Access to Quality Care in Oncology

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UNIVERSITY OF WASHINGTON
MEDICAL CENTER
UW Medicine

Disclosures

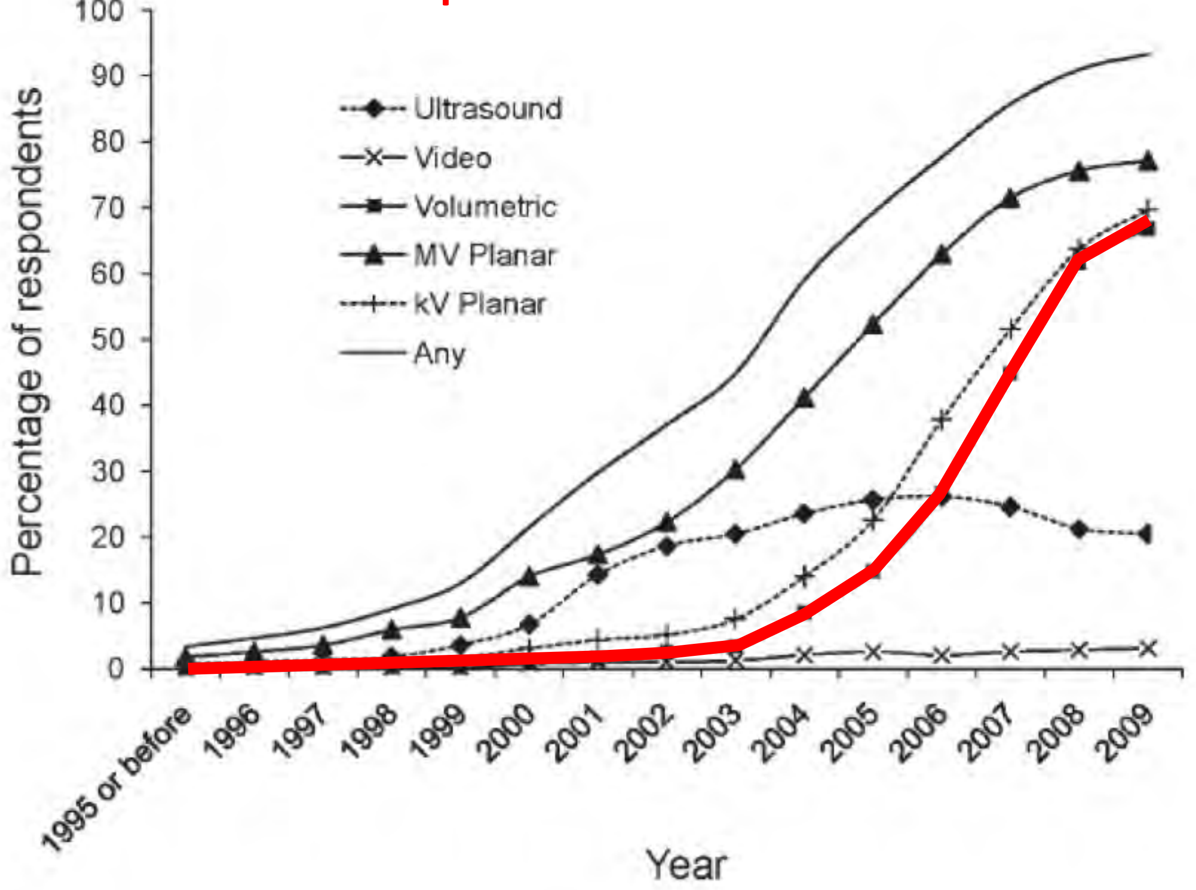
- AHRQ R18 HS022204-01
- NCI UH3 CA211310-03
- Leadership roles ASTRO but all views my own!

Emami et al. J Radiat Oncol 2017



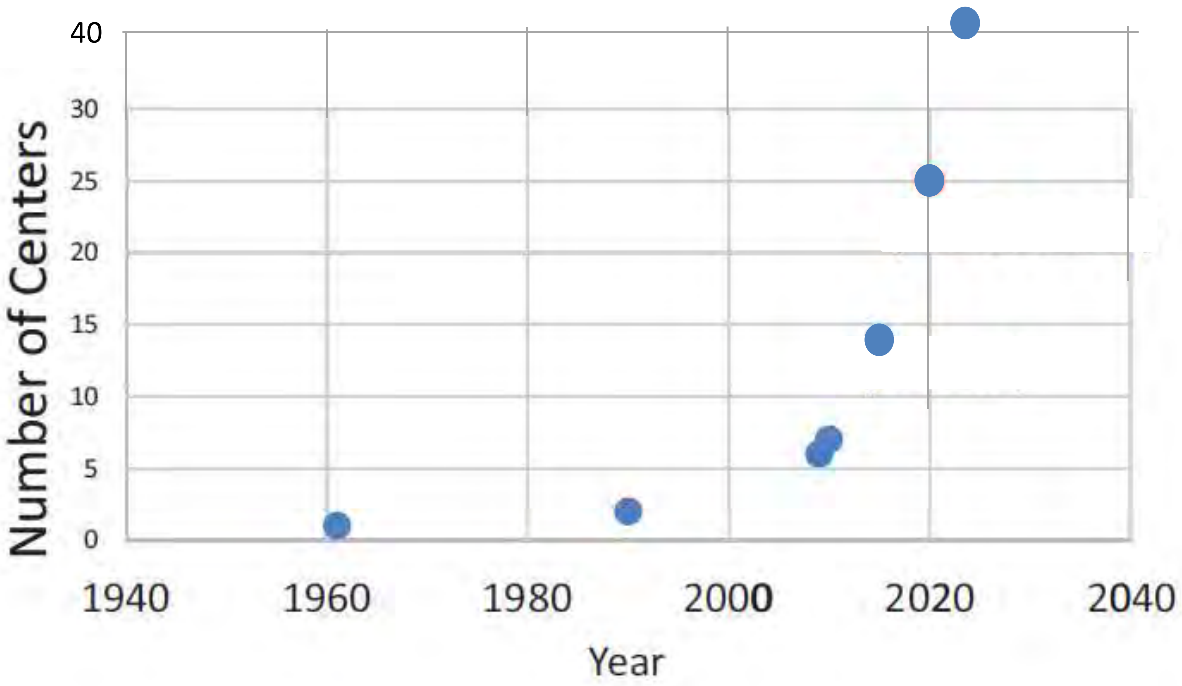

Slide Courtesy of John Wong, PhD

IGRT use in practices in the US



Nabavizadeh N. et al. IJROBP, 94(4), 850-857 (2016)

Proton Therapy Centers in US



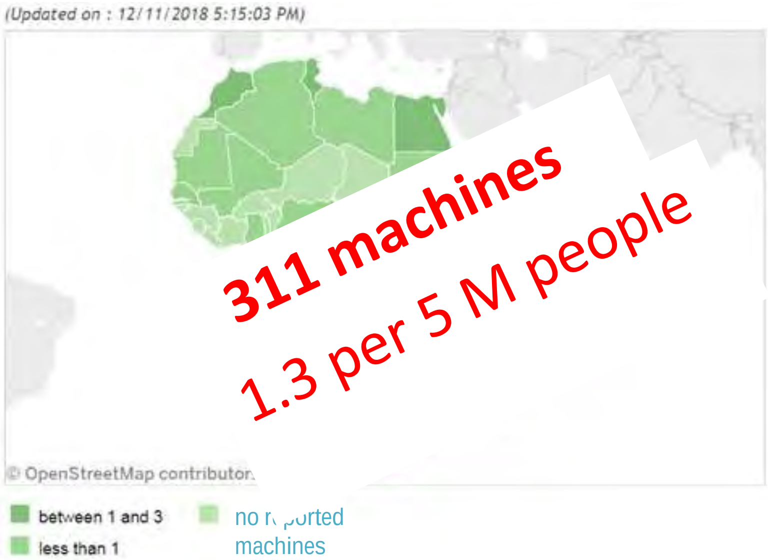
Adapted from “Appropriate use of advanced Technologies for Radiation Therapy and Surgery and Oncology: Workshop Summary”, National Academies of Sciences, Engineering and Medicine, PMID: 26726693, 2016 *(Graph: J. Yu)*

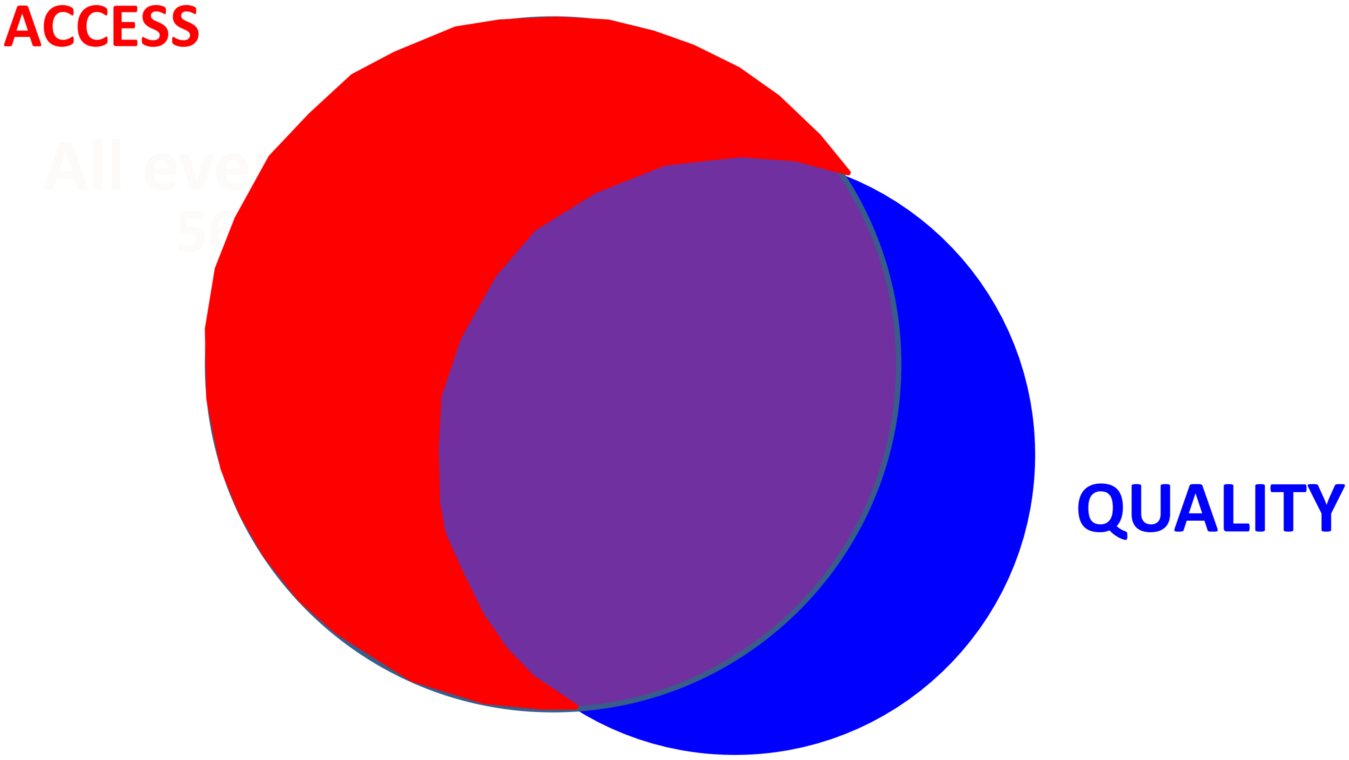
Technology has improved

What about access?

Global Access to Radiation Therapy

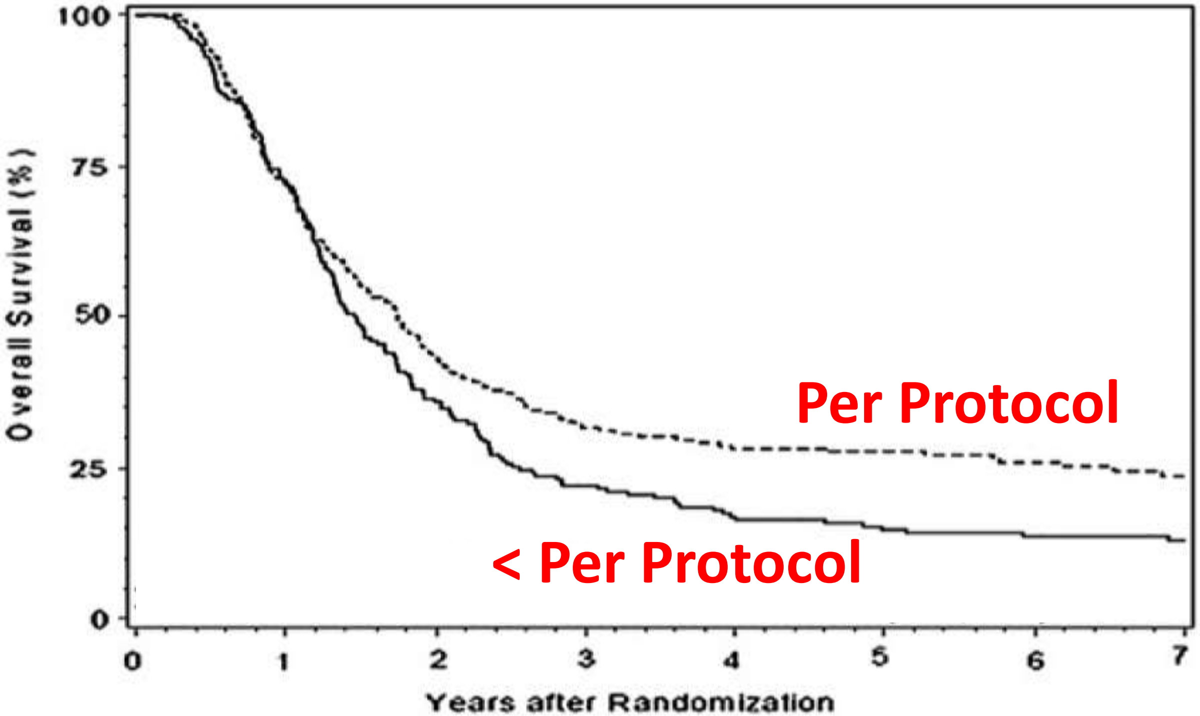
Adapted from IAEA Dirac database




ACCESS
QUALITY

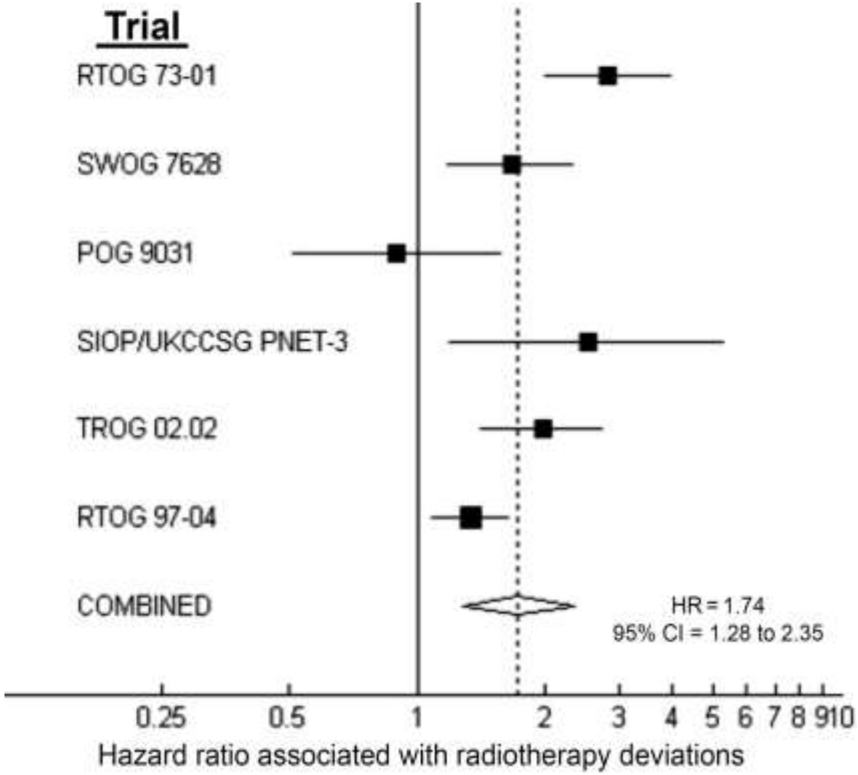
Quality and Outcomes

RTOG 9704 Pancreas



Abrams et al. IJROBP, 82, 809-816, 2012

Protocol deviations and overall survival



p < 0.001

Ohri N et al. J Natl Cancer Inst, 105, 387 (2013)

Outline

- Examples of quality gaps
  - Various domains: medical, physics, planning
- Access issues
- Directions for the future (and the present)

Case Study Example:
Are patients with bone-mets in the US treated according to accepted best practices?

Guideline (ASTRO)

Practical Radiation Oncology (2017) 7, 4-12

pro

www.practicalradonc.org

Special Article

Palliative radiation therapy for bone metastases: Update of an ASTRO Evidence-Based Guideline

Stephen Lutz MD [a,*], Tracy Balboni MD MPH [b], Joshua Jones MD [c], Simon Lo MB ChB [d], Joshua Petit MD [e], Shayna E. Rich MD PhD [f], Rebecca Wong MB ChB [g], Carol Hahn MD [h]

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Received 4 May 2016; revised 15 July 2016; accepted 5 August 2016

One of few current quality measures in RO

Data tracking: HCD

International Journal of
Radiation Oncology
biology • physics

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Clinical Investigation

National Quality Improvement Participation Among US Radiation Oncology Facilities: Compliance with Guideline-Concordant Palliative Radiation Therapy for Bone Metastases

Tru-Khang T. Dinh, MD, MS,* Eric Ford, PhD,* Lia M. Halasz, MD,* and Christoph I. Lee, MD, MS, MBA†

*Departments of *Radiation Oncology and †Radiology, University of Washington, Seattle, Washington*

Dinh et al., *IJROBP*, 108 (3): 564-571, 2020

"Performance" of XRT Facilities Nationally

- Median rate of "guideline-concordant" EBRT = 89%

  but ….

- Significant tail: lowest quartile treated less than 67% of cases in guideline-concordant manner

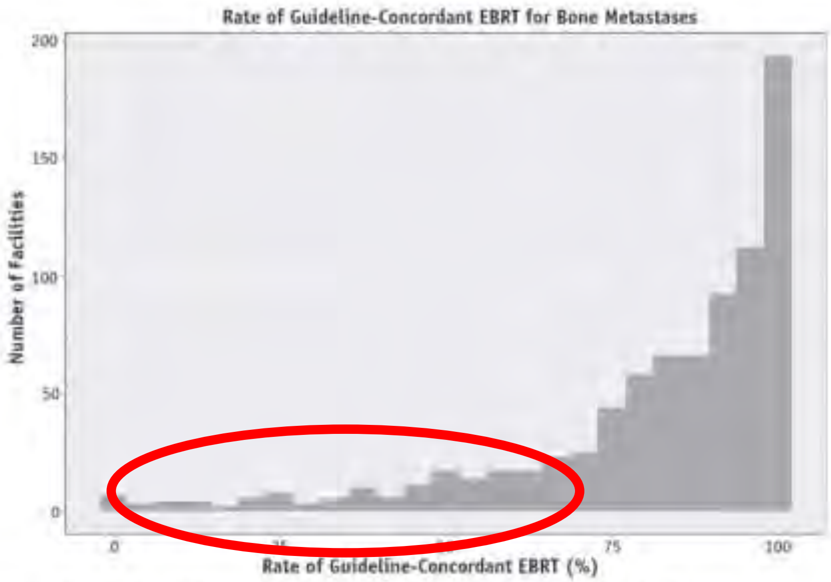

Fig. 2. Histogram of rate of guideline-concordant external beam radiation therapy for bone metastases among hospitals with radiotherapy facilities.

Dinh et al., *IJROBP*, 108 (3): 564-571, 2020

Take-home points

- Rigorous policies and procedures to adhere to established best practices

- Commissioning of new technologies or procedures
  - Potentially high-risk
  - Somewhat rare
  - Under-resourced

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- RO-ILS Case Study 15 highlights a reoccurring error pathway of incorrect digitization of brachytherapy applicators; in this case it resulted in incorrect treatment for multiple patients at one practice.

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CLARITY PSO
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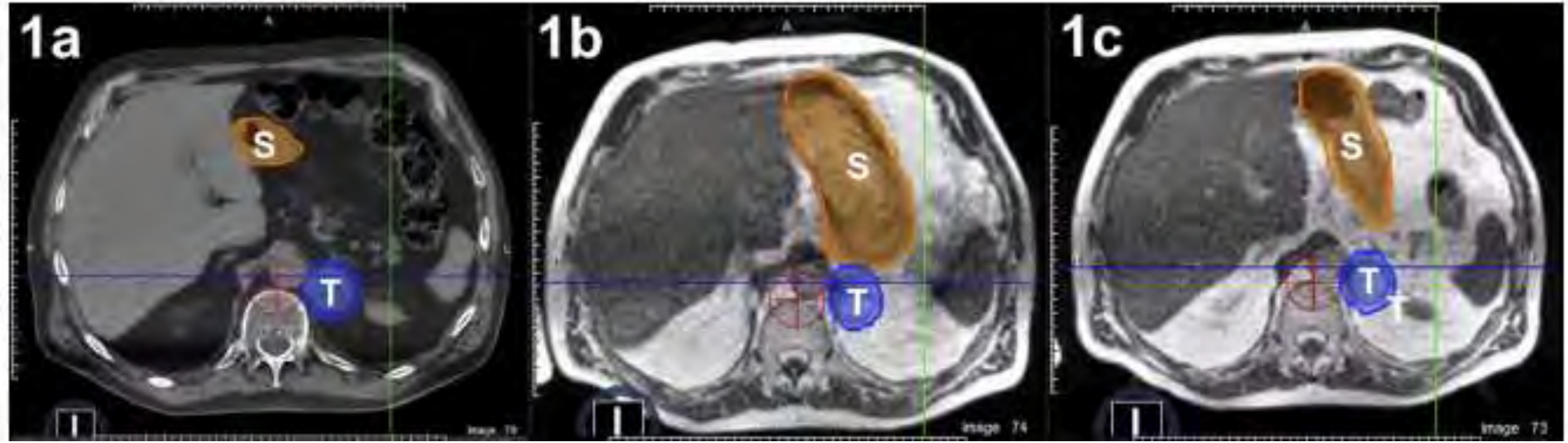
RO-ILS SAFETY NOTICE:
SRS HETEROGENEITY CORRECTION

- Commissioning of new technologies or procedures
- Clinical experience(s)
  - Adaptive radiation therapy

Adaptive Radiation Therapy (ART)

Adrenal Tumor ("T")



Simulation

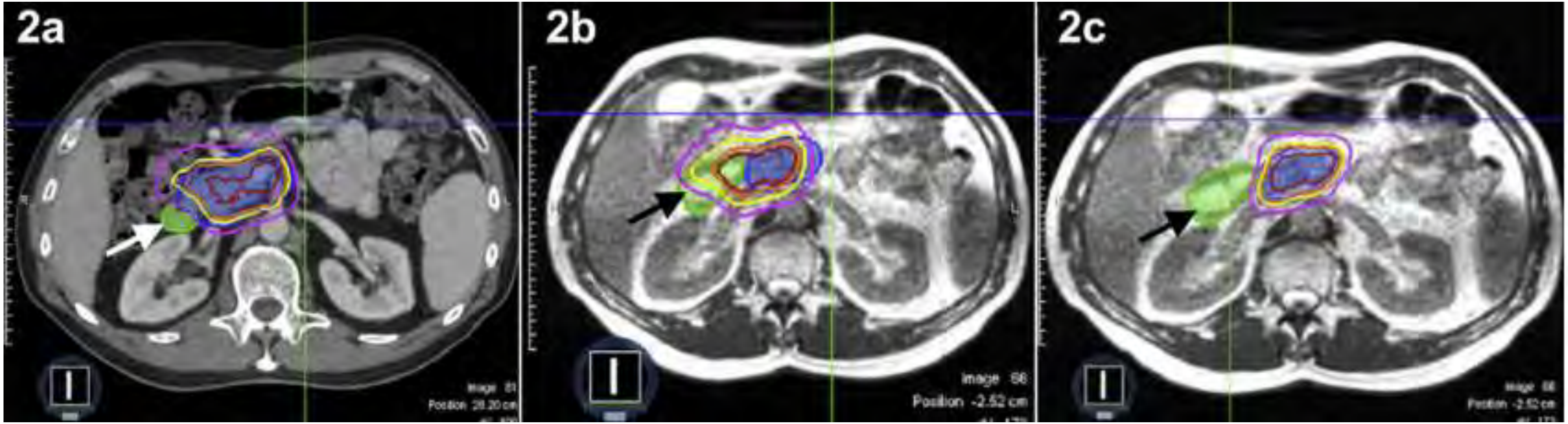
Fraction 1

Fraction 2

Henke et al. IJROBP, 96(5), 1078-1086, 2016

Adaptive Radiation Therapy (ART)

Pancreatic tumor



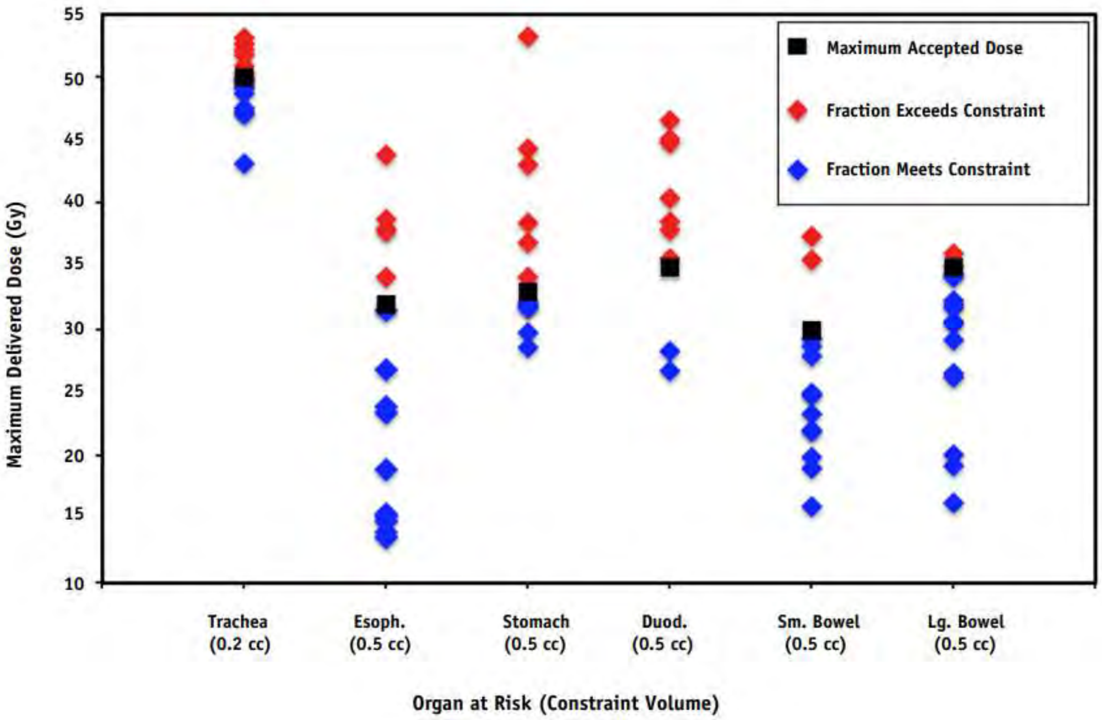
Reference Plan

Scheduled Plan
(Reference plan applied to 'day of' image)

Adapted Plan

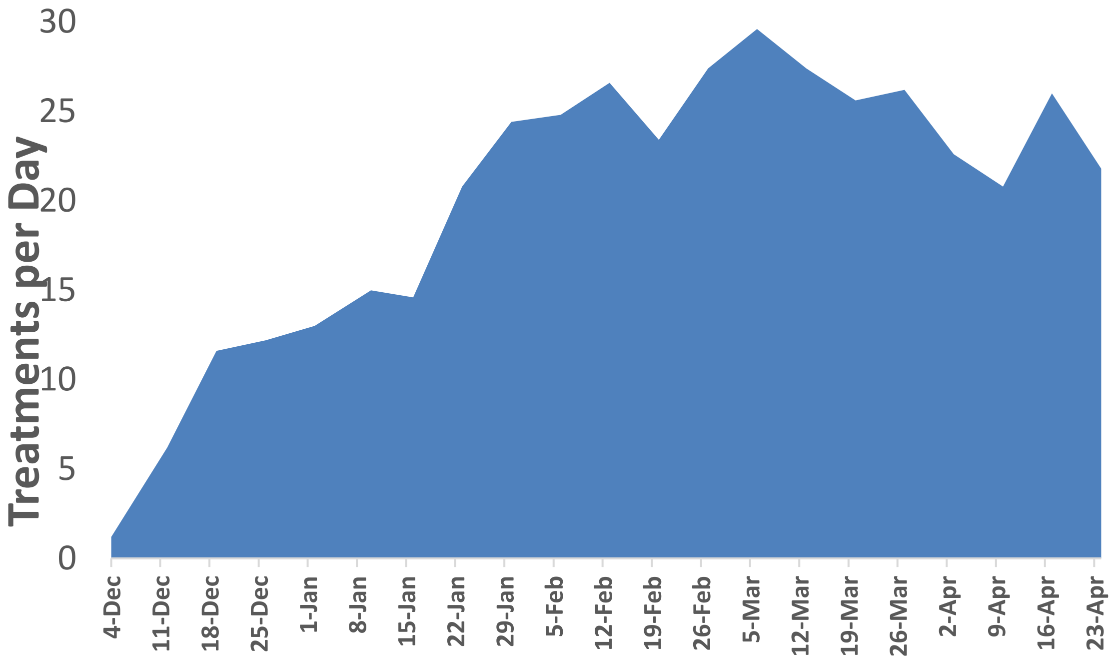
Henke et al. IJROBP, 96(5), 1078-1086, 2016

Adaptive Radiation Therapy (ART)



Henke et al. IJROBP, 96(5), 1078-1086, 2016


ETHOS
varian



Treatments per Day
30
25
20
15
10
5
0
4-Dec
11-Dec
18-Dec
25-Dec
1-Jan
8-Jan
15-Jan
22-Jan
29-Jan
5-Feb
12-Feb
19-Feb
26-Feb
5-Mar
12-Mar
19-Mar
26-Mar
2-Apr
9-Apr
16-Apr
23-Apr

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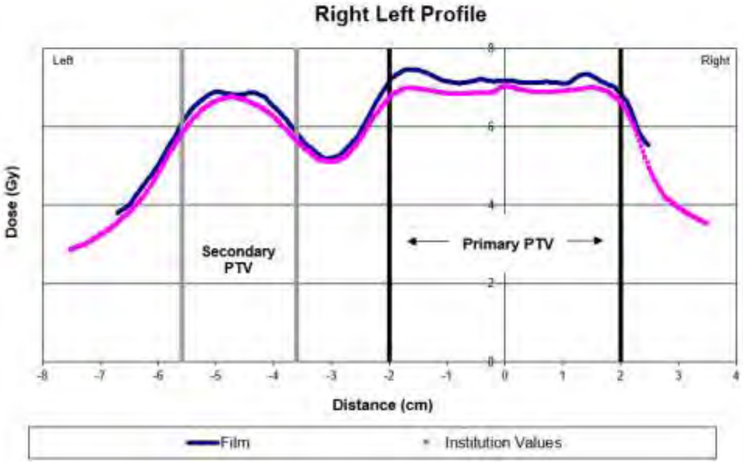
Report of IMRT Head and Neck Phantom Irradiation

Date of Report:	December 05, 2022
Institution:	University of Washington Medical Center
Physicist:	Wade P. Smith
Radiation Machine:	Varian, Halcyon (HAL1676) 6-FFF MV
Intensity Modulation Device:	MLC
IMRT Technique:	Dynamic MLC
Treatment Planning System:	Varian Ethos (Acuros)
Date of Irradiation:	October 28, 2022



IROC-H Phantom Family

2 prostate phantoms

33 lung phantoms

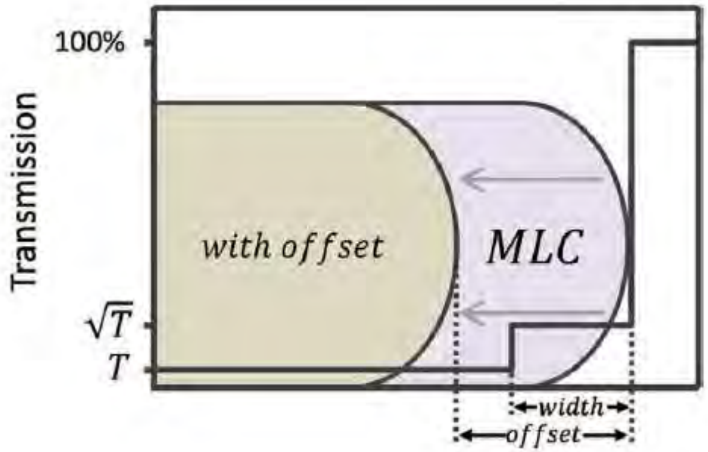
8 Spine phantoms

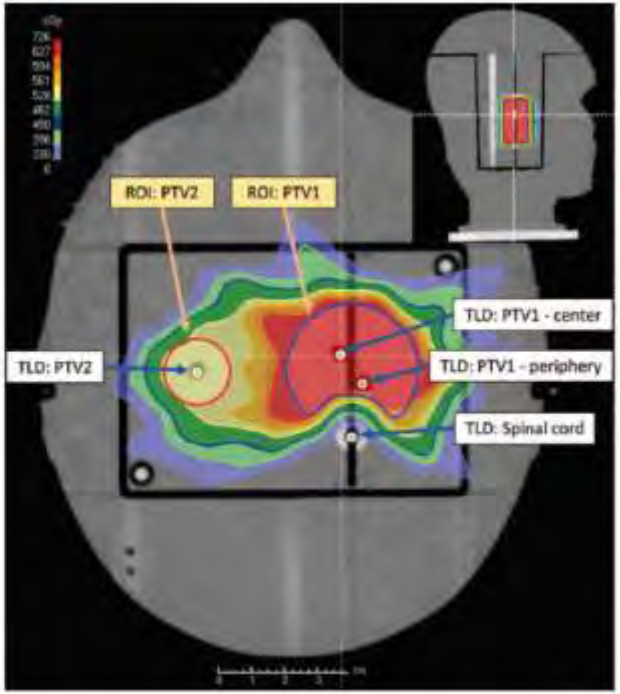
24 H&N phantoms

19 SRS phantoms

10 liver inserts

Courtesy: Dave Followill





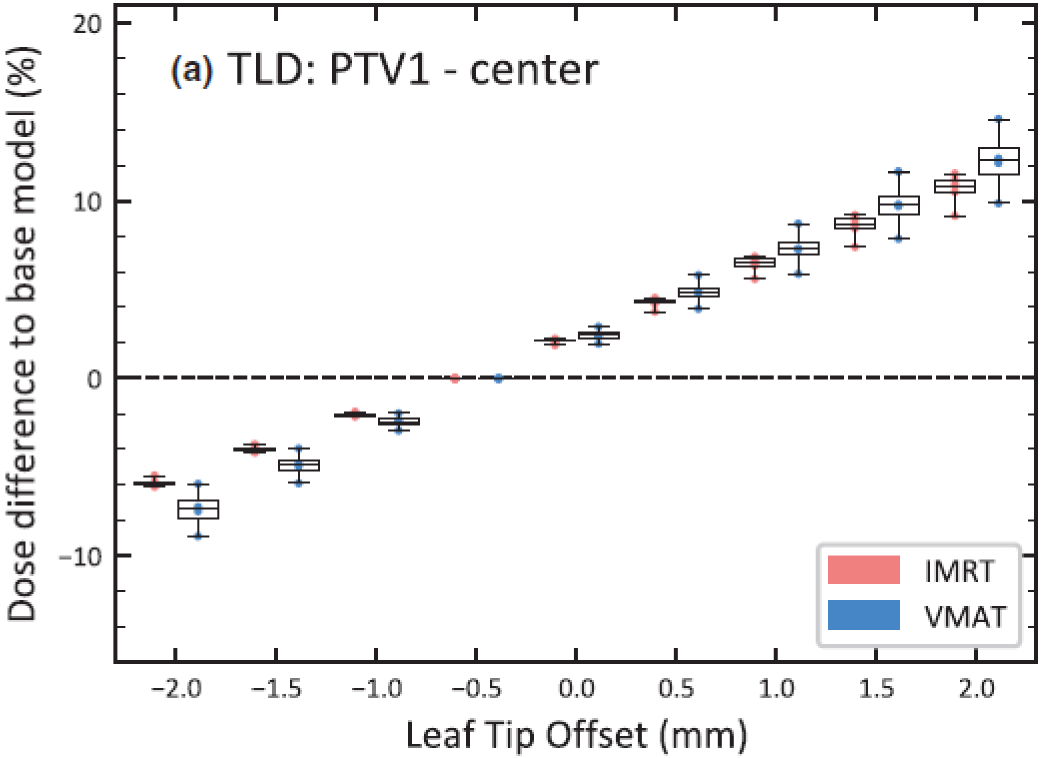
RADIATION ONCOLOGY PHYSICS

WILEY

Impact of the MLC leaf-tip model in a commercial TPS: Dose calculation limitations and IROC-H phantom failures

Brandon Koger | Ryan Price | Da Wang | Dolla Toomeh | Sarah Geneser | Eric Ford

Koger et al. JACMP, 21(2):82-89, 2020



Koger et al. JACMP, 2020

Small changes in TPS model can have large impact on plan delivery

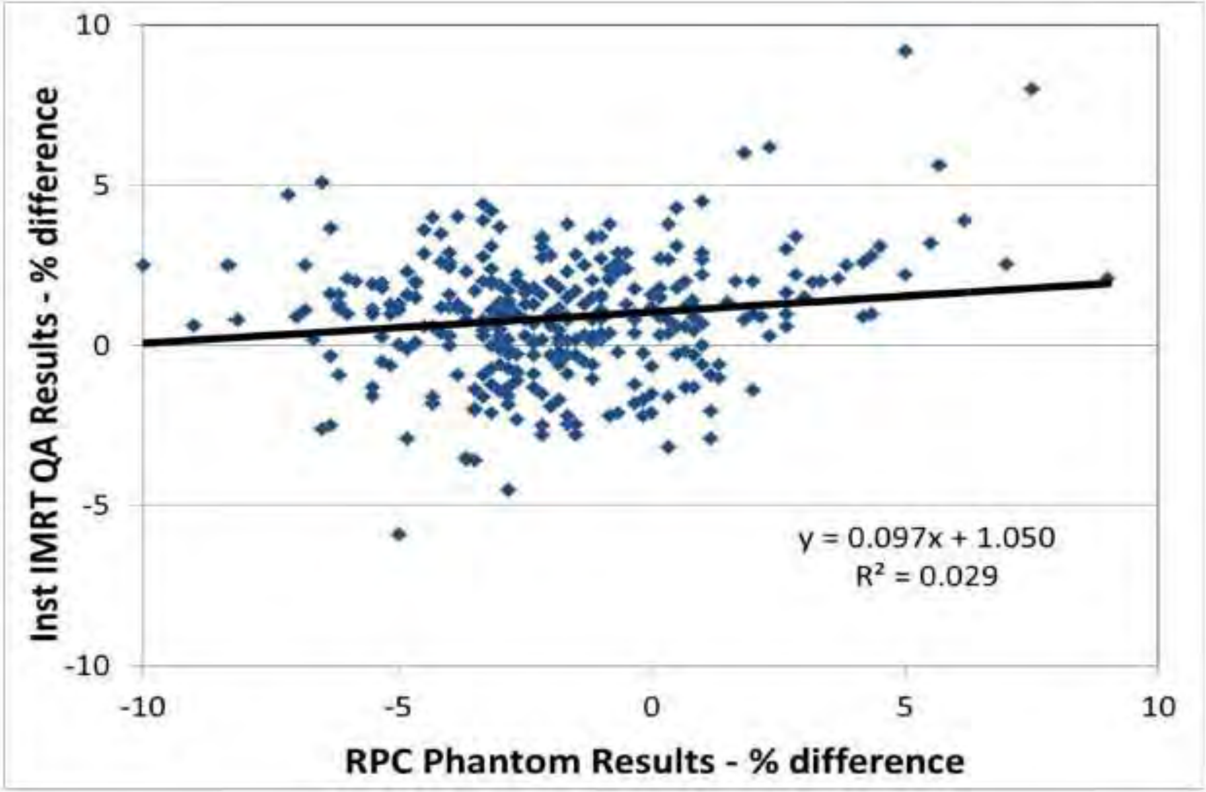


Figure 3.

Percent differences between dose measurements and treatment planning system calculations

Kry et al. IJROBP 90(5), 1195-1201, 2014

IROC-H Phantom Audit Results

Phantom	H&N	Liver	Lung	Prostate	Spine
Irradiations	1880	143	950	556	308
Pass	1595 (85%)	105 (73%)	784 (82%)	474 (85%)	237 (77%)
Fail	285	38	166	82	71
Criteria	7%/4mm	7%/4mm	5%/5mm	7%/4mm	5%/3mm

Courtesy: Dave Followill

How does this potentially translate into patient outcomes?

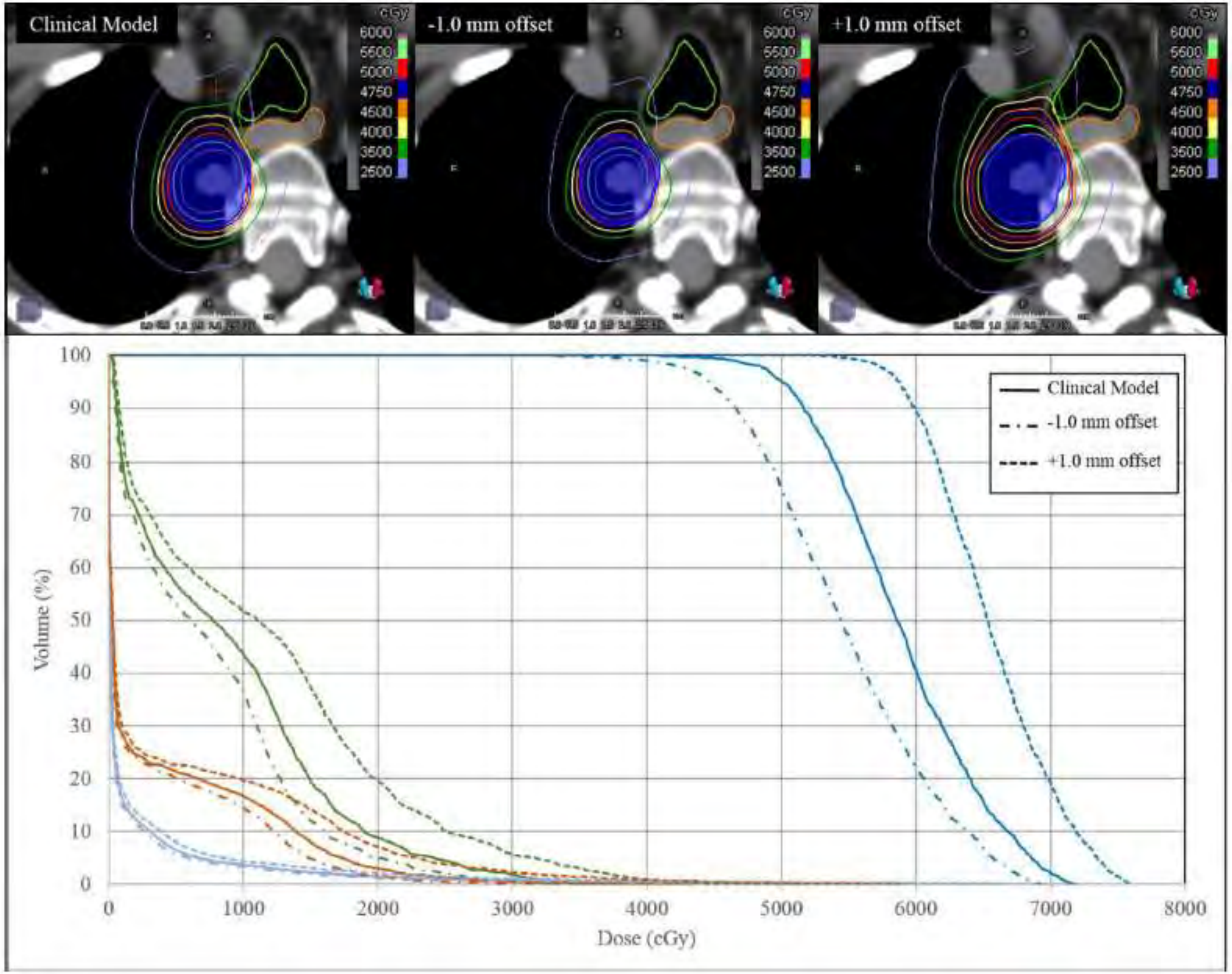
PHYSICS CONTRIBUTION

Predicted Inferior Outcomes for Lung SBRT With Treatment Planning Systems That Fail Independent Phantom-Based Audits

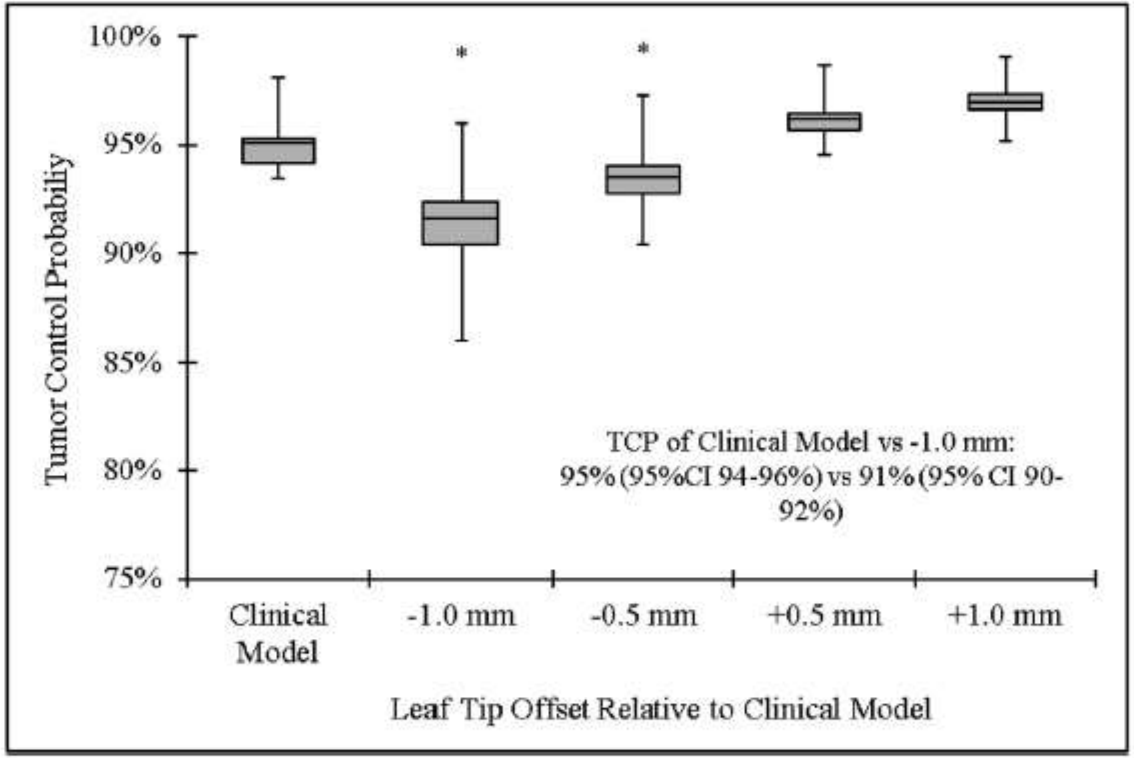
Matthew D. Greer, MD,[a,c] Brandon Koger, PhD,[b] Mallory Glenn, PhD,[a] John Kang, MD, PhD,[a] Ramesh Rengan, MD, PhD,[a] Jing Zeng, MD,[a] and Eric Ford, PhD[a]

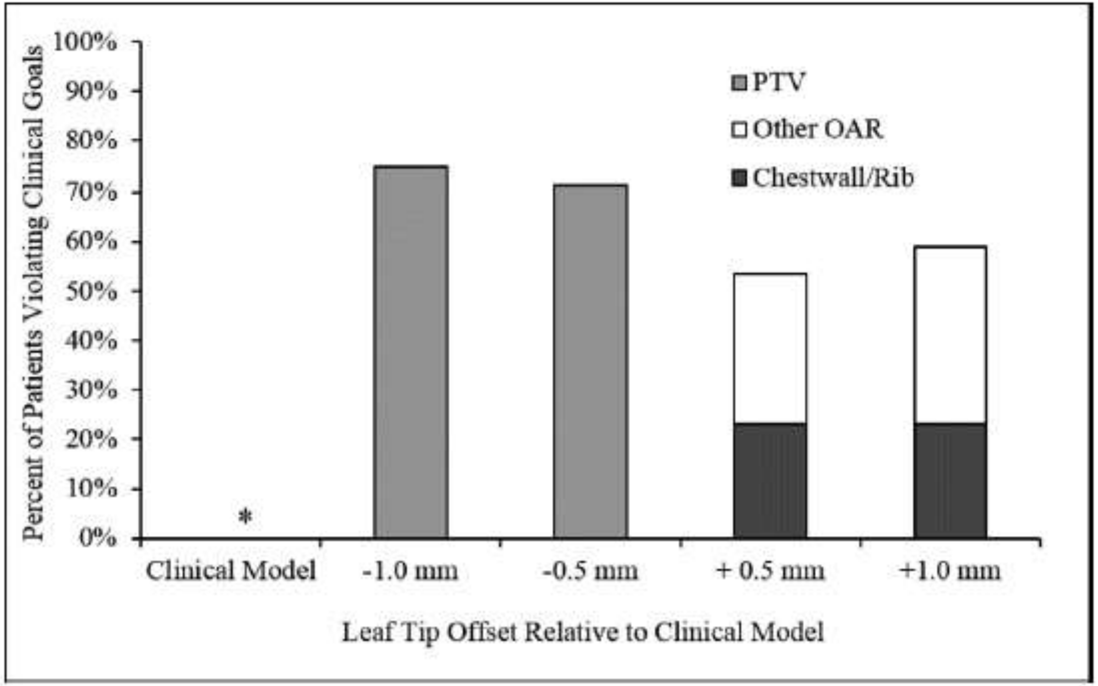
[a]University of Washington Department of Radiation Oncology, Seattle, Washington; [b]University of Pennsylvania Department of Radiation Oncology, Philadelphia, Pennsylvania; and [c]The University of Arizona Cancer Center, Tucson, Arizona

Received Mar 31, 2022; Accepted for publication Dec 5, 2022



Clinical Model
-1.0 mm offset
+1.0 mm offset
cGy
6000
5500
5000
4750
4500
4000
3600
2500
Volume (%)
Dose (cGy)
Clinical Model
-1.0 mm offset
+1.0 mm offset
0
10
20
30
40
50
60
70
80
90
100
0
1000
2000
3000
4000
5000
6000
7000
8000


100%
95%
90%
85%
80%
75%
Tumor Control Probabiliy
*
*
TCP of Clinical Model vs -1.0 mm:
95% (95%CI 94-96%) vs 91% (95% CI 90-92%)
Clinical Model
-1.0 mm
-0.5 mm
+0.5 mm
+1.0 mm
Leaf Tip Offset Relative to Clinical Model



Percent of Patients Violating Clinical Goals
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
PTV
Other OAR
Chestwall/Rib
*
Clinical Model
-1.0 mm
-0.5 mm
+ 0.5 mm
+1.0 mm
Leaf Tip Offset Relative to Clinical Model

Take-home points

- Rigorous policies and procedures to adhere to established best practices
- Be aware of risks in commissioning
  - Independent audits. End-to-end tests

Example in the treatment planning domain

Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275

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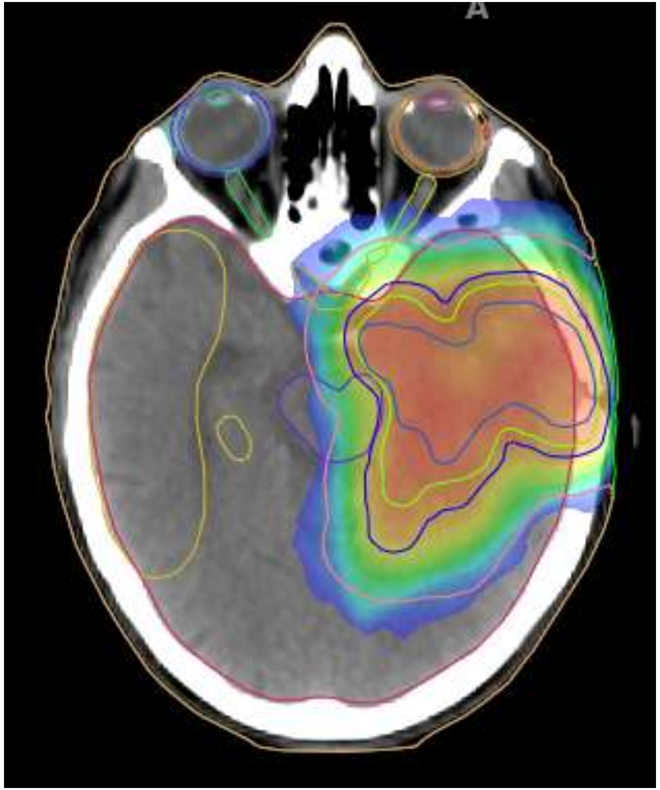
Med. Phys. 47 (6), June 2020   0094-2405/2020/47(6)/e236/37

Table 1a: Photon/electron EBRT high-risk failure modes for initial plan/chart review.

TG275 risk analysis

FM#	Process Step	Failure Mode	Cause	# checks	RPN	S	O	D
1	Tx Plan	"Wrong" or inaccurate MD contours	Workflow/Communication Issue, e.g., Attending MD does not review resident contours, MD does not clearly identify dose levels, Incorrect CT dataset, Fusion incorrect or with wrong image set, Target motion not considered, Wrong set of contours imported	7	261.3	7.4	4.9	7.2
2	Pt Assmnt	Miscommunication about prior dose, pacemaker, pregnancy	Information not communicated or available information incorrect	4	214.1	7.4	5.5	5.3
3	Tx Plan	Improper margins for PTV	Structural issues, e.g. policies and procedures inadequate or non-existent, margins not provided	2	198.0	5.5	6.0	6.0
4	Tx Plan	Unintentional re-irradiation of a previously treated area	Technical Issue: Inadequate medical records in hospital data base, Re-creation of prior plan incorrect, Missing previous RT dose structure, No records available (foreign country, distant past, lost)	3	181.2	7.7	3.8	6.2
5	Pt Assmnt	Incorrect or missing pathology	Pathology report incorrect or not read by MD	3	180.3	6.8	3.6	7.3
6	Tx Plan	Dose in plan does not match intended	Wrong Rx provided to planner, e.g. why: MD wrote wrong Rx (typo, e.g. 220x30 vs. 200x33) maybe via email, MD unintentionally writes Rx to max dose, wrong Rx signed off in chart or Rx not signed	7	175.3	6.4	5.8	4.8
7	Tx Plan	"Wrong" or inaccurate dosimetrist contours	Human performance issue by dosimetrist or other, e.g. distraction or interruption, inattention, slip, lack of training, mistakes CTV for PTV, forgets to expand CTV to PTV, full structure not contoured	5	175.2	6.2	5.5	5.2

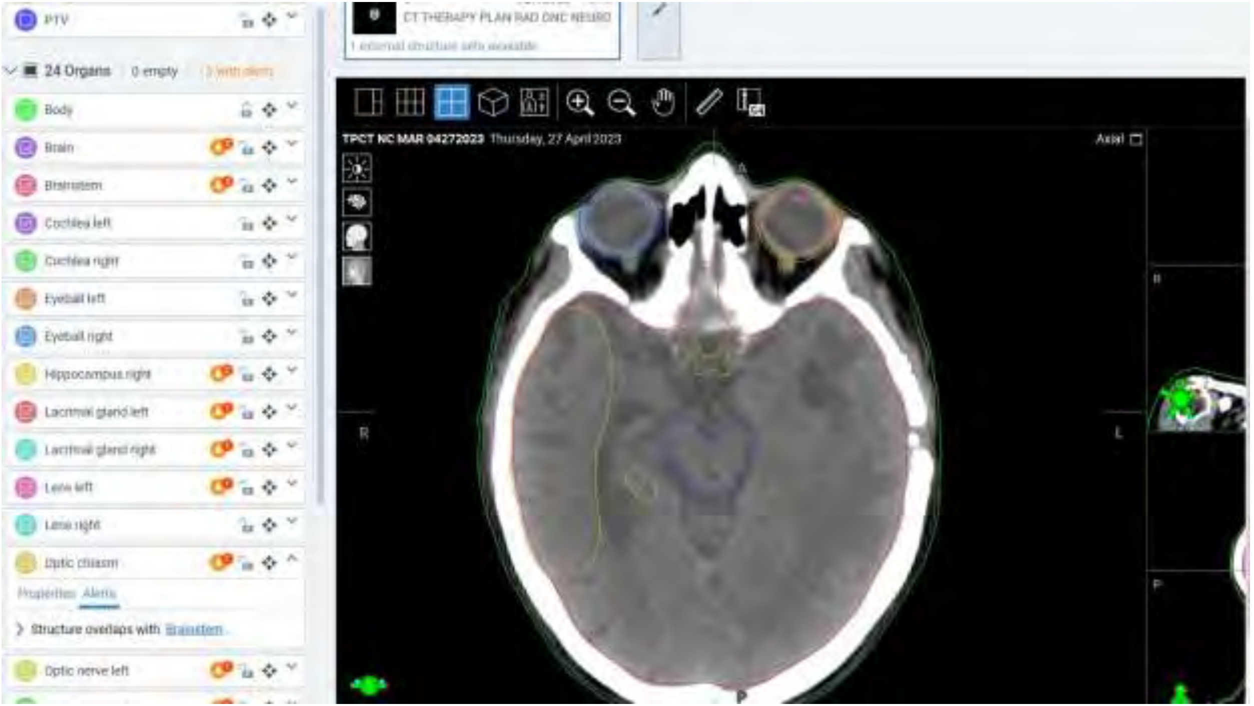
Automatic Planning: Case Study



Pt receiving treatment for GBM

Autoplanning in TPS.

Case Study

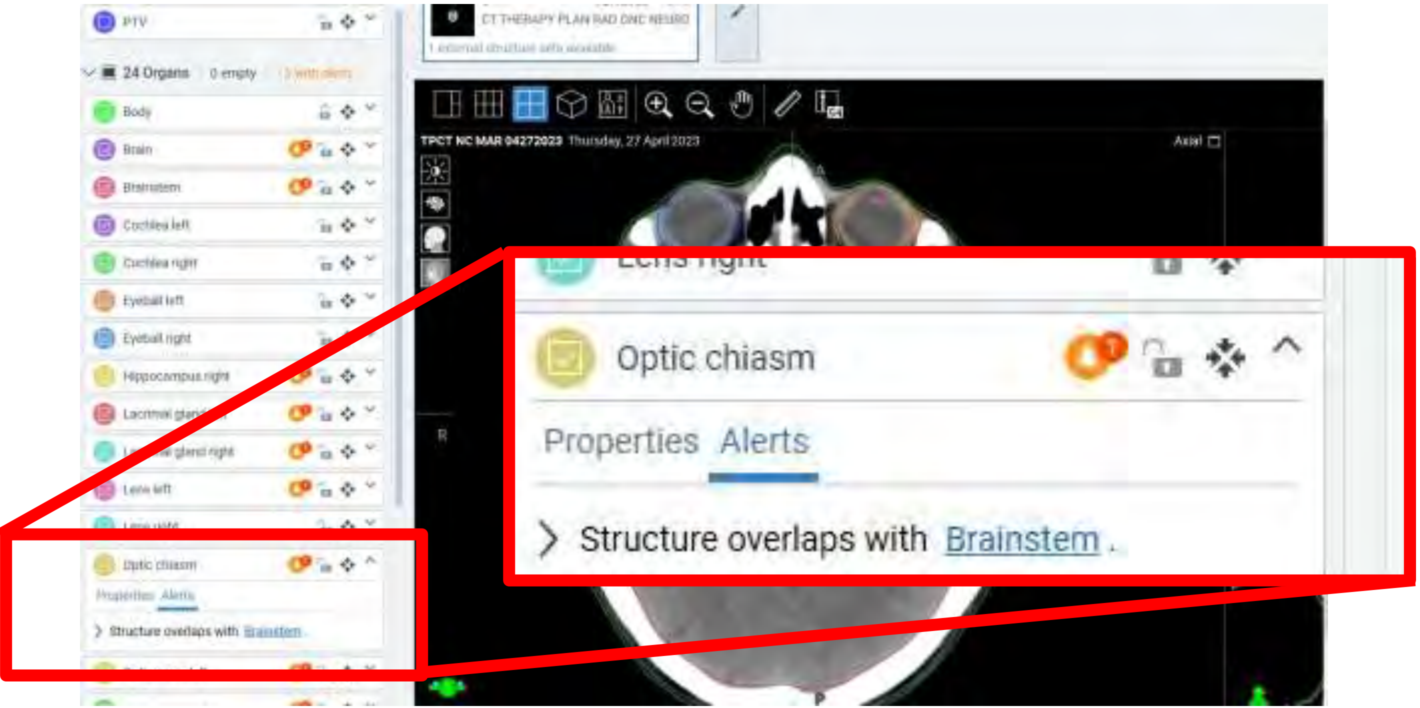


Brainstem OAR selected as type="brain"

Brain OAR
Selected as type = "brainstem"

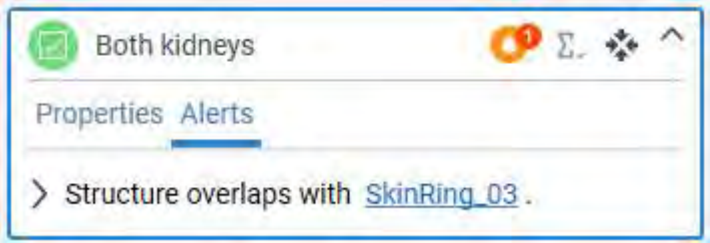
Optimizer creates non-ideal plan

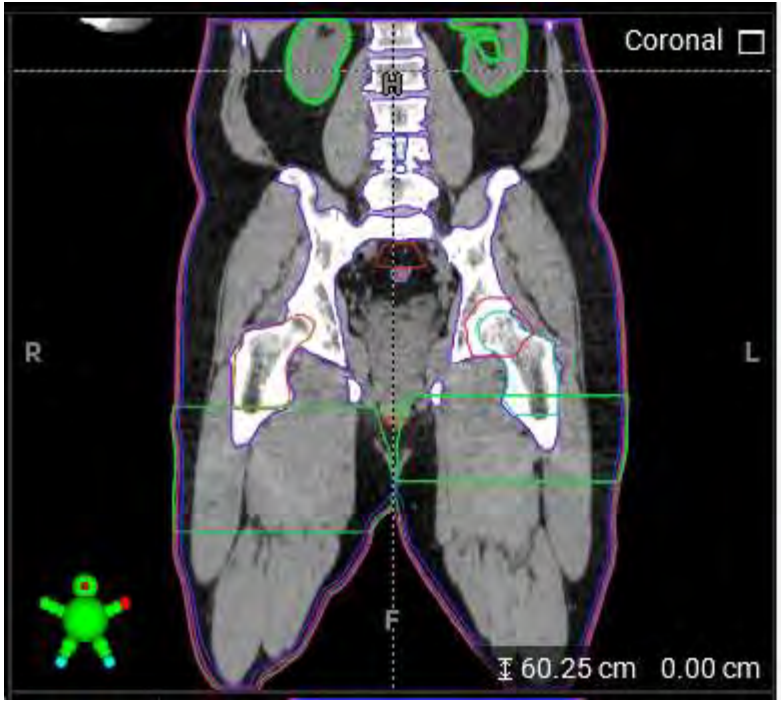
Finding the error



Warning flags

Causal Factor:
Human factors engineering and alert fatigure





Failure Modes and Effects Analysis (FMEA)

Failure mode	Cause	Effect	Process Step	O	S	D	RPN
MD fails to review daily cone beam	Image checks not fed into a queue in Ethos -- hard to tell which images need to be checked	Potential misalignment not reviewed	Image review	8	7	9	504
Dosimetrist mislabels one OAR as another	Wrong structure selected from dropdown menu	Critical structure potentially overdosed	Input and label contours	7	8	8	448
Ethos AI contour assigned to structure in lieu of MD contour for nonstandard anatomy	AI contours supersede contours imported from MIM unless deleted	Plan optimized on inaccurate AI contour	Input and label contours	8	5	10	400
Dosimetrist mis-enters clinical goal (e.g. set target dose > rather than < desired limit)	Wrong clinical goal type selected from dropdown menu	Suboptimal plan quality (e.g. plan too hot)	Input and authorize RT intent	8	5	9	360

Caroline Colbert et al.

Process steps

No	Process Steps	Role	High-Risk FMs
1	Simulation	RTT	
2	Import pt from Aria	Dosi	
3	Regster Images	Dosi	
4	Input and label contours	Dosi	3
5	Input and authorize RT intent	Dosi	1
6	Add sim iso, couch, and density overrides	Dosi	
7	Generate plans	Dosi	
8	Export/import from Eclipse	Dosi	
9	Make and review any composites in MIM	Dosi	
10	MD approves plan for treatment	MD	
11	Physics checks and approves plan for treatment	Physics	
12	Mobius plan check	Physics	
13	Perform composite QA	Resident	
14	Physics checks QA	Physics	
15	Select kV CBCT parameters	RTT	
16	Align and load pt	RTT	
17	Verify pt ID	RTT	
18	Beam on	RTT	
19	Mobius fx report	Physics	
20	Image review	MD	1

Caroline Colbert et al.

Safety Program for Residents

EDUCATION

WILEY

A patient safety education program in a medical physics residency

Eric C. Ford | Matthew Nyflot | Matthew B. Spraker | Gabrielle Kane | Kristi R. G. Hendrickson

J Appl Clin Med Phys 2017; 18:6: 268–274

Take-home points

- Rigorous policies and procedures to adhere to established best practices
- Be aware of risks in commissioning
  - Independent audits. End-to-end tests
- Opportunities to identify risk
  - Incident learning (RO-ILS, etc)
  - Failure Mode and Effects Analysis

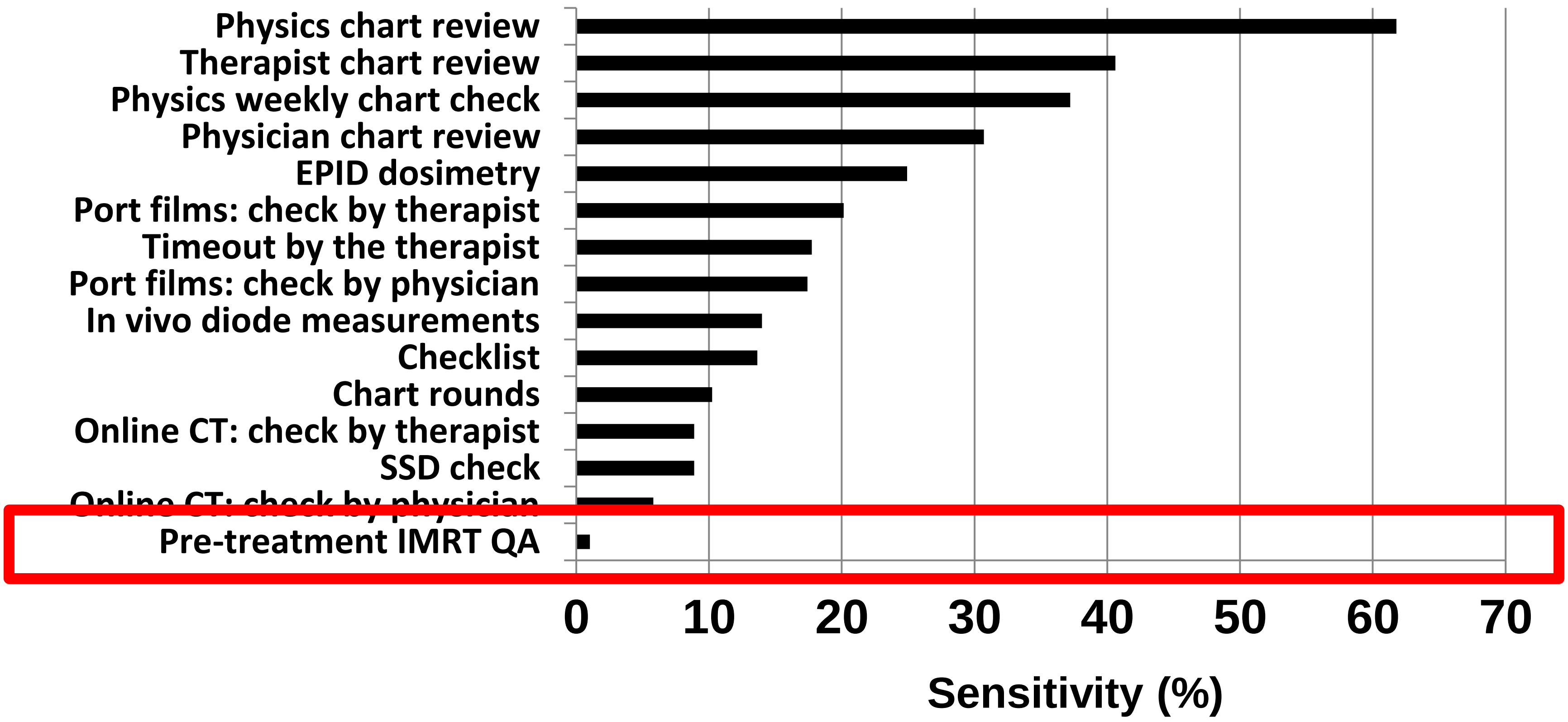
Outline

- Examples of quality gaps
  - Various domains: medical, physics, planning
- Access issues
- Directions for the future (and the present)

Quality Assurance

- What about our QA measures?
  - PSQA
  - Chart rounds

Limitations of Patient-Specific QA



Ford et al. Int J Radiat Oncol Biol Phys, 84(3), e263-9 (2012)

Yale SCHOOL OF MEDICINE

Practical Radiation Oncology® (2020) 10, 312-320

www.practicalradonc.org

Clinical Investigation

A Blinded, Prospective Study of Error Detection During Physician Chart Rounds in Radiation Oncology

Wesley J. Talcott, MD, MBA,[a,*] Holly Lincoln, MS, DABR,[a] Jacqueline R. Kelly, MD, MSc,[a] Lauren Tressel, BS,[b] Lynn D. Wilson, MD, MPH, FASTRO,[a] Roy H. Decker, MD, PhD,[a] Eric Ford, PhD, FAAPM,[c] Pehr E. Hartvigson, MD,[d] Todd Pawlicki, PhD, FAAPM, FASTRO,[e] and Suzanne B. Evans, MD, MPH[a]

[a]Department of Therapeutic Radiology, Yale School of Medicine, New Haven, Connecticut; [b]Department of Radiation Oncology, Yale-New Haven Hospital, New Haven, Connecticut; [c]Department of Radiation Oncology, University of Washington, Seattle, Washington; [d]Department of Radiation Medicine, Oregon Health & Science University, Portland, Oregon; and [e]Department of Radiation Medicine and Applied Sciences, University of California San Diego, La Jolla, California

Methods

- Generated 20 problematic treatment plans
- Inserted PPs randomly into a weekly, hour-long chart rounds
- Blinded to minimize the Hawthorne effect

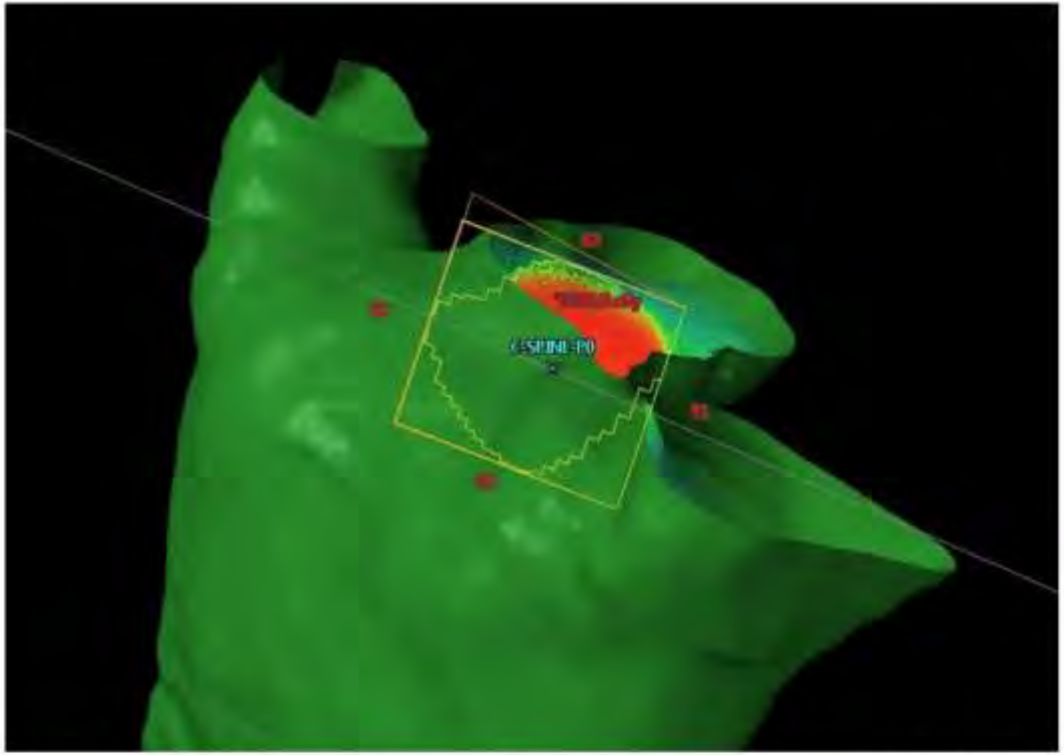
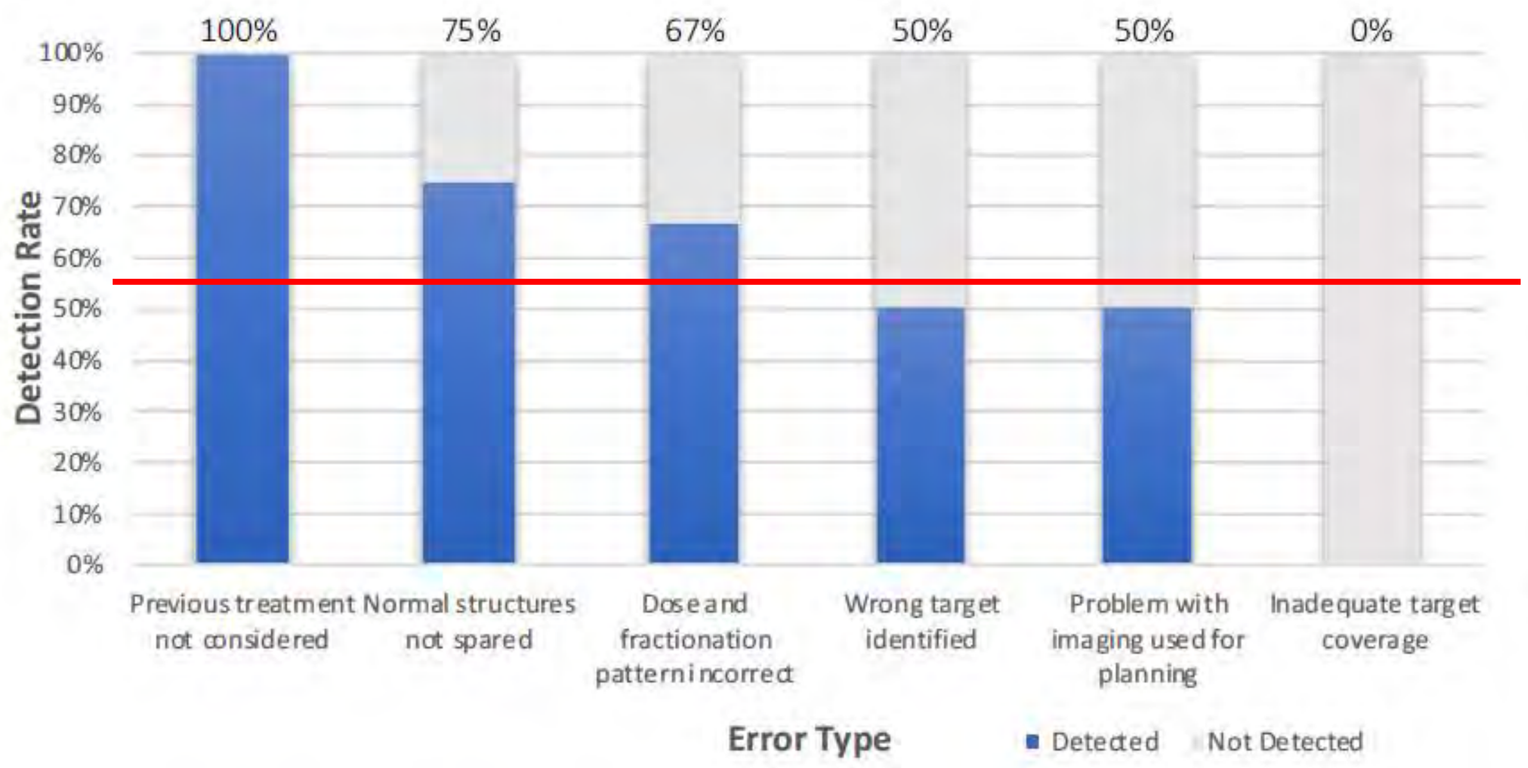


Figure 1. Radiation field for a C spine treatment with missing CT data in the beam path.

Slides courtesy of Suzanne Evans, MD

Results

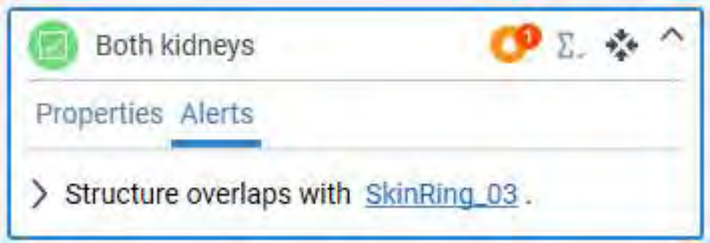


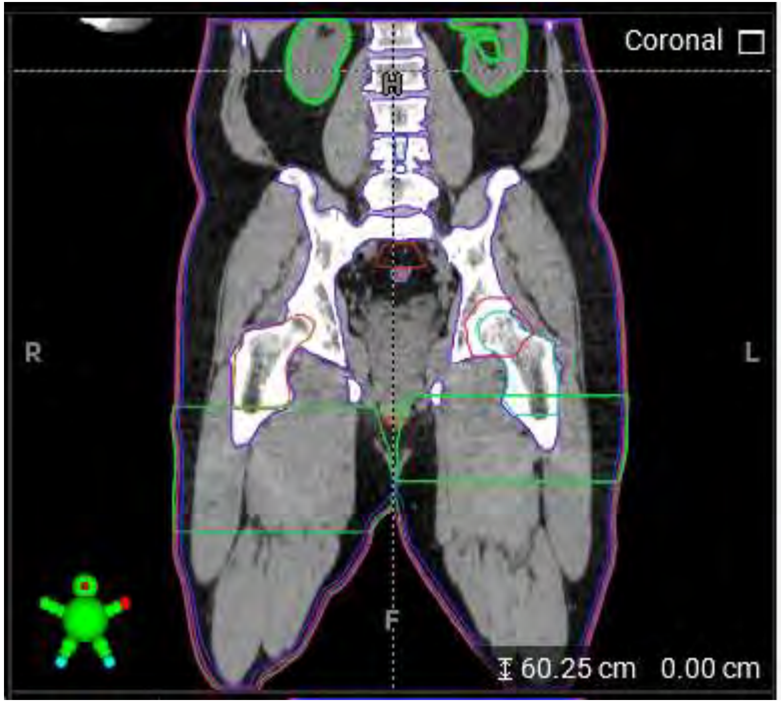
100%
75%
67%
50%
50%
0%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Detection Rate
Previous treatment not considered
Normal structures not spared
Dose and fractionation pattern incorrect
Wrong target identified
Problem with imaging used for planning
Inadequate target coverage
Error Type
Detected
Not Detected

Outline

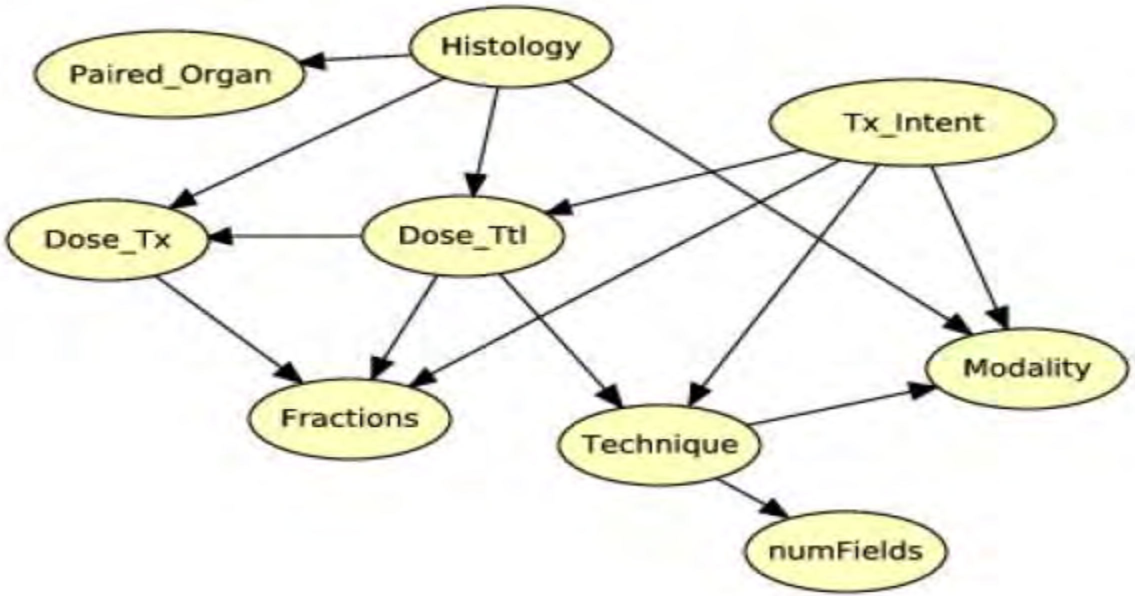
- Examples of quality gaps
  - Various domains: medical, physics, planning
- Access issues
- Directions for the future (and the present)
  - Automation

Can systems be re-designed?





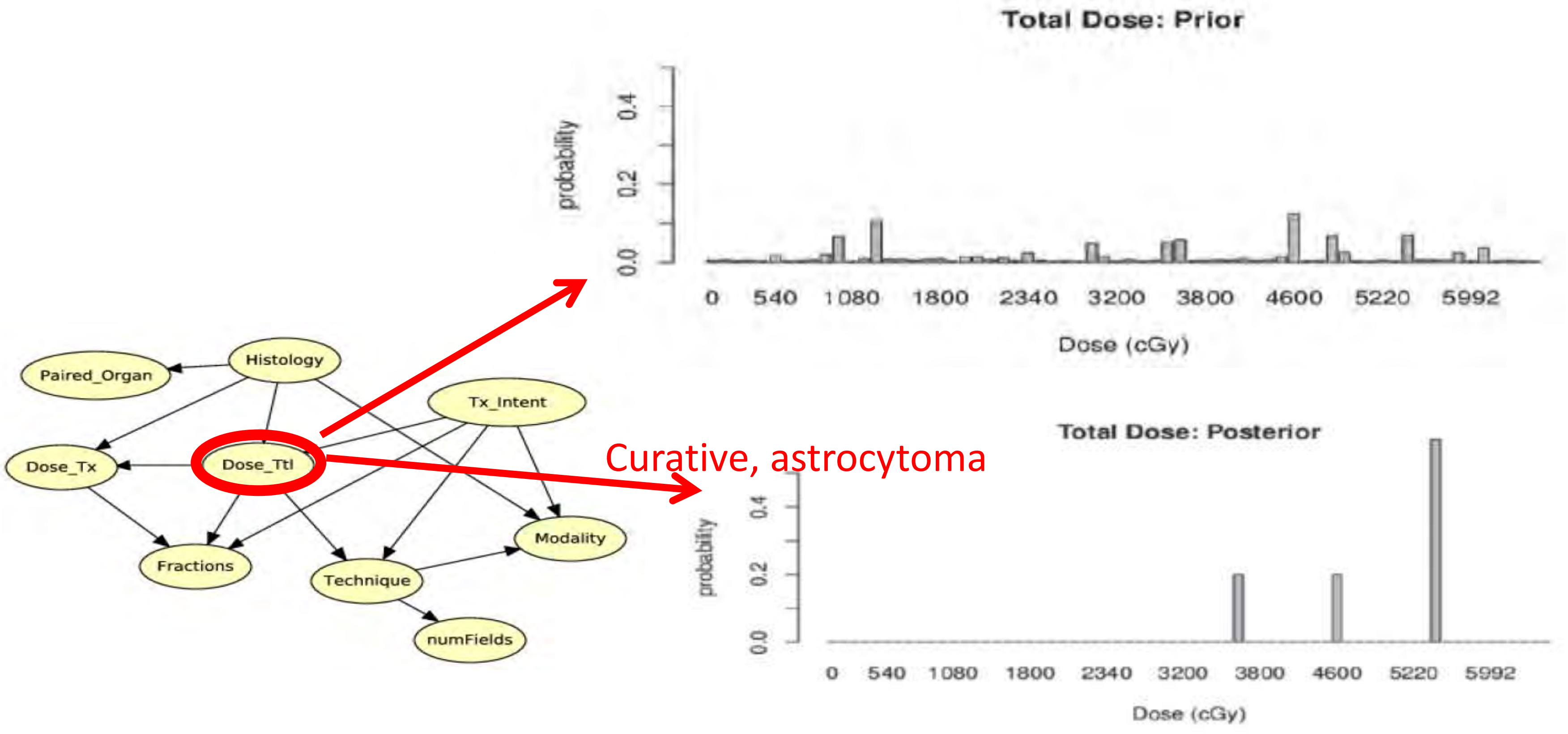
Automate tasks like chart checks or peer-review?



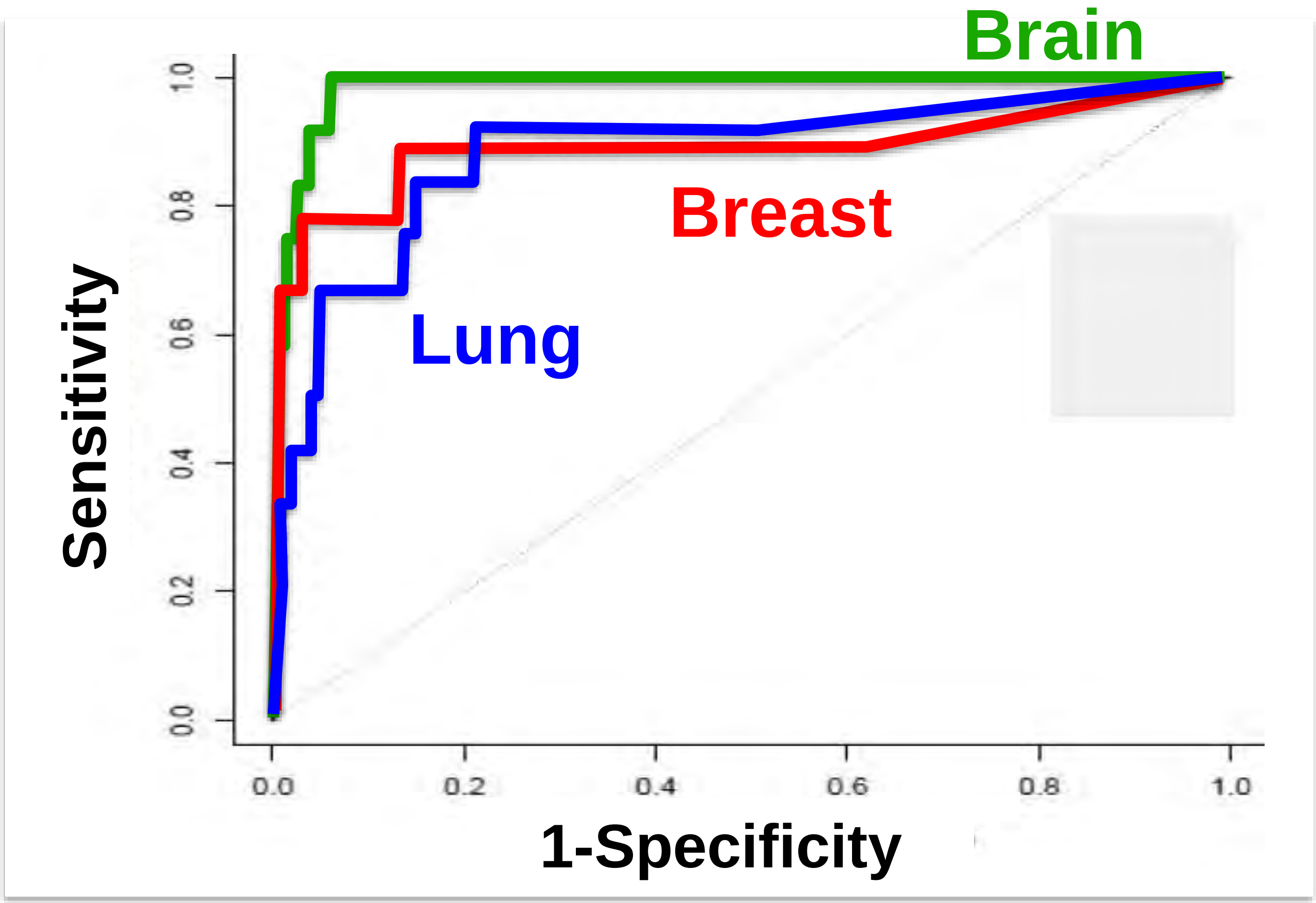
Probabilistic Network for Error Detection

Alan Kalet, Mark Phillips et al. Phys Med Bio, 60, 2735-2749, 2015

Bayesian Network



Kalet et al. Phys Med Bio, 60, 2735-2749, 2015



Kalet et al. Phys Med Bio, 60, 2735-2749, 2015

Table 1a: Photon/electron EBRT high-risk failure modes for initial plan/chart review.

TG275 risk analysis

FM#	Process Step	Failure Mode	Cause	# checks	RPN	S	O	D
1	Tx Plan	"Wrong" or inaccurate MD contours	Workflow/Communication Issue, e.g., Attending MD does not review resident contours, MD does not clearly identify dose levels, Incorrect CT dataset, Fusion incorrect or with wrong image set, Target motion not considered, Wrong set of contours imported	7	261.3	7.4	4.9	7.2
2	Pt Assmnt	Miscommunication about prior dose, pacemaker, pregnancy	Information not communicated or available information incorrect	4	214.1	7.4	5.5	5.3
3	Tx Plan	Improper margins for PTV	Structural issues, e.g. policies and procedures inadequate or non-existent, margins not provided	2	198.0	5.5	6.0	6.0
4	Tx Plan	Unintentional re-irradiation of a previously treated area	Technical Issue: Inadequate medical records in hospital data base, Re-creation of prior plan incorrect, Missing previous RT dose structure, No records available (foreign country, distant past, lost)	3	181.2	7.7	3.8	6.2
5	Pt Assmnt	Incorrect or missing pathology	Pathology report incorrect or not read by MD	3	180.3	6.8	3.6	7.3
6	Tx Plan	Dose in plan does not match intended	Wrong Rx provided to planner, e.g. why: MD wrote wrong Rx (typo, e.g. 220x30 vs. 200x33) maybe via email, MD unintentionally writes Rx to max dose, wrong Rx signed off in chart or Rx not signed	7	175.3	6.4	5.8	4.8
7	Tx Plan	"Wrong" or inaccurate dosimetrist contours	Human performance issue by dosimetrist or other, e.g. distraction or interruption, inattention, slip, lack of training, mistakes CTV for PTV, forgets to expand CTV to PTV, full structure not contoured	5	175.2	6.2	5.5	5.2

Groupwise Conditional Random Forests for Automatic Shape Classification and Contour Quality Assessment in Radiotherapy Planning

Chris McIntosh*, Igor Svistoun, and Thomas G. Purdie

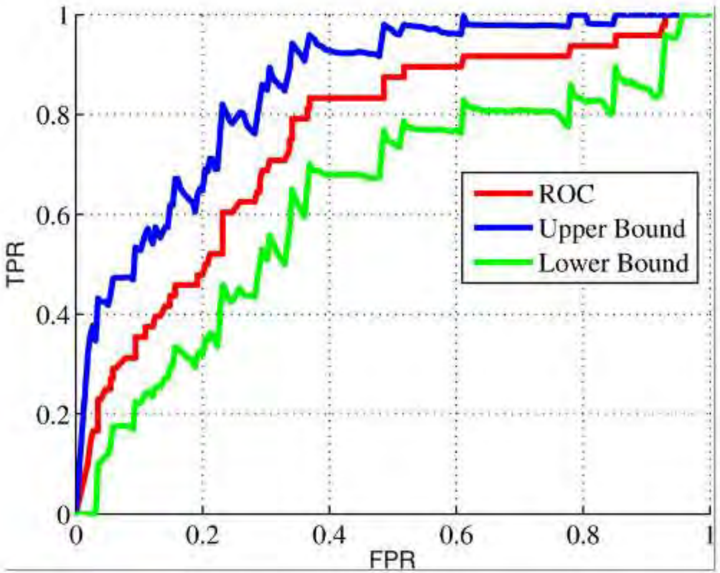


Fig. 7. ROC curve with 95% confidence interval for detection of contour drawing errors in ROIs.

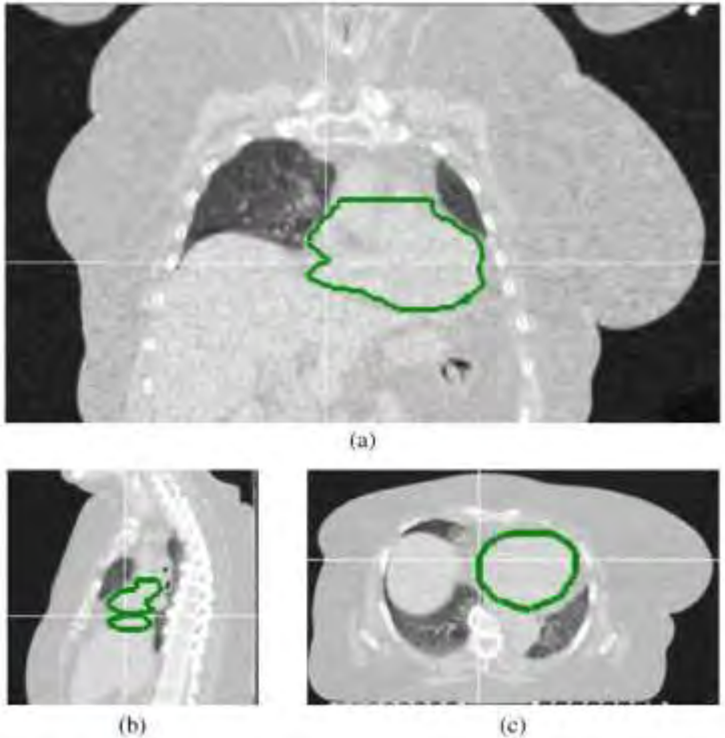


Fig. 2. (Color Figure) A radiotherapy plan showing only the heart ROI.

Automatic detection of contouring errors using convolutional neural networks

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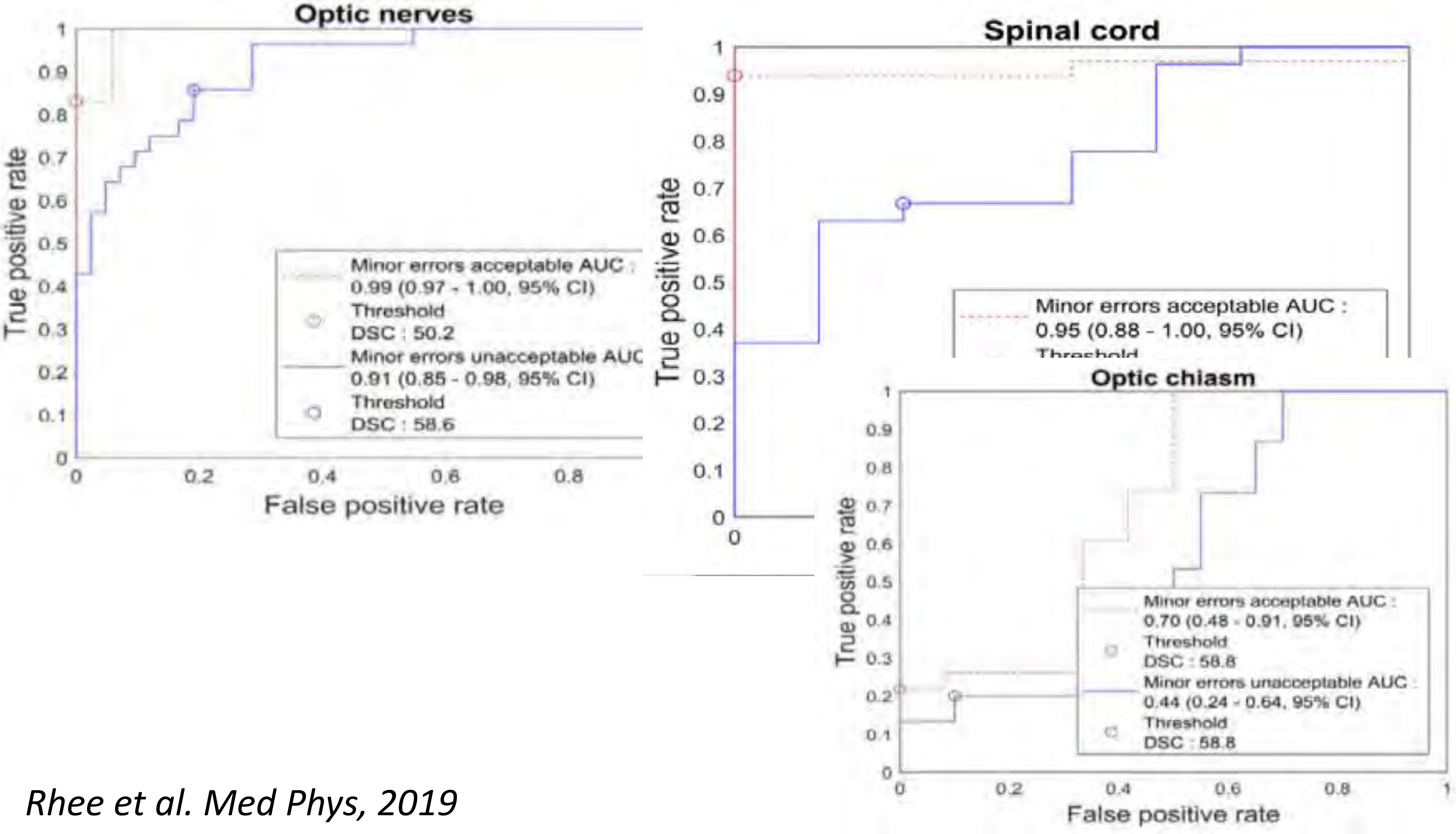
Med. Phys. 0 (0), xxxx (Received 30 April 2019; revised 28 August 2019; accepted for publication 30 August 2019;



Rhee et al. Med Phys, 2019

Sample TG275 recommended checks

Physics Check Item		Corresponding Failure Modes	# FM	Highest RPN	Use Freq	Status	Auto. target
Patient Assessment							
PA-Q1-1	Prescription (with respect to standard of care or institutional clinical guidelines)	6,9,13,15,17,20,26,28,34,67	10	175.3	86%	++	
PA-Q1-2	Prescription approval by attending radiation oncologist	6,17,74,87	4	175.3	92%		F
PA-Q1-3	Diagnosis definition including imaging and outside records	5,8,13,31,45,48	6	180.3	37%	OP	
PA-Q1-4	Pathology Report	5	1	180.3	18%	OP	
PA-Q1-5	Medical Chart to confirm laterality, site, etc	5,31,48	3	180.3	57%	+	
PA-Q1-6	Special Considerations for radiotherapy (e.g. pacemakers, ICDs, pumps, etc.)	2,19,23,46,68,73,83,91,107,110	10	214.1	89%	++	P
PA-Q1-7	Previous radiotherapy treatments	2,4,10,12,23,58	6	214.1	87%	++	P
Treatment Planning							
	Contouring checks Items reviewed during contour checks:	**Yes: 77%**					
TP-Q1a-1	Target(s)	1,3,7,18	4	261.3	65%	++	P
TP-Q1a-2	Organs-at-Risk (OAR's)	1,7,18	3	261.3	69%	++	P
TP-Q1a-3	Body/External contour (if required/applicable)	1,7	2	261.3	57%	+	P
TP-Q1a-4	PTV and OAR Margin	3,7,18	3	198	59%	+	F

Sample TG275 recommended checks

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Patient Assessment							
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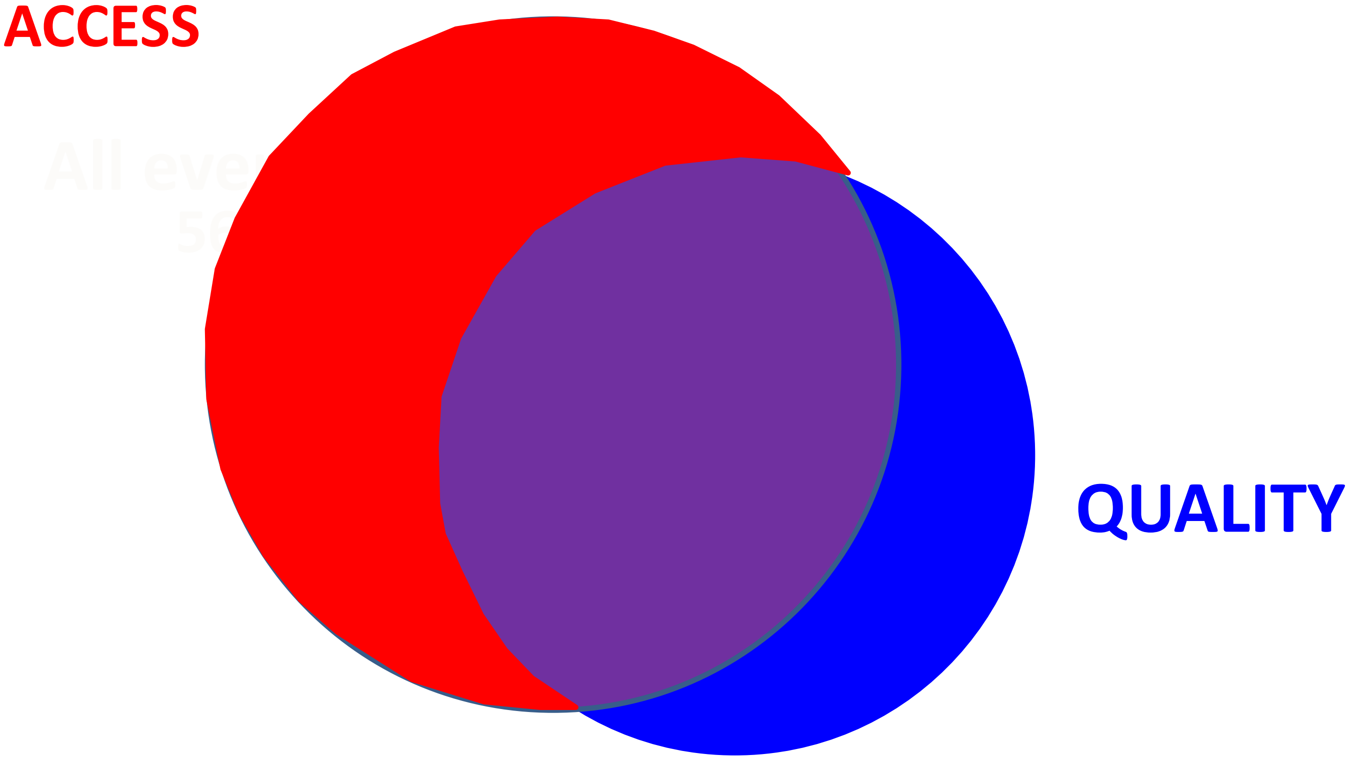
TP-Q1a-4	PTV and OAR Margin	3,7,18	3	198	59%	+	F

Targets for Automation

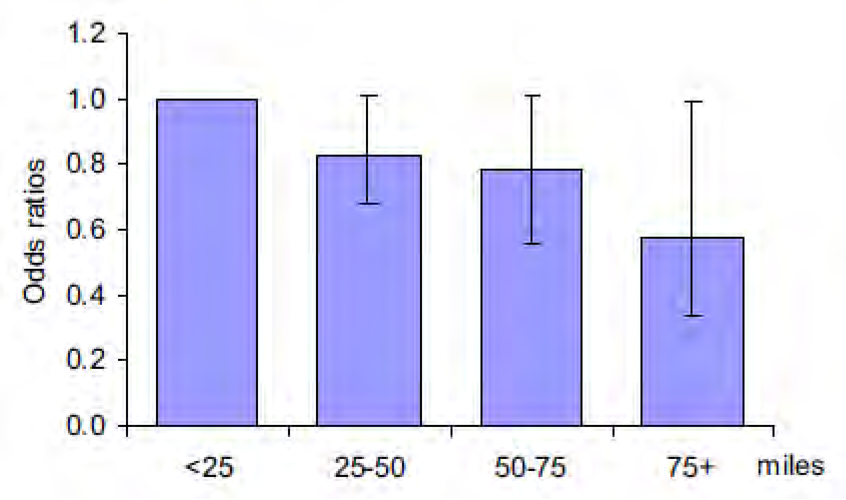
Outline

- Examples of quality gaps
  - Various domains: medical, physics, planning
- Access issues
- **Directions for the future (and the present)**
  - **Automation**
    - **Autoplanning, plan quality, automatic machine QA, etc**


ACCESS
QUALITY

Access to RT

SEER. Stage I/II Breast Cancer. N=19,787 in 1990's.
Likelihood of receiving PMRT: Distance to nearest RT facility (esp in older pts)



Punglia et al. IJROBP, 66, 56-63, 2006.

Access

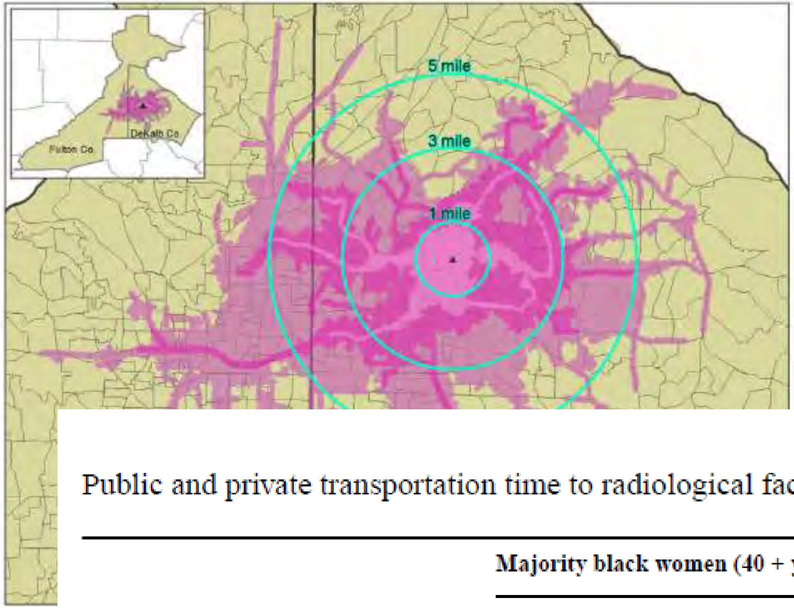


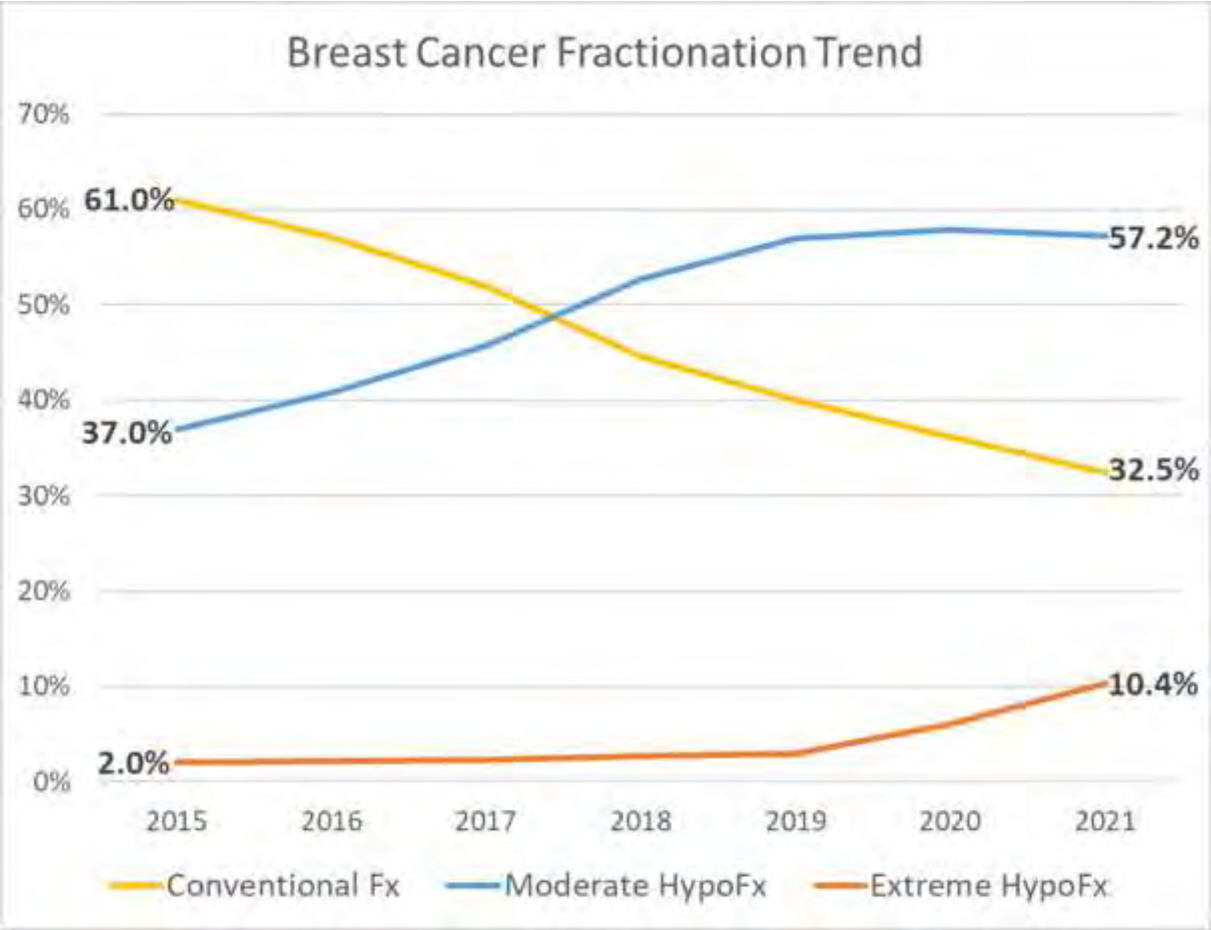
Fig. 2.
Compariso
counties.

Table 2

Public and private transportation time to radiological facilities by household availability of a private vehicle and by race, Fult

	Majority black women (40 + years)					Majority white women (40 + years)				
	# Tracts (n = 154)	Mean	Median	25%	75%	# Tracts (n = 115)	Mean	Median	25%	75%
Public transportation time (minutes)										
Low vehicle access (NVA > 20%)	80	46.0	45.6	38.9	55.2	2	13.1[a]	13.4[a]	13.4[a]	13.4[a]

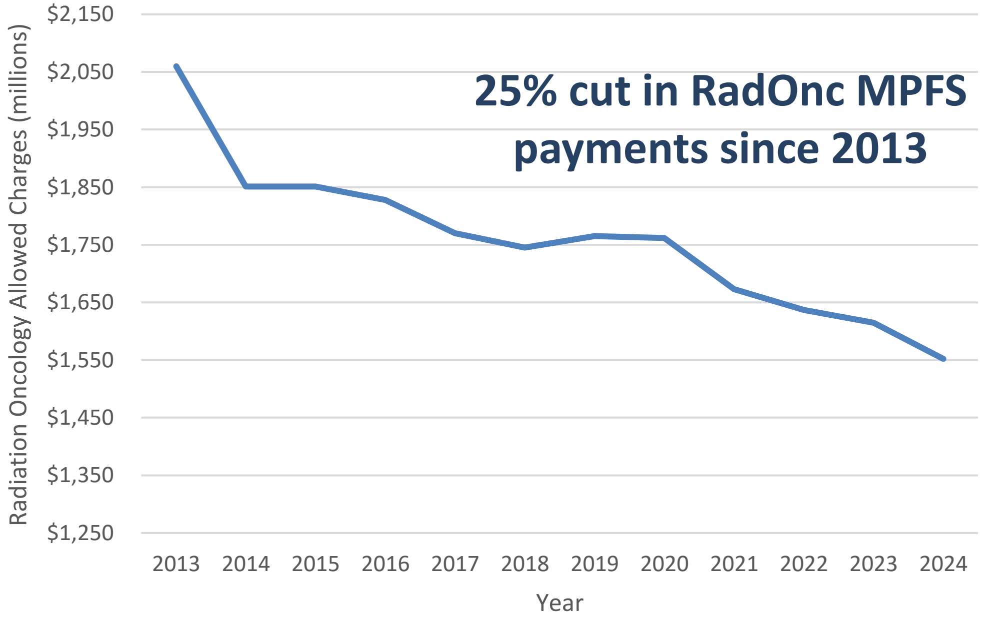
Peipins et al. Soc Sci Med, 89: 32-38, 2013



Slide courtesy of Anne Hubbard, ASTRO

Threats to US Radiation Oncology Clinics

- Increased use of hypofractionation
- Declining reimbursements
- Reduced access



courtesy of Anne Hubbard, ASTRO

ASTRO

TARGETING CANCER CARE

Advocacy

Home / Advocacy / Key Issues / ROCR

ASTRO PAC
- Key Issues
  - Medicare Payments
  - Cancer Research
  - Access to Care

Radiation Oncology Case Rate Program (ROCR)

The ASTRO-proposed Radiation Oncology Case Rate (ROCR) program represents a legislative initiative to reverse disastrous Medicare payment trends that are expected to continue. ASTRO believes ROCR represents the best chance to secure long-term rate stability and continue to deliver cutting-edge care to our patients close to home.

ROCR: features

Included

- All radiation oncology practices participating in Medicare
- Professional and technical services paid under Medicare fee schedule and hospital outpatient prospective payment system
- 15 common cancer types
- External beam modalities and associated services
    - » Conventional, IMRT, SRS, SBRT

ROCR Payment Methodology

1. Professional and technical payment rates derived from "M code" case rates for 15 cancer types
   – Treatment planning triggers first half of payment
   – Second payment at completion of treatment
2. Inflationary update to professional and technical payments
   – Medicare Economic Index to professional
   – Hospital Market Basket update to technical
3. Savings adjustment
   – Designed to save Medicare ~1% per year (about $17,500 per practice, per year)
   – Savings necessary for Congressional consideration

Slide courtesy of Anne Hubbard, ASTRO

ROCR Payment Methodology continued

- Health Equity Achievement in Radiation Therapy (HEART) payment adjustment to technical payment
  - $500/patient for transportation assistance for eligible patients
- Accreditation incentive adjustment to technical payment
  - Years 1 - 3: +0.5% adjustment
  - Year 4 and beyond: -1.0% adjustment

Slide courtesy of Anne Hubbard, ASTRO

Conclusions

- Current gaps in quality of care & access for ca patients
- Near & long-term strategies
- Acute global need

Thank you!

eford@uw.edu

@HoldDownTheFord