895

- Designed/improved using incident learning
- Checks:
  - Inconsistency in delivery
  - Overrides
  - Documentation
- Pre-screening of chart checks
- "Spend more time investigating and less time searching"



Custom automation (PCT – Univ. of Mich)

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 17, NUMBER 6, 2016

Improving treatment plan evaluation with automation

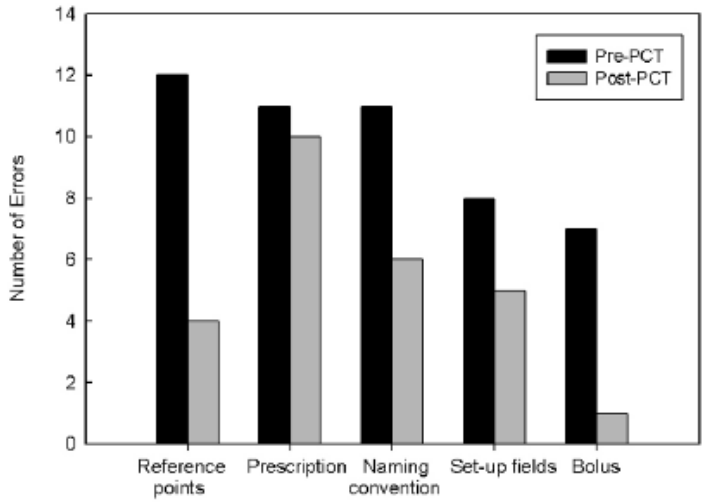
Elizabeth L. Covington,[1] Xiaoping Chen,[1] Kelly C. Younge,[1] Choonik Lee,[1] Martha M. Matuszak,[1] Marc L. Kessler,[1] Wayne Keranen,[2] Eduardo Acosta,[2] Ashley M. Dougherty,[1] Stephanie E. Filpansick,[1] and Jean M. Moran[1a]

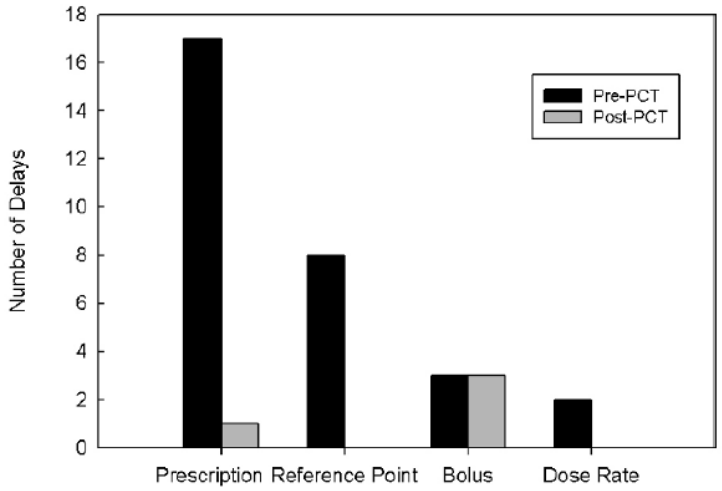
Department of Radiation Oncology,[1] University of Michigan, Ann Arbor, MI; Varian Medical Systems,[2] Palo Alto, CA, USA

jmmoran@med.umich.edu

- Goal to reduce amount of time checking "mundane details" and more time dedicated to plan quality
- Designed w/ lean thinking

Type of Check	*Item Checked*
Automated	CT dataset name
	Course name
	Number of courses created per day
	Plan name
	Plan normalization
	Dose calculation model
	Dose calculation settings
	Prescription energy matches plan
	Prescription dose and dose/fraction matches plan
	Prescription and plan dose matches reference point dose
	Dose limits match reference point dose
	Bolus
	Field dose rates
	Plan approval status
	DRRs created for all fields
	DRRs have overlays and match anatomy
	Plan labeling
	Scheduled machine
	Prescription linked to plan
Manual	Interpolation of structures
	Presence of stray contouring points
	Quality of image registration
	Field names
	Required documents present
	Fraction scheduling
	Gantry clearance
	User origin set correctly
	Isocenter for imaging and treatment fields match
	Beam energy/modality appropriate
	Plan quality
	Couch moves from the CT reference
	Plan exported to second check software
	Check billing (Dosimetry only)





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Custom automation (EcCk – Wash Univ.)

TABLE I. List of patient chart checking tasks supported by EcCk.

	Tasks	Explanation
1	On-demand physics initial chart checking	Check the treatment plan parameters against R&V system, the documents and their approvals, and the IMRT QA results prior to the physics approval of the treatment sessions.
2	On-demand dosimetrist chart checking	After the approved treatment plans have been imported into the R&V, check the completeness, accuracy and consistency of treatment plan parameters and required documents.
3	On-demand final chart checking	After a patient's treatment course has completed, check the completeness of treatment records and presence of all required documents, per ACR requirements
4	Automatic physics daily/weekly checks	Check the treatment plan parameters to ensure consistency of treatments from fraction to fraction. Check weekly for changes in patient weight, documentation changes, setup parameters, rejection of portal images, and treatment couch position trends.

- Technical vs clinical vs quality
- Many items difficult to check once sent to R&V

Automated radiotherapy treatment plan integrity verification

Deshan Yang and Kevin L. Moore

Medical Physics **39**, 1542 (2012); doi: 10.1118/1.3683646

Technical Note: Electronic chart checks in a paperless radiation therapy clinic

Deshan Yang, Yu Wu, Ryan S. Brame, Sridhar Yaddanapudi, Dharanipathy Rangaraj, H. Harold Li, S. Murty Goddu, and Sasa Mutic

Citation: Medical Physics **39**, 4726 (2012); doi: 10.1118/1.4736825

Automated radiation therapy treatment plan workflow using a commercial application programming interface

Lindsey A. Olsen MS [a,*], Clifford G. Robinson MD [a], Guangrong R. He MS [a], H. Omar Wooten PhD [a], Sridhar Yaddanapudi MS [a], Sasa Mutic PhD [a], Deshan Yang PhD [a], Kevin L. Moore PhD [b]

Practical Radiation Oncology: November-December 2014

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Custom automation (planCheck – Mass Gen)

Automating checks of plan check automation

Tarek Halabi ✉, Hsiao-Ming Lu

Journal of Applied Clinical Medical Physics, Vol. 15, No. 4, 2014

Automated survey of 8000 plan checks at eight facilities

Tarek Halabi, Hsiao-Ming Lu, Damian A. Bernard, James C. H. Chu, Michael C. Kirk, Russell J. Hamilton, Yu Lei, Joseph Driewer

Med. Phys. 43 (9), September 2016

#	Violation description	Frequency across facilities
1	Maximum dose carried in Record and Verify Treatment Calendar does not match plan	
2	Beam's number of fractions in Record and Verify Treatment Calendar does not match plan	
3	Dose carried for Rx site in Record and Verify Treatment Calendar does not match Rx dose in Record and Verify	
4	Rx dose in Record and Verify System does not match plan	

- PDF parser to compare documents with treatment management software
  - "Oncologist do not review or sign DICOM RT files"
- Versatility and ease of implementation

Custom solutions

Detailed review and analysis of complex radiotherapy clinical trial planning data: Evaluation and initial experience with the SWAN software system

Martin A. Ebert[a,b,*], Annette Haworth[c,d], Rachel Kearvell[a], Ben Hooton[a], Rhonda Coleman[a], Nigel Spry[a,e], Sean Bydder[a,e], David Joseph[a,f]

Radiotherapy and Oncology 86 (2008) 200–210
www.thegreenjournal.com

Table 3
Items checked for compliance with the TROG 03.04 'RADAR' trial involving 3DCRT for prostate cancer

Item	Verification
CT Slice Thickness.	Automatic
Immobilisation device used as planned	Manual
Planned dose compared to nominated dose	Automatic
DRR created for treatment position verification	Manual
Number of treatment fields	Automatic
Maximum dose for combined plan	Automatic
95% Coverage of PTV1	Automatic
95% Coverage of PTV2	Automatic
95% Coverage of PTV3	Automatic
CTV Contoured Appropriately	Manual
Margin of PTV1 appropriate	Automatic
Margin of PTV2 appropriate	Automatic
Margin of PTV3 appropriate	Automatic
Rectal wall contoured as recommended	Manual
Left femoral head contoured as recommended	Manual
Bladder contoured as recommended	Manual
Conformity index for PTV1	Automatic
Conformity index for PTV2	Automatic
Conformity index for PTV3	Automatic
DVH constraints on rectum	Automatic
DVH constraints on left femoral head	Automatic
DVH constraints on bladder	Automatic
Beam Energy	Automatic
Prescription point	Manual
Percentage isodose encompassing rectum	Manual
Dose per fraction	Automatic

Items are verified either automatically or manually using SWAN. Fig. 4 provides a sample report generated for these items.

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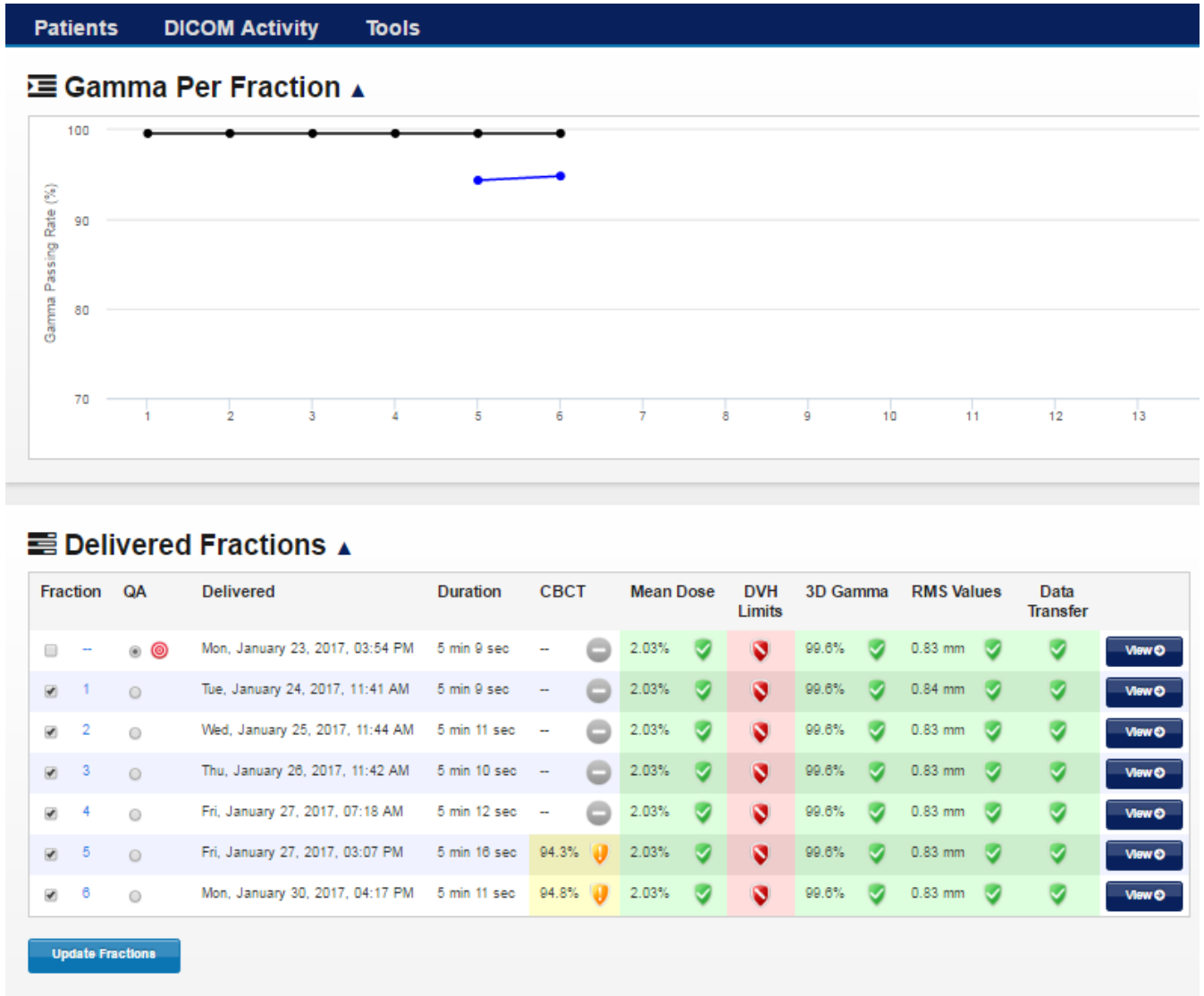
Vendor solutions – Mobius 3D

Mobius3D Benefits

- **Verifies dose throughout** the patient treatment volume
- **3% accuracy for IMRT & VMAT** plans with complex anatomy
- **Patient heterogeneities** are automatically handled
- **Verifies DVH objectives** are met by your plans
- **RTOG and TG-101** DVH objectives are pre-loaded
- **Validates beam model** commissioning in your TPS
- **Creates PDF reports** for every patient's plan
- **Billing code 77300** for secondary calculations
- **Every modern treatment planning system** is compatible
- **Conventional linacs and TomoTherapy** are compatible



Fraction	QA	Delivered	Duration	CBCT	Mean Dose	DVH Limits	3D Gamma	RMS Values	Data Transfer	
--		Mon, January 23, 2017, 03:54 PM	5 min 9 sec	--	2.03%		99.6%	0.83 mm		View
1		Tue, January 24, 2017, 11:41 AM	5 min 9 sec	--	2.03%		99.6%	0.84 mm		View
2		Wed, January 25, 2017, 11:44 AM	5 min 11 sec	--	2.03%		99.6%	0.83 mm		View
3		Thu, January 26, 2017, 11:42 AM	5 min 10 sec	--	2.03%		99.6%	0.83 mm		View
4		Fri, January 27, 2017, 07:18 AM	5 min 12 sec	--	2.03%		99.6%	0.83 mm		View
5		Fri, January 27, 2017, 03:07 PM	5 min 16 sec	94.3%	2.03%		99.6%	0.83 mm		View
6		Mon, January 30, 2017, 04:17 PM	5 min 11 sec	94.8%	2.03%		99.6%	0.83 mm		View

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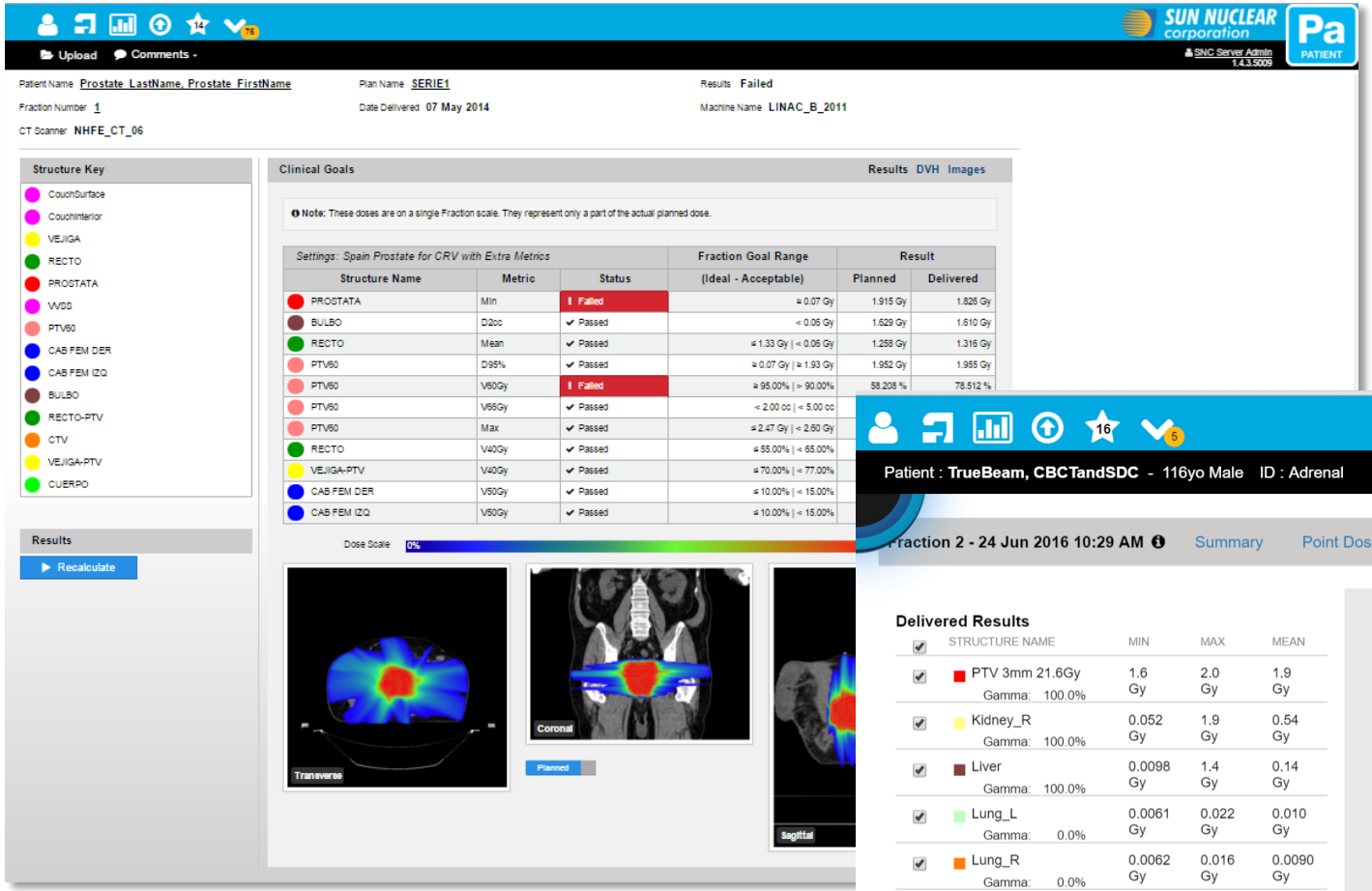
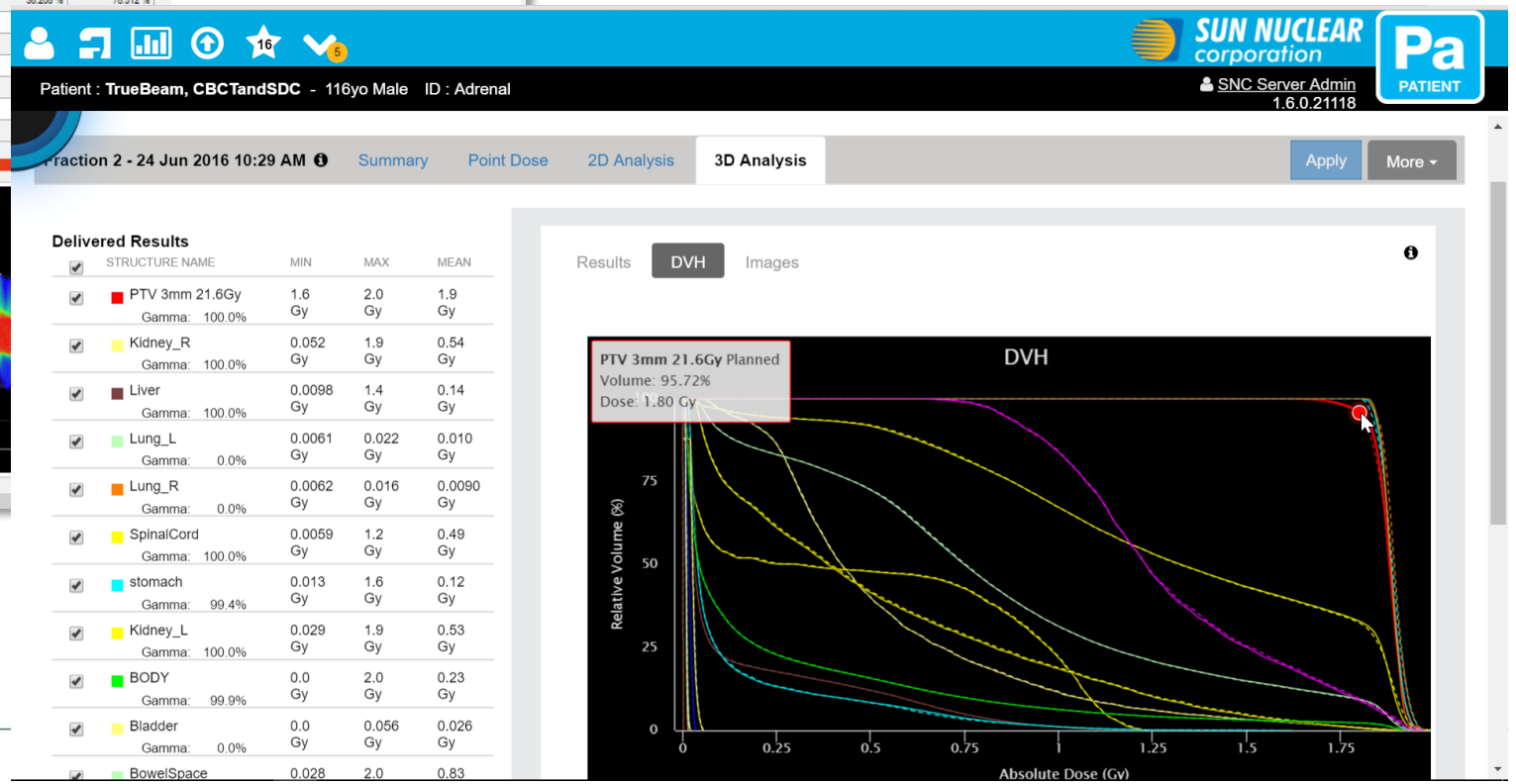
Vendor solutions – Sun Nuclear Per Fraction





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New directions

Vision 20/20: Automation and advanced computing in clinical radiation oncology
Kevin L. Moore, George C. Kagadis, Todd R. McNutt, Vitali Moiseenko, and Sasa Mutic
Medical Physics **41**, 010901 (2014); doi: 10.1118/1.4842515

Automation

- Cost reduction
- Productivity
- Availability
- Reliability
- Performance

Smart systems

- Daily dashboards
- Local “red flags”

Big data

- Statistical process control
- Bayesian modeling

Beyond the chart

- Comprehensive checking
- Outside the bailiwick

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 10, NUMBER 1, WINTER 2009

Automating the initial physics chart-checking process

Eli E. Furhang,[1,a] James Dolan,[1] Jussi K. Sillanpaa,[1] Louis B. Harrison,[1]
Department of Radiation Oncology,[1] Beth Israel Medical Center, 10 Union Square East, New York, NY, U.S.A.
efurhang@chpnet.org

Bayesian network models for error detection in radiotherapy plans

Alan M Kalet[1,2], John H Gennari[2], Eric C Ford[1] and Mark H Phillips[1,2]

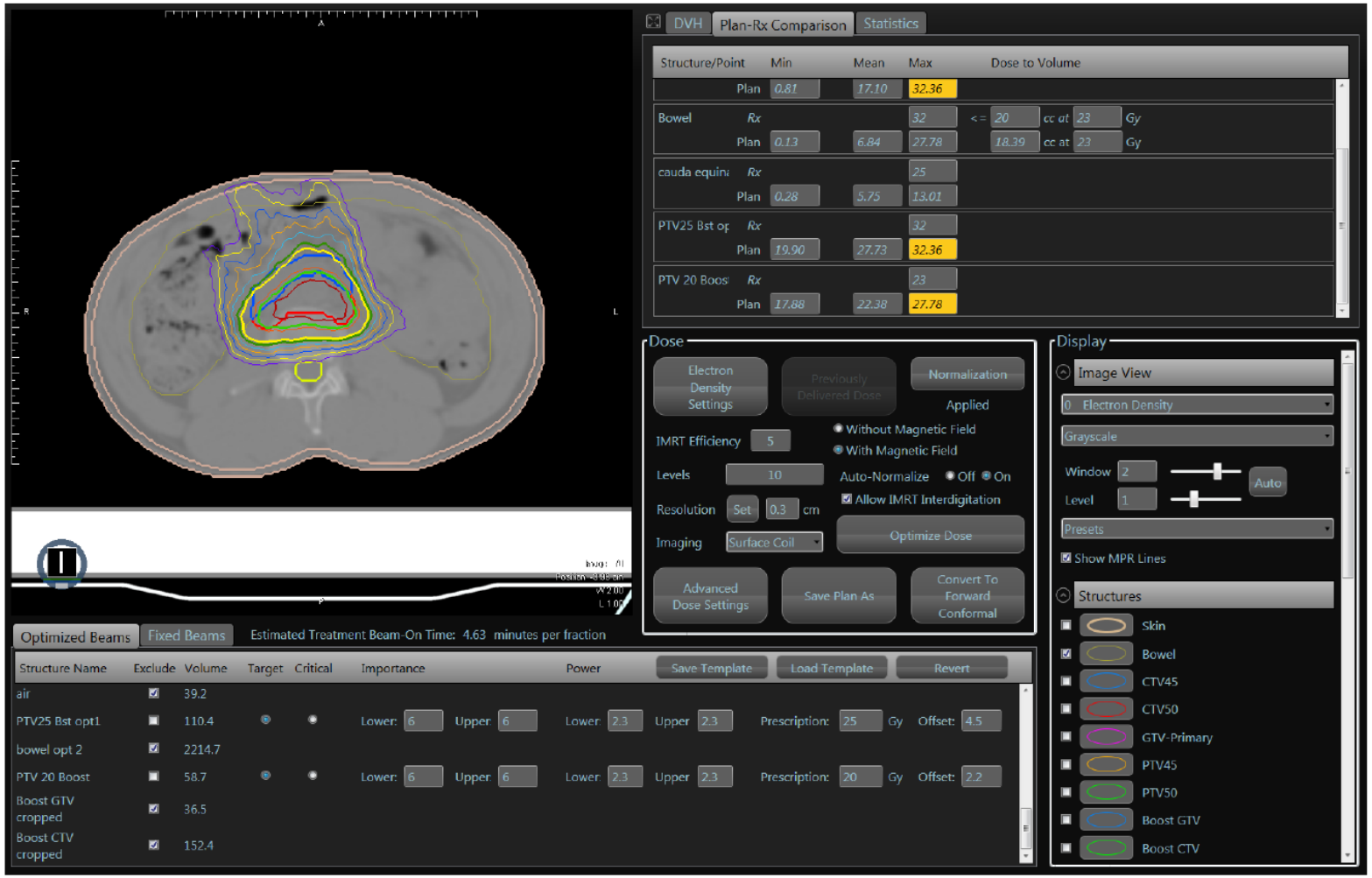
[1] Department of Radiation Oncology, University of Washington Medical Center, Seattle, WA 98195-6043, USA
[2] Department of Biomedical Informatics and Medical Education, University of Washington, Seattle, WA 98019-4714, USA

Phys. Med. Biol. **60** (2015) 2735–2749

Beyond the chart

ViewRay plan checks

- Deformable registration
- Contours
- Isocenter location
- Table placement
- Beam placement
- Rules for adaptation
- Etc…



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Beyond the chart

Contouring errors in lung SBRT

- 25 of 472 (5%) had violation
  - PTV, n = 17
  - Ribs, n = 5
  - Spinal canal, n = 2
  - Heart, n = 1
- For 17 PTVs, $V100_{mean}$ = 90%
  - Range, 75 – 95%

TABLE 4. Reason for PTV Changes for the 17 PTV Violations

Reason for PTV Change	No. of Cases
ITV not contoured even though 4D-CT available	4
Inadequate coverage of GTV or ITV	3
Inadequate margin from ITV to PTV	1
Not specified	9

PTV, planning target volume; ITV, internal target volume; 4D-CT, four-dimensional computed tomography; GTV, gross tumor volume.

The Impact of Peer Review of Volume Delineation in Stereotactic Body Radiation Therapy Planning for Primary Lung Cancer: A Multicenter Quality Assurance Study

Andrea C. Lo, MD,† Mitchell Liu, MD, CM, FRCPC,*† Elisa Chan, MD, FRCPC,*†‡ Chad Lund, MD, FRCPC,†§ Pauline T. Truong, MD, CM, FRCPC,†‖ Shaun Loewen, MD, FRCPC,*†¶ Jeffrey Cao, MD, FRCPC,*† Devin Schellenberg, MD, FRCPC,†§ Hannah Carolan, MD, FRCPC,*† Tanya Berrang, MD, FRCPC,†‖ Jonn Wu, MD, FRCPC,*† Eric Berthelet, MD, CM, FRCPC,*† and Robert Olson, MD, FRCPC*†#*

Journal of Thoracic Oncology® • Volume 9, Number 4, April 2014

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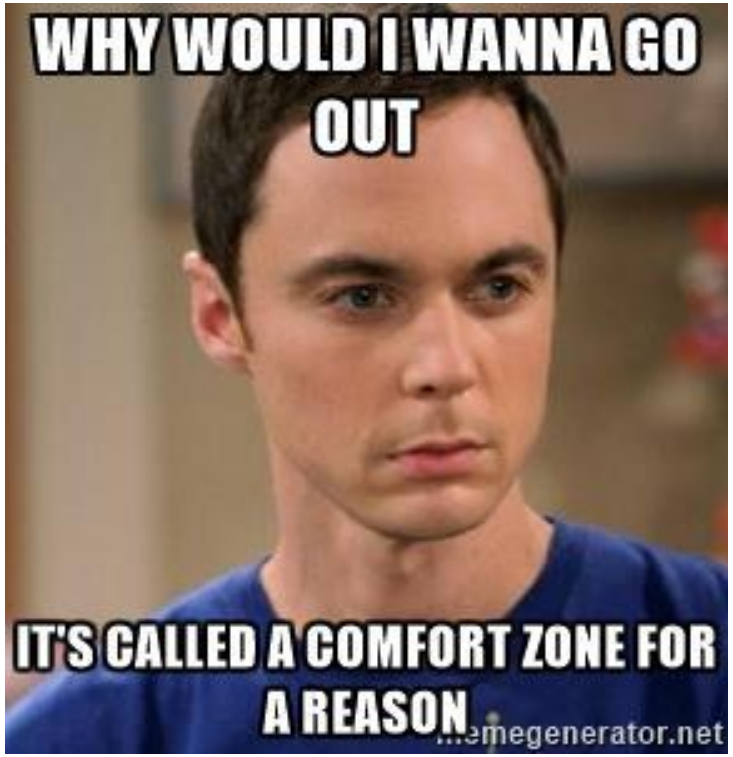
Summary

- Physics plan/chart review = safety, quality, and value
- Evolving nature of the plan/chart review
- Automation will play a role
- Vendors are helping fill gaps
- Step outside our comfort zone



Questions?