Enhancing quality through continuous improvement in reirradiation

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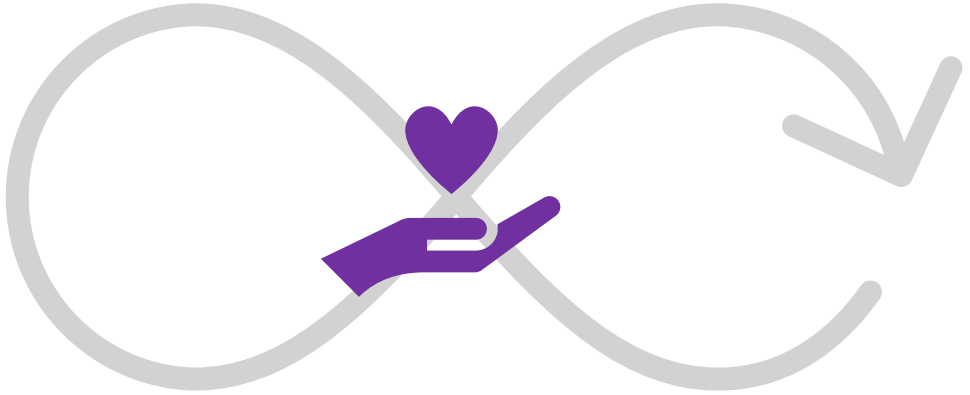

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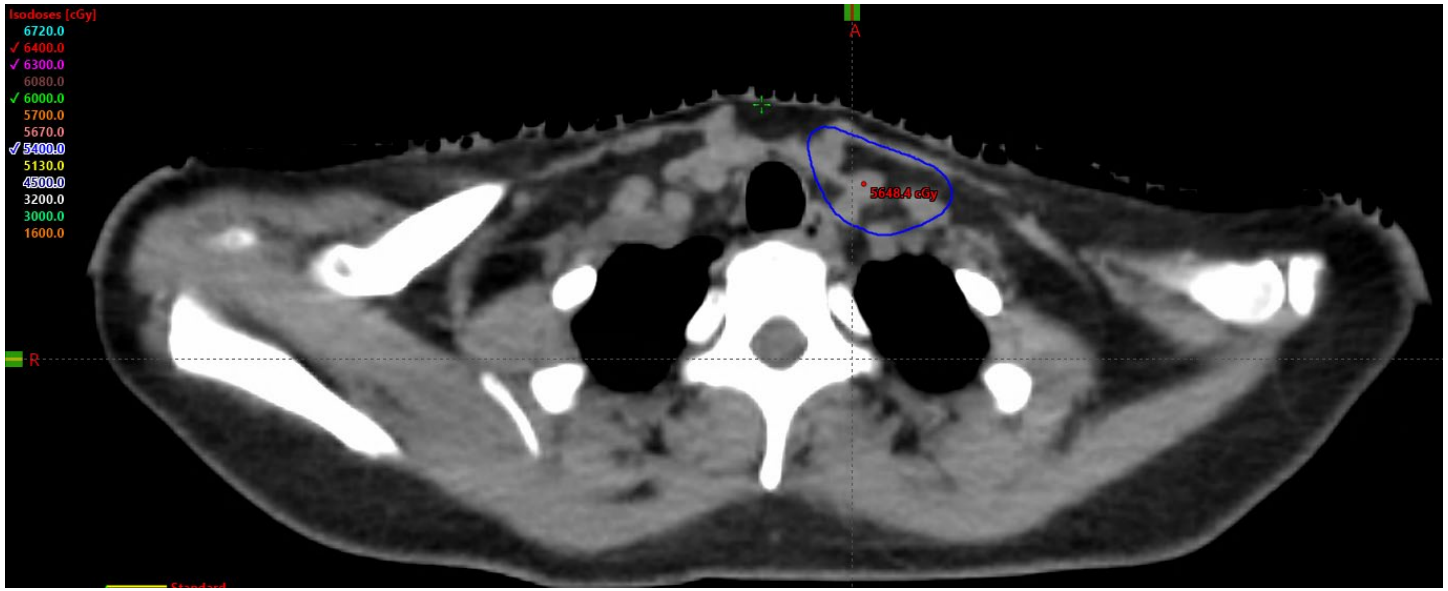
A Case To Start Off

53 year-old woman underwent resection of a primary salivary gland lymphoepithelial-like carcinoma of the left parotid.

Pathology: T2N2b, positive margins, 10/33 nodes positive.

Received adjuvant RT, 64 Gy in 30 fractions, completed March 2022



Lowest slice of plan
(arms down with shell)

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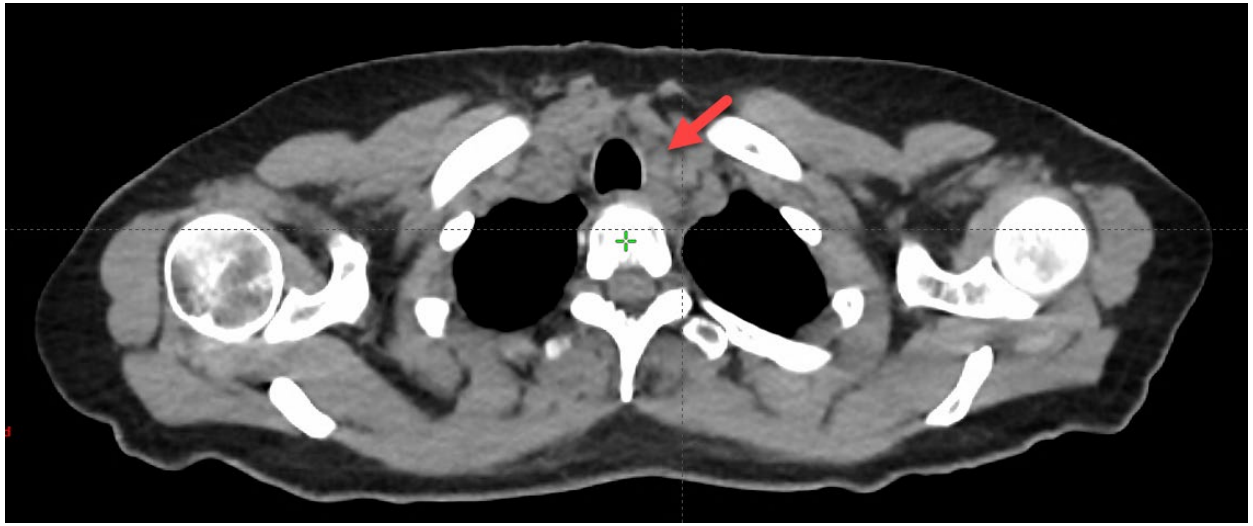
A Case To Start Off

March 2024, new stage III NSCLC left lower lobe (new primary) with high neck nodes.



Dilemma: Trachea, esophagus, and plexus in this area received ~52 Gy in 30 fractions (EQD_2 of 49 Gy). Giving another 60 Gy will exceed tolerance.

Do you forgive any dose to try for a curative-intent treatment?

The Re-Irradiation Tightrope

Dose Too High

Injury to normal structures

Can lead to morbidity and mortality

Dose Too Low

Local recurrence

Can lead to morbidity and mortality

A cancer that is uncontrolled because of undertreatment is a serious toxicity

What is an acceptable toxicity risk?

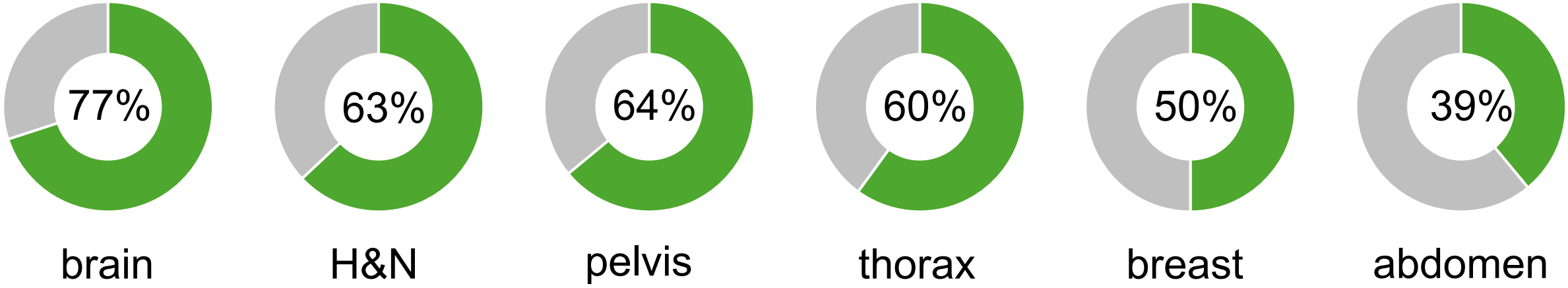
Our Talk Today

- Overview of Re-Irradiation Patterns of Practice
- Review of Recent Guidelines and Approaches
- Our REPAIR trial
- How can MROQC Improve the Field?

The evolving role of reirradiation

- Growing interest in reirradiation, made feasible by technology
- Practice goes back to the 1920s!
- ESTRO-EORTC E^2RADIatE platform
  - ReCare cohort
  - Patterns of practice

What do you treat with reirradiation?



How do we improve access?

How can we improve care?

Toward consensus

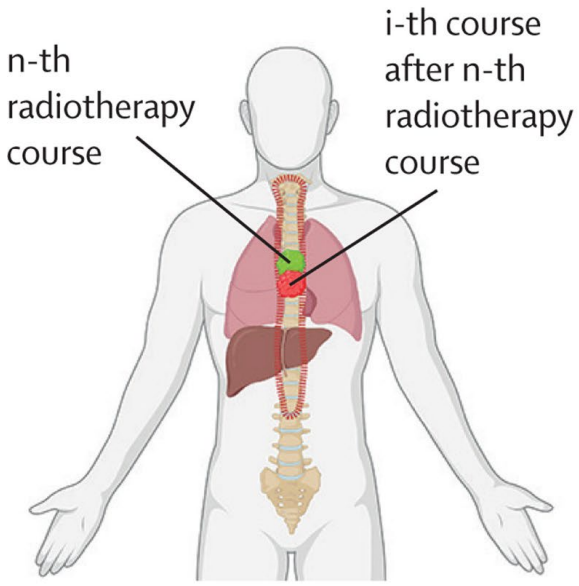
European Society for Radiotherapy and Oncology and European Organisation for Research and Treatment of Cancer consensus on re-irradiation: definition, reporting, and clinical decision making

Nicolaus Andratschke, Jonas Willmann*, Ane L Appelt, Najlaa Alyamani, Panagiotis Balermpas, Brigitta G Baumert, Coen Hurkmans, Morten Høyer, Johannes A Langendijk, Orit Kaidar-Person, Yvette van der Linden, Icro Meattini, Maximilian Niyazi, Nick Reynaert, Dirk De Ruysscher, Stephanie Tanadini-Lang, Peter Hoskin, Philip Poortmans, Carsten Nieder*

Definitions

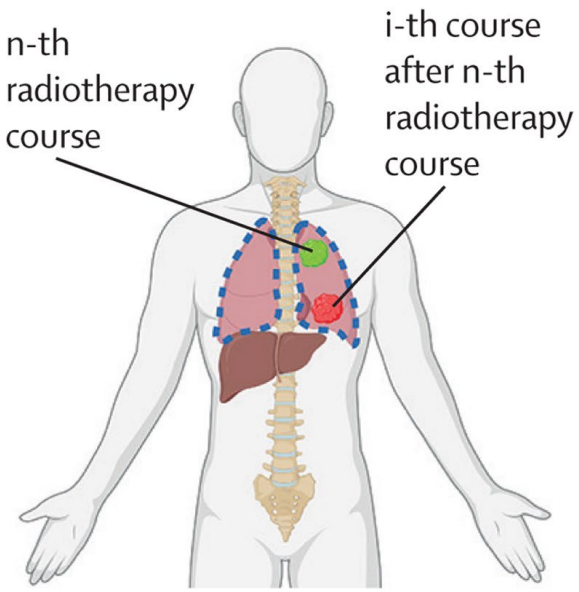
Re-irradiation

Type 1



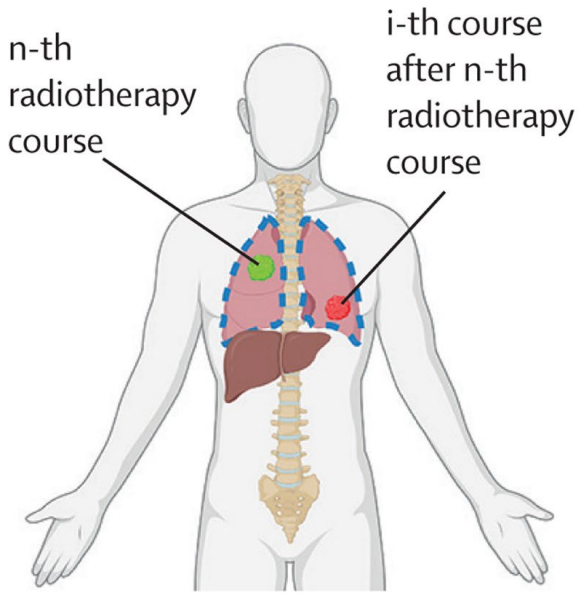
- Overlap of irradiated volumes
- With or without concern for toxicity from cumulative doses

Type 2



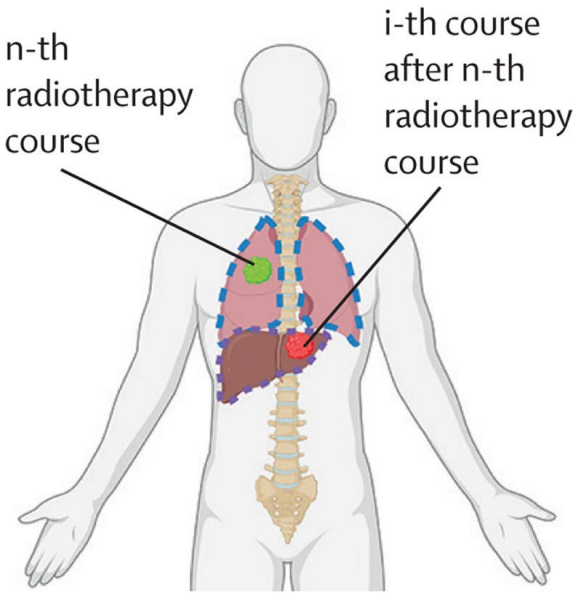
- No overlap of irradiated volumes
- Concern for toxicity from cumulative doses

Repeat organ irradiation



- No overlap of irradiated volumes
- No concern for toxicity from cumulative doses
- Target volumes in the same organ

Repeat irradiation



- No overlap of irradiated volumes
- No concern for toxicity from cumulative doses
- Target volumes in different organs

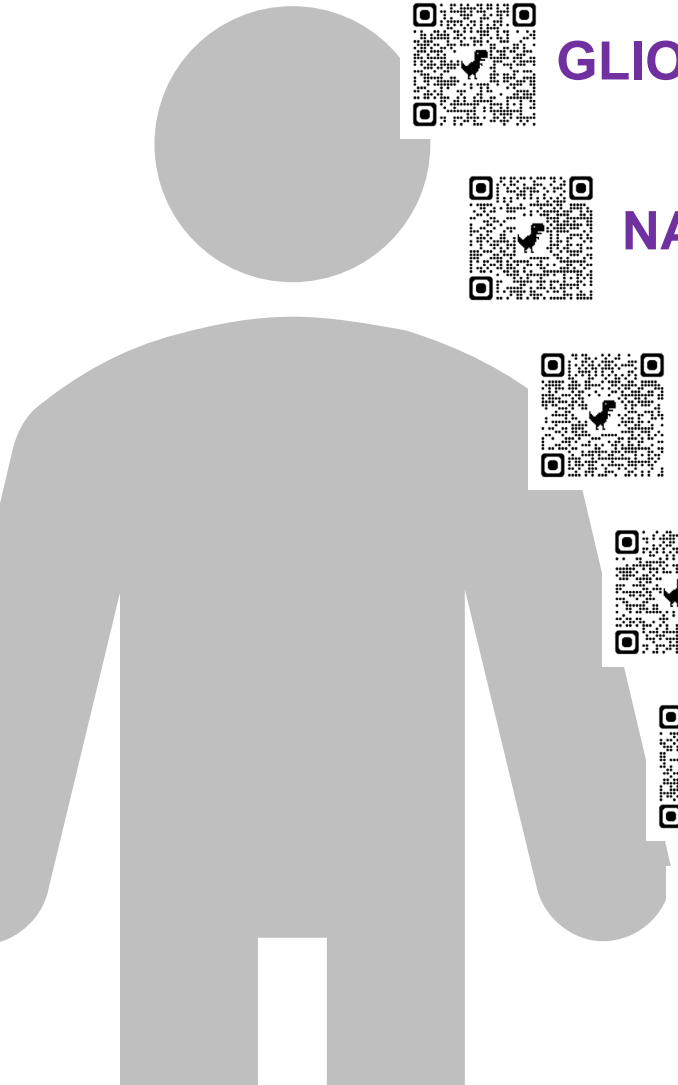
Select consensus statements

2 For patients with **short life expectancy**, reirradiation for symptom control might be considered **without concerns for irreversible toxicity** despite excessive cumulative doses

12 If high-dose reirradiation is considered, **access to full information** on previous treatments, including imaging, treatment plans, and dose distributions is strongly recommended for assessing cumulative dose summation

17 **Prioritization of target volumes and the dose to organs at risk** should be guided by the patient's life expectancy, risk acceptance, and the general treatment goal

Site-specific guidance



GLIOBLASTOMA – systematic review & evidence-based clinical practice guideline

NASOPHARYNGEAL CACINOMA – international recommendations using IMRT

NSCLC – international expert survey on indications and practice

BREAST – practical guidelines from DEGRO from German expert panel

PELVIS – international Delphi consensus for using SBRT

PROSTATE – ASTRO ACROP Delphi consensus for prostate SBRT

What do they agree on?

Reirradiation is safe and generally well tolerated

More data is needed to reach consensus on the details

- Mostly small, retrospective, single institution studies
- Lacking details on dosimetry

How do we implement best practice?

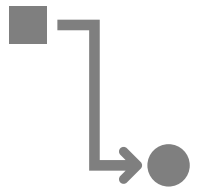
1 

TEAM

Multidisciplinary leadership

All stakeholders

Define roles

2 

PROCESS

Policy & Procedures

Communication and information transfer

3 

STANDARDIZE

Dose summation

Dose limits

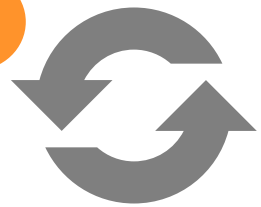
Recovery

4 

REVIEW

Peer review

Quality assurance

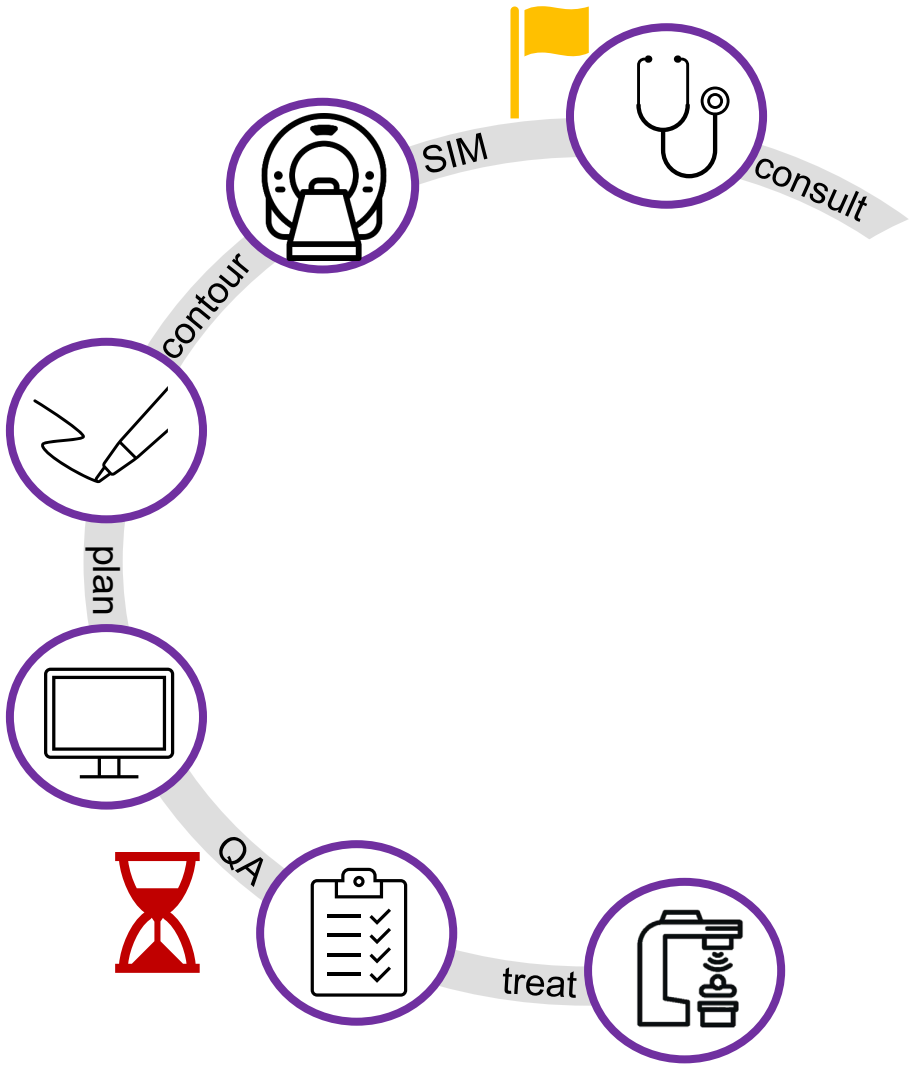
5 

UPDATE

Review and improve

New literature

Improving process



identify reirradiation cases early

- to support record collection
- to facilitate time for planning and peer review
- to inform simulation possibilities

efficiencies offering impact

- consider feasibility analysis
- mitigate iterative/futile planning

STANDARDIZE

Dose summation guidance

11 When assessing the risk for toxicity from cumulative doses, **maximum doses** need to be considered for serial organs (eg, the spinal cord), whereas the **irradiated volume** is relevant for parallel organs (eg, the lung or liver)

16 **Biologically effective doses** (eg, EQD2 or BED) should be calculated when doing dose summations of treatment plans, especially when different doses are used per fraction

European Society for Radiotherapy and Oncology and European Organisation for Research and Treatment of Cancer consensus on re-irradiation: definition, reporting, and clinical decision making

Nicolaus Andratschke, Jonas Willmann*, Ane L Appelt, Najlaa Alyamani, Panagiotis Balermpas, Brigitta G Baumert, Coen Hurkmans, Morten Høyer, Johannes A Langendijk, Orit Kaidar-Person, Yvette van der Linden, Icro Meattini, Maximilian Niyazi, Nick Reynaert, Dirk De Ruysscher, Stephanie Tanadini-Lang, Peter Hoskin, Philip Poortmans, Carsten Nieder*

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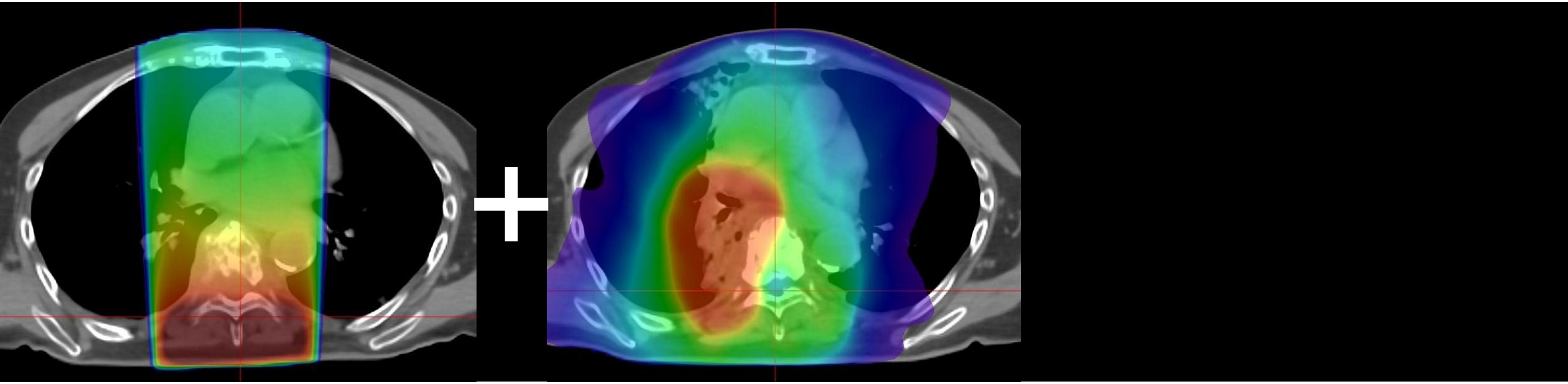
STANDARDIZE

Dose summation methodologies

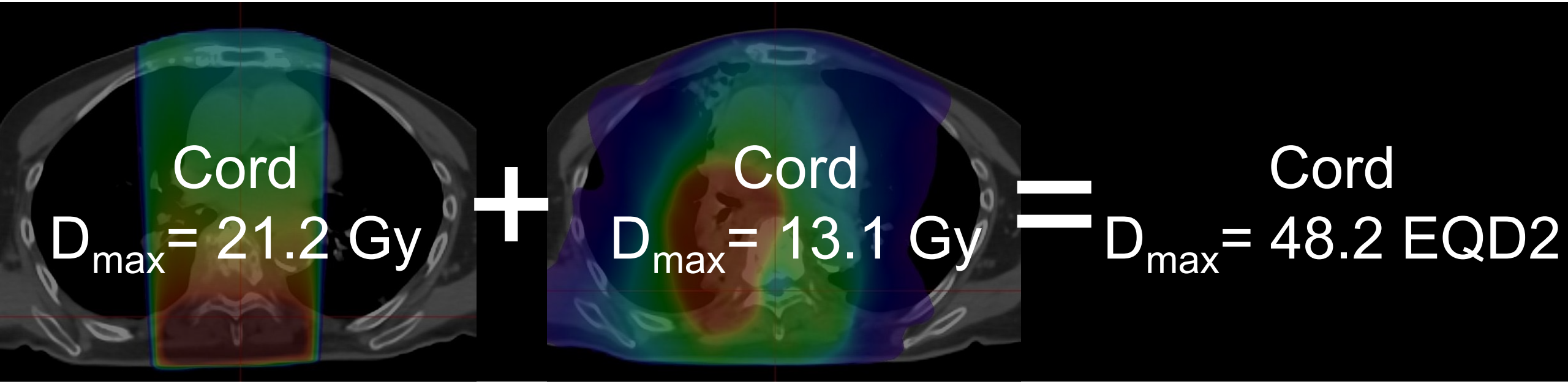


increasing complexity

3

STANDARDIZE

Dose summation methodologies



point sum

increasing complexity

Point sum process

Organ at Risk 1:	**spinal cord**						
alpha-beta ratio:	2						
Total EQD2 allowed OAR:	50	☑ MAX ☐ MEAN					
Total BED allowed OAR:	100						
Plan ID	Date (mmm/yyyy) Trt Completed	Prescription Dose (Gy)	Fractions	OAR Dose (Gy)	repair (%)	BED	EQD2
OLD PLAN	Mar-18	20	5	21.2		66.1	33.1
NEW PLAN	Oct-24	20	5	13.1		30.3	15.1
						#DIV/0!	#DIV/0!
						#DIV/0!	#DIV/0!
Total	Pass					**96.4**	**48.2**
Organ at Risk 2:							
alpha-beta ratio:							
Total EQD2 allowed OAR:		☑ MAX ☐ MEAN					
Total BED allowed OAR:	#DIV/0!						
Plan ID	Date (mmm/yyyy) Trt Completed	Prescription Dose (Gy)	Fractions	OAR Dose (Gy)	repair (%)	BED	EQD2
						#DIV/0!	#DIV/0!
						#DIV/0!	#DIV/0!

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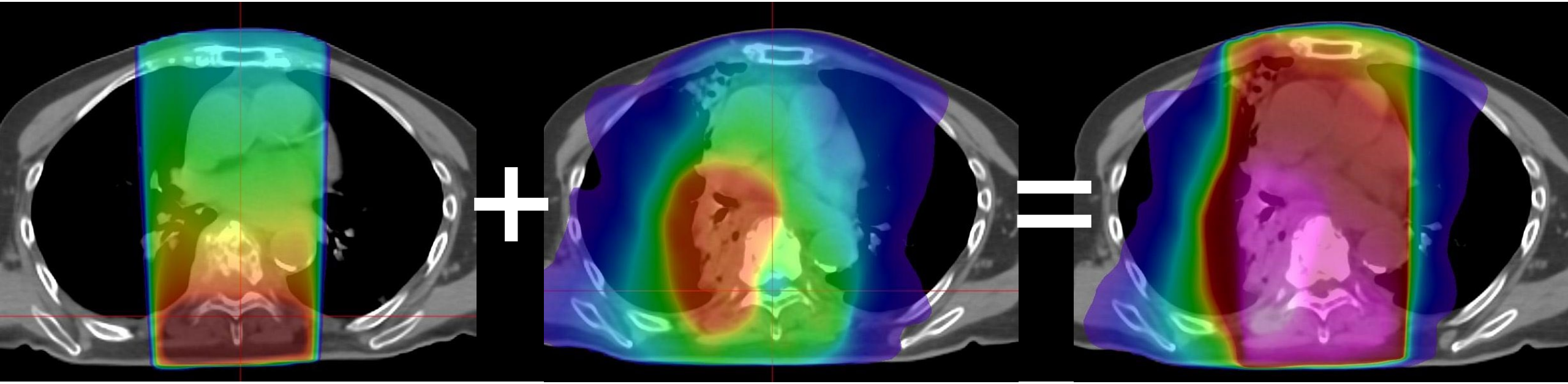
STANDARDIZE

Dose summation methodologies



point sum

registration

increasing complexity

3

STANDARDIZE

Registration process

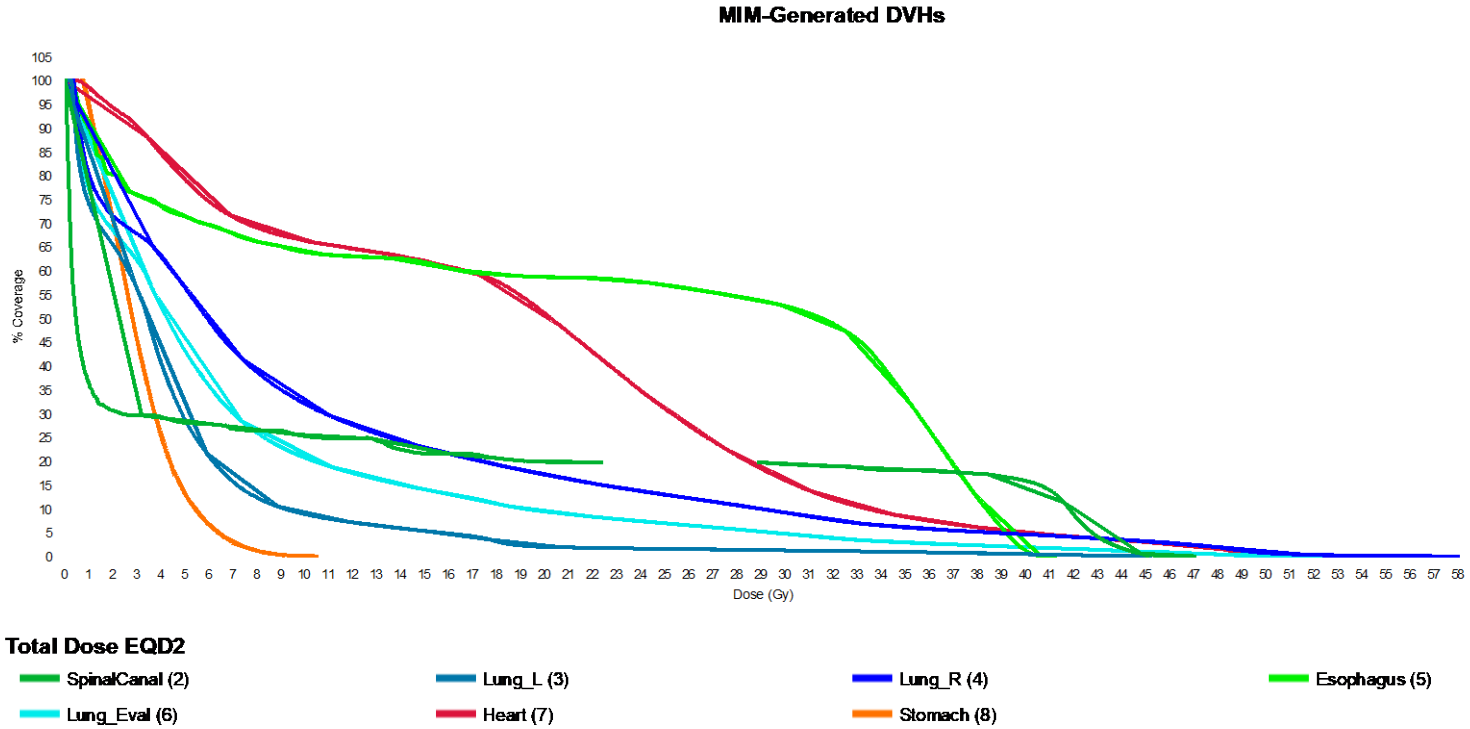
Summary

History

1) SPIT1 20 Gy in 5 fx (March 2018) no recovery, rigid registration
2) SPIT3 20 Gy in 5 fx (October 2024) no recovery

All dose values in this report are in EQD2

Cumulative DVH (1 of 3 pages)



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STANDARDIZE

Registration process

Contour	Color	Max Dose D1	Mean Dose D1
Esophagus		41.53	22.29
External		63.51	3.93
Heart		50.67	18.60
Lung_Eval		58.21	7.33
Lung_L		45.48	4.57
Lung_R		58.21	10.32
SpinalCanal		47.55	9.49
Stomach		10.58	3.11

Registration process

MIM-Generated DVHs

Dose Name
Total Dose EQD2

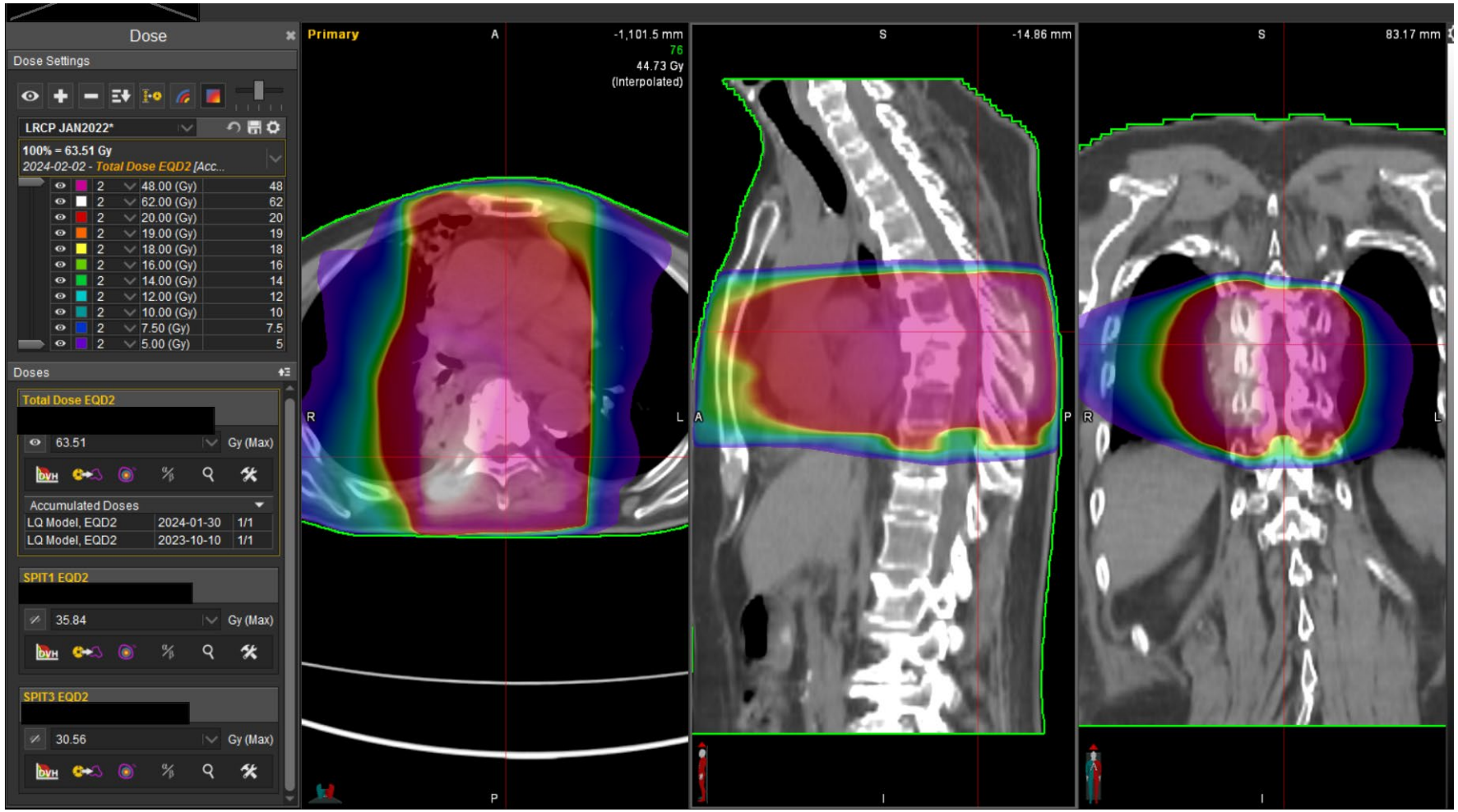
Patient Name [redacted]

Date [redacted]

Prescription Dose
63.51 Gy

Contour	Constraint Name	Total Dose EQD2	Fulfilled
SpinalCanal	D0.01cc < 50 (54) EQD2	46.41 Gy	✔
Stomach	D0.01cc < 60 EQD2	10.25 Gy	✔
Esophagus	D0.01cc < 65 (75) EQD2	40.72 Gy	✔
Heart	D0.01cc < 100 EQD2	50.48 Gy	✔
Lung_Eval	mean Dose < 20 EQD2	7.33 Gy	✔
Lung_Eval	V14.7 EQD2 < 37%	14.33 % Contour Vol	✔

Registration process



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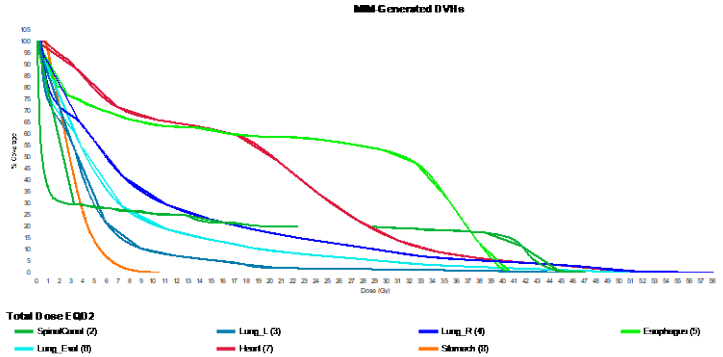

MIM-Generated DVHs

Dose Name	Patient Name	Date	Prescription Dose
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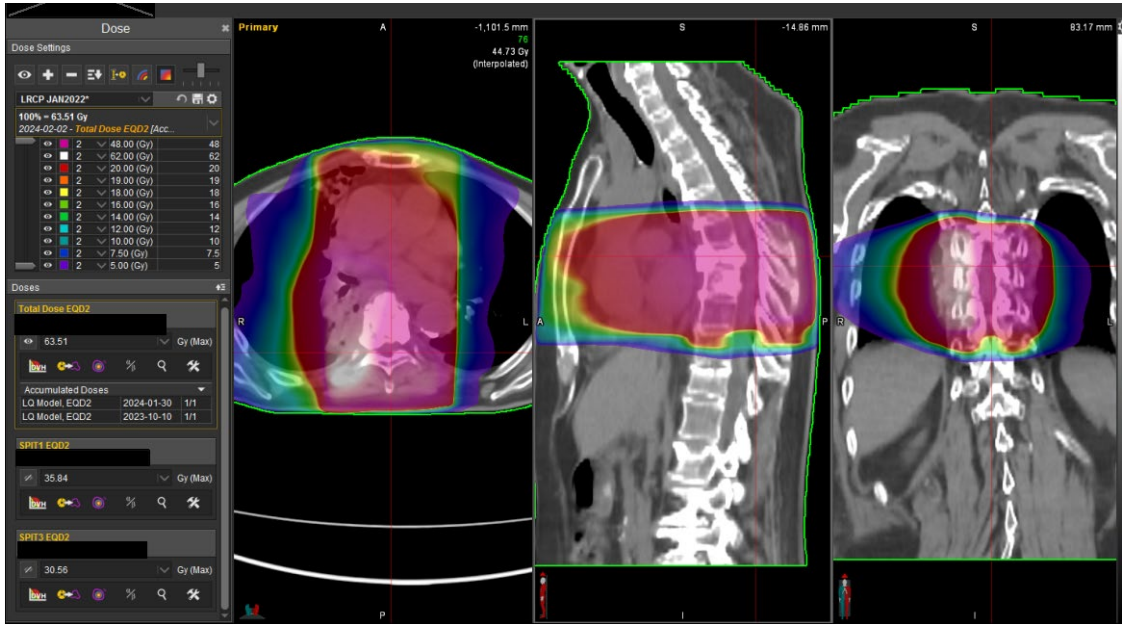

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What can the normal tissues tolerate?

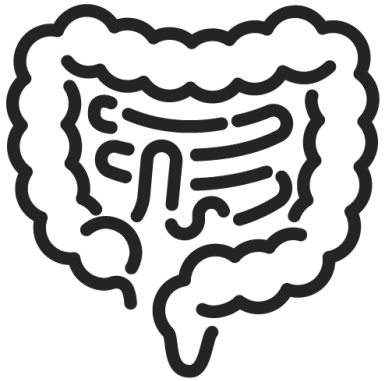
- We don’t know this…yet!
- Exacerbated with conversion to equieffective dose
  - Example: SABR conversions of bronchus

UK 2022 Consensus	38 Gy in 5 fx	80 EQD2
SABR-COMET10	40 Gy in 5 fx	88 EQD2
SUNSET	66 Gy in 15 fx	97 EQD2
SUNSET	64 Gy in 8 fx	140 EQD2

3

STANDARDIZE

What dose constraints to use?



☒ D0.5cc < 70 EQD2 (no recovery) *55% agreement*

☒ D0.5cc < 90 EQD2 (assumes some recovery) *41% agreement*

participants considered the constraint
too high or too low

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Can the previous dose be discounted?

- May be reported as higher constraint or as a recovery factor
- Evidence for recovery in spinal cord
  - Nieder et al: If >6 months, 120 BED to cord is safe ($\alpha/\beta=2$)
  - QUANTEC: tolerance increases at least 25% after 6 months
  - Doi et al: MRI-defined cord, if >6 months, D0.1cc = 76 EQD2
- For most other organs, recovery is unknown but commonly used

Nieder et al. (2005) IJROBP *Nieder et al. (2006) IJROBP*
Kirkpatrick et al. (2010) IJROBP *Doi et al. (2021) Strahlenther Onkol*

The REPAIR trial

- **Goal:** Identify the magnitude of radiation injury recovery in the thorax to enable safe reirradiation, balancing toxicity and tumor control
- Pragmatic approach that can be a starting point for future trials
- Start with some amount of “forgiveness” (e.g. 10% / year), then escalate/de-escalate that forgiveness based on toxicity

Phase I Design Options

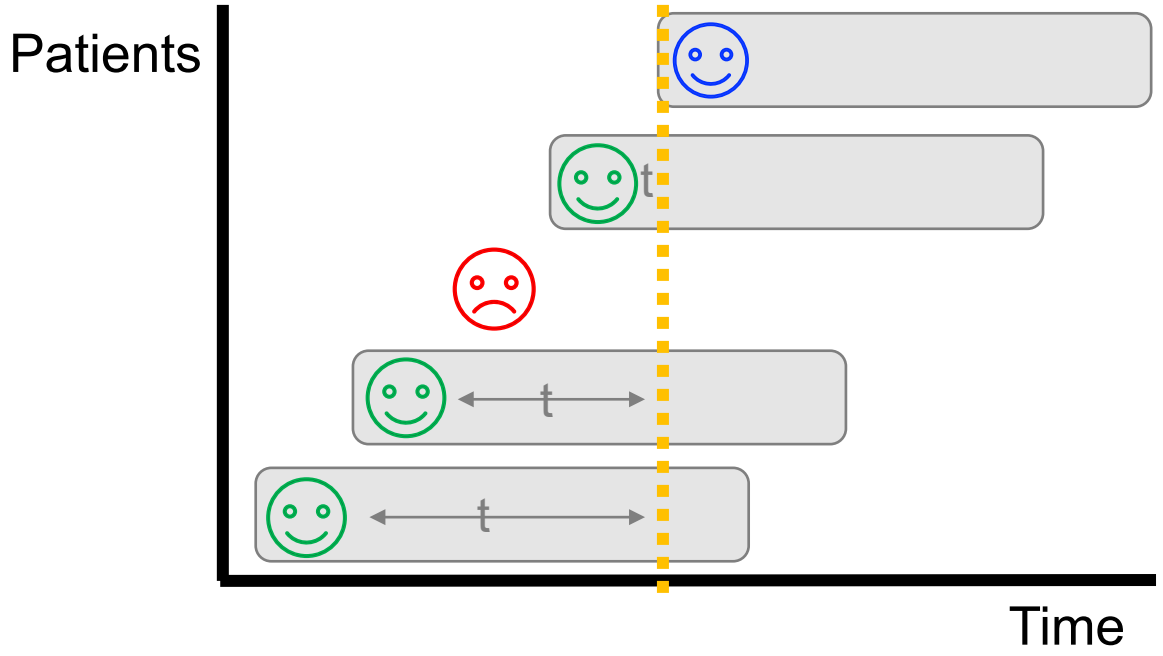
- Old School: **3+3 design**
  - Enroll 3 patients, wait for some time for toxicity, then decide whether to de-escalate
  - Doesn’t work for long observation periods

- A Better Approach: **TiTE-CRM**
  - Uses toxicity outcomes from previously enrolled patients, weighted by length of follow-up, to assign a dose level
  - SUNSET trial, RTOG 0813

TiTE-CRM: An Example

RTOG 0813 (SBRT for central tumors)

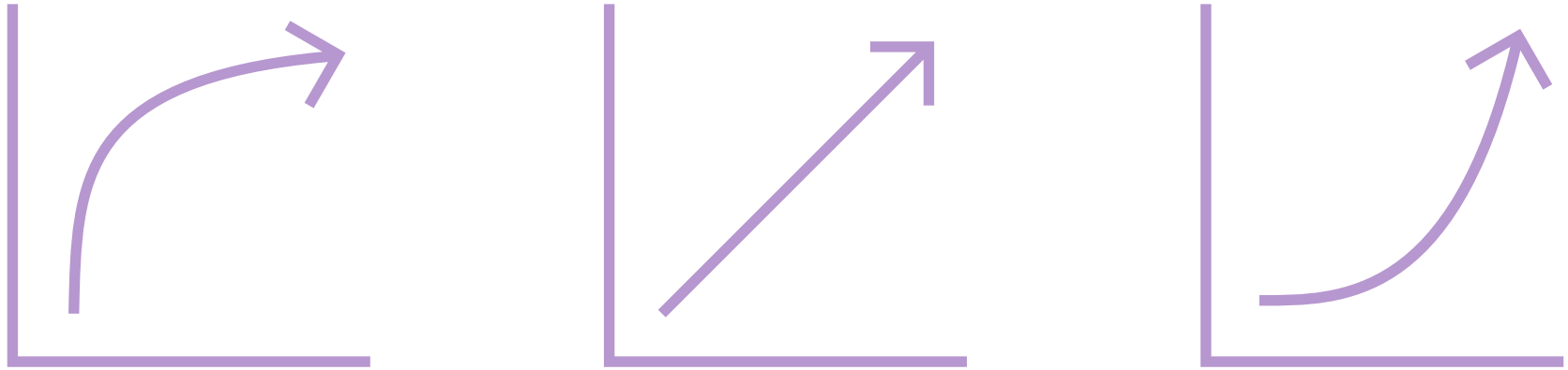
Dose Level	Dose per Fraction	Total Dose
1	8 Gy	40 Gy
2	8.5 Gy	42.5 Gy
3	9 Gy	45 Gy
4	9.5 Gy	47.5 Gy
5	**10 Gy†**	**50 Gy**
6	10.5 Gy	52.5 Gy
7	11 Gy	55 Gy
8	11.5 Gy	57.5 Gy
9	12 Gy	60 Gy



Things to decide:

- Allowable toxicity rate (<35% G3-5)
- Follow-up period for the model to count toxicity (1 year)
- Total follow-up before you escalate (2 years)

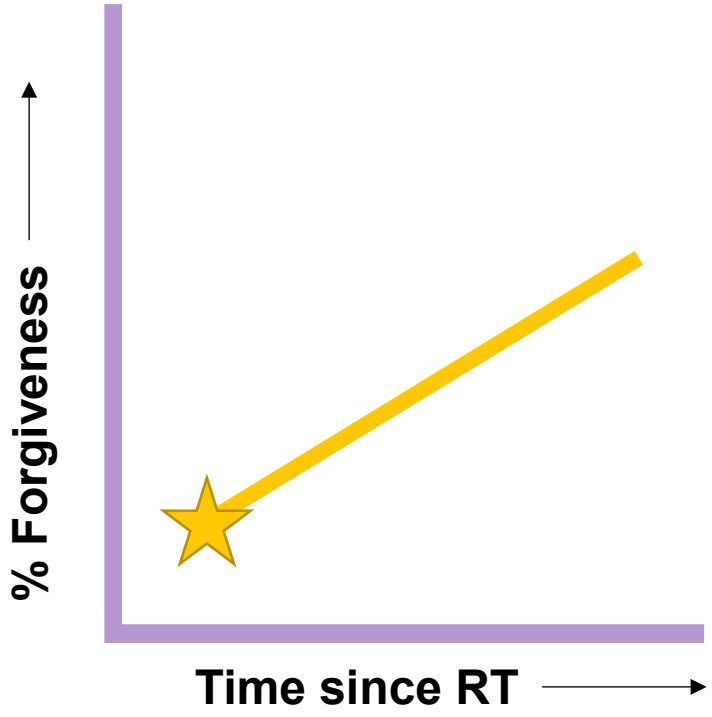
What should the recovery curves look like?



Main Considerations

- Academic vs. pragmatic approach – **keep it simple**
- Dose levels need to be distinct

Our Approach: Very Simple



- Include an initial starting percentage of repair at 6 months after previous RT (we call it a “cliff”)
- Beyond 6 months, add another small percentage per month
- No further repair after 5 years for this trial
- Same amount of forgiveness to all intrathoracic OARs
- Spinal cord not being escalated – fixed at 20% beyond 6 months

Examples of Possible Levels

<u>Conservative</u>

10% at 6 months, 0.5% per month thereafter

- Works out to 25% at 3 years and 37% at 5 years

<u>Very Aggressive</u>

25% at 6 months, 1.4% per month thereafter

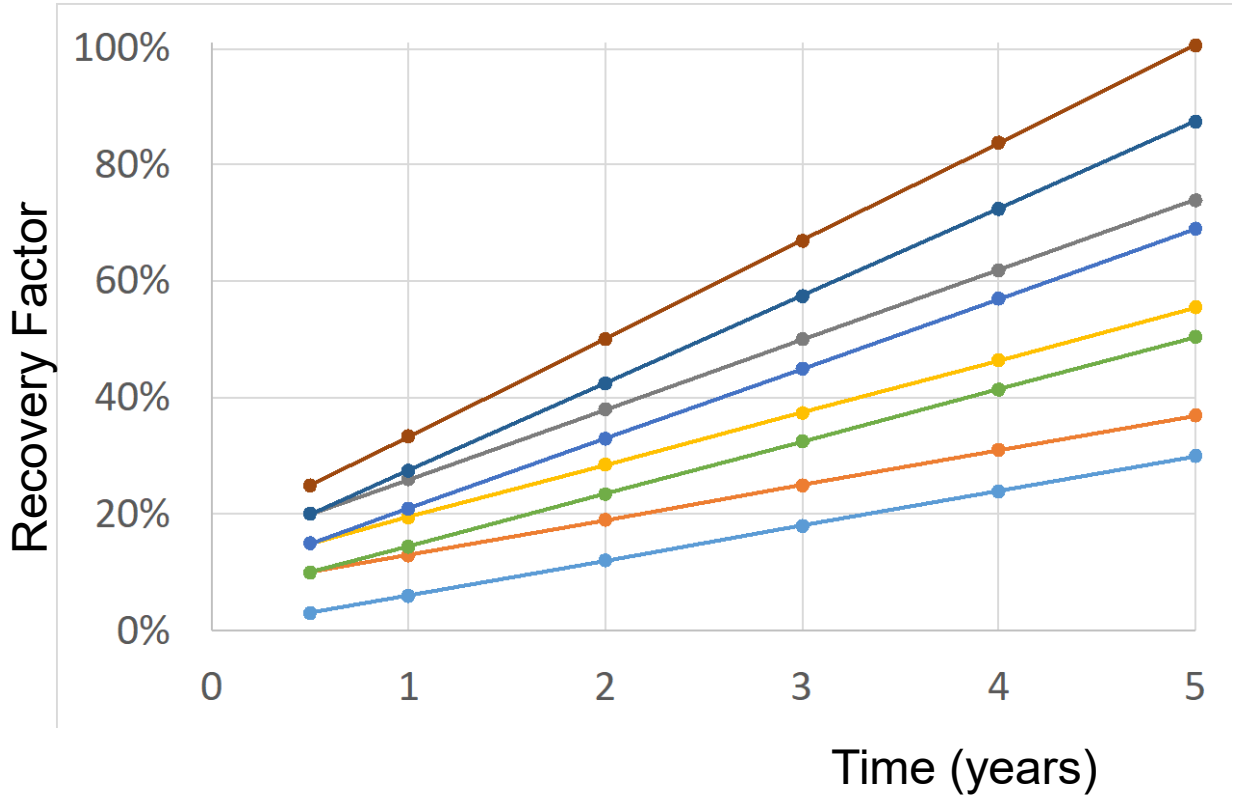
- Works out to 67% at 3 years and 100% at 5 years

REPAIR Dose Levels

Level	6m	+Rate/month
-1	3%	0.50%
0	10%	0.50%
1	10%	0.75%
2	15%	0.75%
3	15%	1.00%
4	20%	1.00%
5	20%	1.25%
6	25%	1.40%

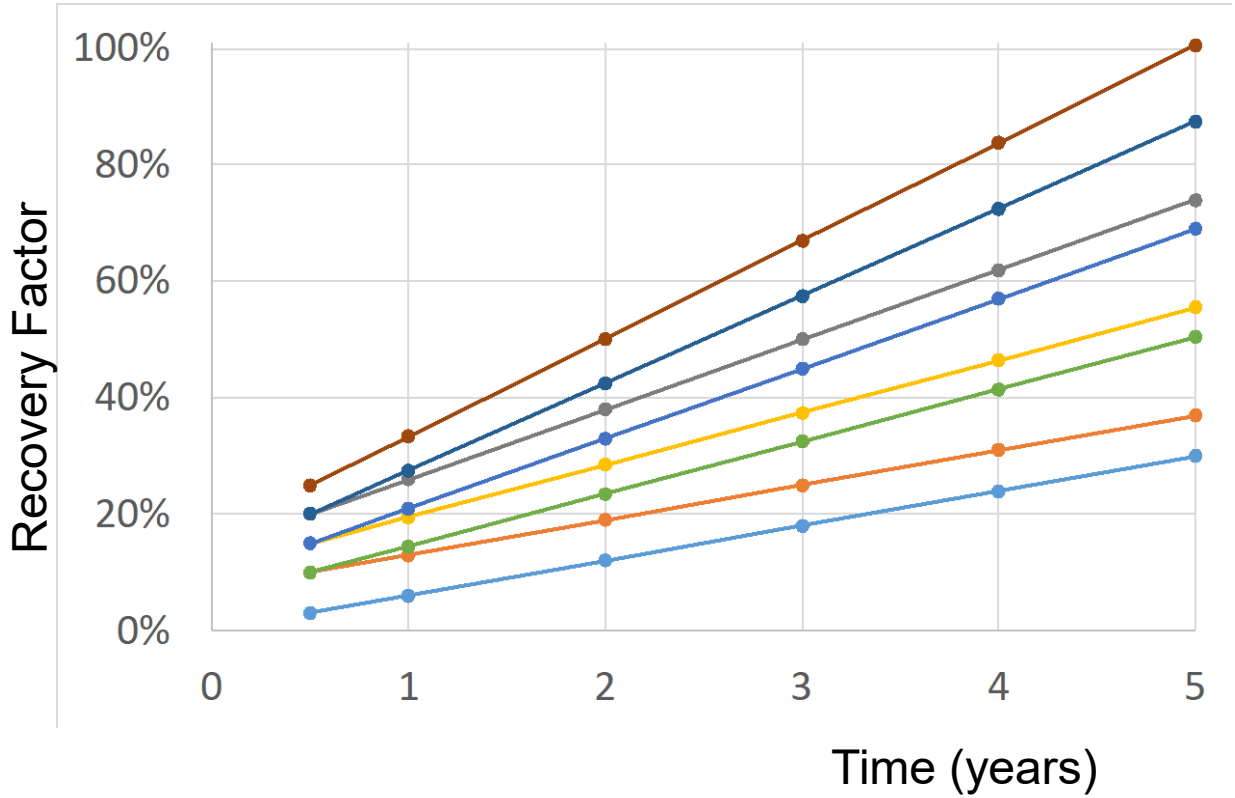
REPAIR Dose Levels

Level	6m	+Rate/month
-1	3%	0.50%
0	10%	0.50%
1	10%	0.75%
2	15%	0.75%
3	15%	1.00%
4	20%	1.00%
5	20%	1.25%
6	25%	1.40%



REPAIR Dose Levels

Level	6m	+Rate/month	1y	3 y	5 y
-1	3%	0.50%	6%	18%	30%
0	10%	0.50%	13%	25%	37%
1	10%	0.75%	15%	33%	51%
2	15%	0.75%	20%	38%	56%
3	15%	1.00%	21%	45%	69%
4	20%	1.00%	26%	50%	74%
5	20%	1.25%	28%	58%	88%
6	25%	1.40%	33%	67%	100%



Patient selection

Inclusion Criteria:

- ☑ Proven diagnosis of malignancy with disease in the thorax requiring reRT
- ☑ Received prior thoracic radiotherapy with photons ≥ 6 months ago
- ☑ Expected life expectancy >6 months
- ☑ ECOG performance status 0-2
- ☑ Age 18+
- ☑ **Your current re-irradiation plan needs some allowance for repair of previous doses to meet constraints**

Exclusion criteria:

- ✗ Persistent toxicity from previous RT
- ✗ Prior development of pneumonitis
- ✗ Prior RT delivered BID, or by brachytherapy, protons, electrons, radionuclides
- ✗ Plans to receive other local therapy
- ✗ Some limitations on systemic therapy
- ✗ Surgery that has moved an OAR of concern
- ✗ Pregnancy
- ✗ Scleroderma, Lupus, ILD

What Do We Use As Constraints?

- There is more variation between different published baseline dose constraints than between some of our levels!
- We had to pick a set of baseline dose constraints
- Based mostly on 2022 UK SABR dose constraints

Organ	α/β	Metric	Dose Limit
Spinal cord*	2	D0.035cc	60 Gy EQD2
Brachial plexus	3	D0.1cc	66 Gy EQD2
Esophagus	3	D0.1cc	70 Gy EQD2
Heart	3	D0.1cc	80 Gy EQD2
Trachea	3	D0.1cc	80 Gy EQD2
Bronchus	3	D0.1cc	80 Gy EQD2
Great Vessels	3	D0.1cc	144 Gy EQD2
Chest wall	3	D0.1cc	180 Gy EQD2
Lung_eval	3	V14.7EQD2	37%

How Can MROQC Improve the Field?

Recent Publications and Abstract Acceptances Highlighting MROQC Members' Contributions

We are excited to share some recent achievements and contributions from our talented members, showcasing their dedication to advancing radiation oncology research and patient care. Here's a roundup of noteworthy publications and abstract acceptances:

Publications:

"Are We Missing Acute Toxicities Associated With Hypofractionated Breast Irradiation? A Report From a Large Multicenter Cohort Study?" The Red Journal

- **Authors:** Hassan Beydoun (Karmanos), Kent Griffith (University of Michigan), Reshma Jagsi (University of Michigan), Jacob Burmeister (Karmanos) Jean Moran, (University of Michigan), Frank Vicini (MHP), Jim Hayman (University of Michigan), Pete Paximadis (Corewell Health South), Tom Boike (MHP), Eleanor Walker (Henry Ford Detroit), Lori Pierce (University of Michigan) and Mike Dominello (Karmanos)

"Factors Associated with Acute Esophagitis During Radiation Therapy for Lung Cancer" Radiotherapy & Oncology

- **Authors:** Dan Herr (University of Michigan), Maggie Yin (University of Michigan), Derek Bergma (Trinity Health Saint Mary's), Alekszandar Dragovic (Brighton Center for Specialty Care) Martha Matuszak (University of Michigan), Maggie Grubb (University of Michigan), Mike Dominello (Karmanos), Benjamin Movsas (Henry Ford Detroit), Larry Kestin (MHP), Tom Boike (MHP), Amit Bhatt (McLaren Greater Lansing), Jim Hayman (University of Michigan), Shruti Jolly (University of Michigan), Matt Schipper (University of Michigan), and Pete Paximadis (Corewell Health South)

"Variation in Androgen Deprivation Therapy Use Among Men With Intermediate-Risk Prostate Cancer: Results From a Statewide Radiation Oncology Quality Consortium" The Red Journal

- **Authors:** Michael Dykstra (University of Michigan), Sam Regan (University of Michigan), Maggie Yin (University of Michigan), Bill McLaughlin (Ascension Providence), Tom Boike (MHP), Amit Bhatt (McLaren Greater Lansing), Mark Zaki (Covenant), Danielle Kendrick (University of Michigan), Mazen Mislmani (West Michigan Cancer Center), Sarah Paluch (Covenant), Dale Litzenberg (University of Michigan), Melissa Mietzel (University of Michigan), Vrinda Narayana (Ascension Providence), Andrea Smith (University of Michigan), Dave Heimburger (Munson), Matt Schipper (University of Michigan), Will Jackson (University of Michigan), and Bob Dess (University of Michigan)

MRQC MICHIGAN RADIATION ONCOLOGY QUALITY CONSORTIUM

2024 Abstracts

1. Contemporary androgen deprivation therapy practice patterns in locally advanced prostate cancer treated with definitive radiotherapy: Prospective results from a statewide radiation oncology quality consortium. (ASCO GU 2024; poster; Conquer Cancer Merit Award)
   Michael Dykstra, Samuel Regan, Huiying Yin, Patrick McLaughlin, Thomas Boike, Amit Bhatt, Eleanor Walker, Mark Zaki, Danielle Kendrick, Mazen Mislmani, Sarah Paluc Dale Litzenberg, Melissa Mietzel, Vrinda Narayana, Andrea Smith, William Jackson, David Heimburger, Matthew Schipper, Robert Dess
2. Microboost dose escalation for localized prostate cancer within a statewide radiation oncology quality consortium. (ASCO GU 2024; poster; Conquer Cancer Merit Award)
   Samuel Regan, Michael Dykstra, Huiying Yin, Patrick McLaughlin, Thomas Boike, Amit Bhatt, Mark Zaki, Danielle Kendrick, Mazen Mislmani, Sarah Paluch, Dale Litzenber Melissa Mietzel, Vrinda Narayana, Andrea Smith, William Jackson, David Heimburger, Matthe Schipper, Robert Dess
3. Navigating Challenges in Collecting Patient-Reported Outcomes Within a Statewide Consortium (NAHQ 2024; poster)
   Danielle Kendrick
4. Prospective Evaluation of Acute Toxicity from Tumor Bed Boost Following Whole Breast Radiotherapy (ASTRO 2024; poster)
   Michael Dykstra, Kent Griffith, Alexander Moncion, Margaret Grubb, Robin Marsh, Melissa Mietzel, Frank Vicini, Lori Pierce
5. Analysis of Patient Reported Outcomes in the Prevention of Acute Radiation Dermatitis with Topical Therapies (ASTRO 2024; poster)
   Aria Kieft, Huiying Yin, Amit Bhatt, Frank Vicini, Danielle Kendrick, Kent Griffith, Emily Trumpower, Melissa Mietzel, James Hayman, Lori Pierce, Michael Dominello
6. Prospective evaluation of non-small cell lung cancer radiation therapy treatment interruptions in a large statewide quality collaborative (ASTRO 2024; poster)
   Ameer Elaimy, Huiying Yin, Derek Bergsma, Michael Dominello, Aleksander Dragovic, Mark Zaki, James Hayman, Peter Paximadis, Larry Kestin, Martha Matuszak, Matthew Schipper, Shruti Jolly
7. Characterizing Post-Treatment Cardiac and Pulmonary Hospitalizations in Locally Advanced Lung Cancer: A Statewide Quality Consortium Analysis (ASTRO 2024; poster)
   Shruti Jolly, Huiying Yin, Weilin Wang, Martha Matuszak, Peter Paximadis, Michael Dominello, Derek Bergsma, Steven Allen, Aleksandar Dragovic, Larry Kestin, Robert Dess, Mark Zaki, James Hayman, Matthew Schipper
8. Deep Learning-Based Dose Prediction for Thoracic Radiation in a Statewide Radiation Oncology Quality Consortium (ASTRO 2024; oral quick pitch)
   Daniel Polan, Chase Hadley, Charles Matrosic, Margaret Grubb, Shruti Jolly, Peter Paximadis, Martha Matuszak
9. Progress in Shortening Treatment Courses for Bone Metastases in a Statewide Quality Consortium (ASTRO 2024; oral quick pitch)
   Luke Higgins, Huiying Yin, Kent Griffith, Jumoke Johnson-Olokesusi, Amit Bhatt, Kelly Paradis, Lana Critchfield, Brendan Coutu, Kaitlyn Baldwin, Vrinda Narayana, Howayda Messiha, Jennifer Davis, Mohamad Fakhreddine, James Hayman
10. Relationship between Cannabis Use and Opioid Use in Patients with Cancer Metastatic to Bone in a Large Multicenter Cohort from a State with Legalized Adult Non-Medical Cannabis (ASTRO 2024; oral scientific session)

MRQC MICHIGAN RADIATION ONCOLOGY QUALITY CONSORTIUM

2024 Abstracts

Matthew Cousins, Michael Dykstra, Kent Griffith, Melissa Mietzel, Danielle Kendrick, Emily Trumpower, Deborah Dusseau, Michael Dominello, Michelle Mierzwa, Elizabeth Covington, Lori Pierce, James Hayman

11. Evaluating Guideline-Concordant Androgen Deprivation for High-Risk Prostate Cancer in a Statewide Quality Consortium (ASTRO 2024; poster)
    Michael Dykstra, Samuel Regan, Huiying Yin, Patrick McLaughlin, Mark Zaki, Mazen Mislmani, Steven Miller, Vrinda Narayana, Danielle Kendrick, Murshed Khadija, Daniel Dryden, Dale Litzenberg, Melissa Mietzel, David Heimburger, Matthew Schipper, William Jackson, Robert Dess
12. Microboost and Dosimetric Variability in Localized Prostate Cancer: Analysis of a Prospective Statewide Quality Collaborative (ASTRO 2024; poster)
    Samuel Regan, Michael Dykstra, Huiying Yin, Margaret Grubb, Neil Vaishampayan, Mark Zaki, Mazen Mislmani, Patrick McLaughlin, Danielle Kendrick, Steven Miller, Daniel Dryden, Murshed Khadija, Dale Litzenberg, Melissa Mietzel, Vrinda Narayana, David Heimburger, Matthew Schipper, William Jackson, Robert Dess
13. Current Use and Perspectives of Artificial Intelligence in Radiation Oncology: A Statewide Consortium Survey (ASTRO 2024; poster)
    Amina Tanweer, Michael Dykstra, Anneka Hallstrom, Melissa Mietzel, Joseph Evans, Sean Miller, Samuel Regan, Sue Merkel, Shruti Jolly, Martha Matuszak, Lori Pierce, Robert Dess
14. Advancing Quality of Care Using a Knowledge Transfer Approach to Foster the Use of Single-Fraction Radiation Therapy (ASCO Quality 2024; poster)
    Jumoke Johnson-Olokesusi, Kelly Paradis, Danielle Kendrick, Melissa Mietzel, James Hayman

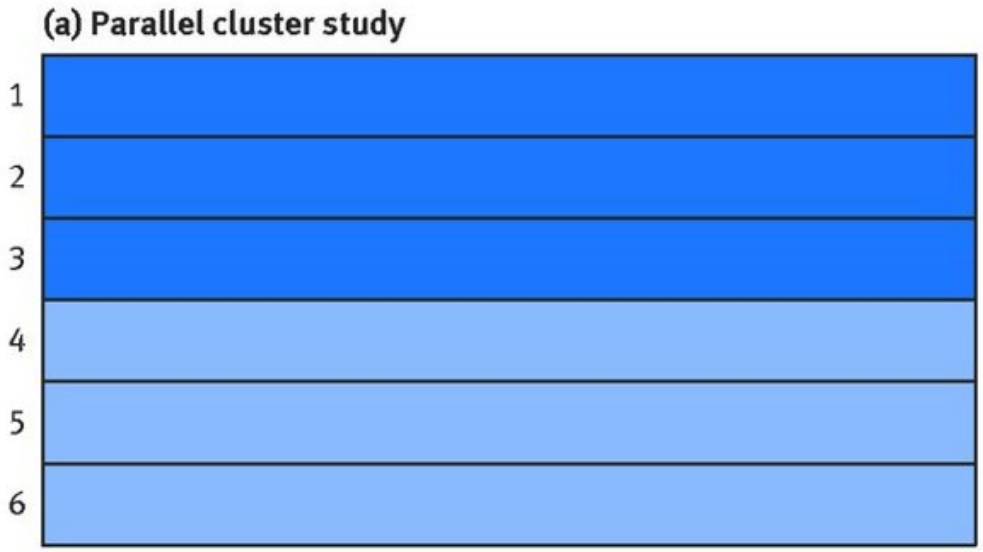
London Health Sciences Centre Western

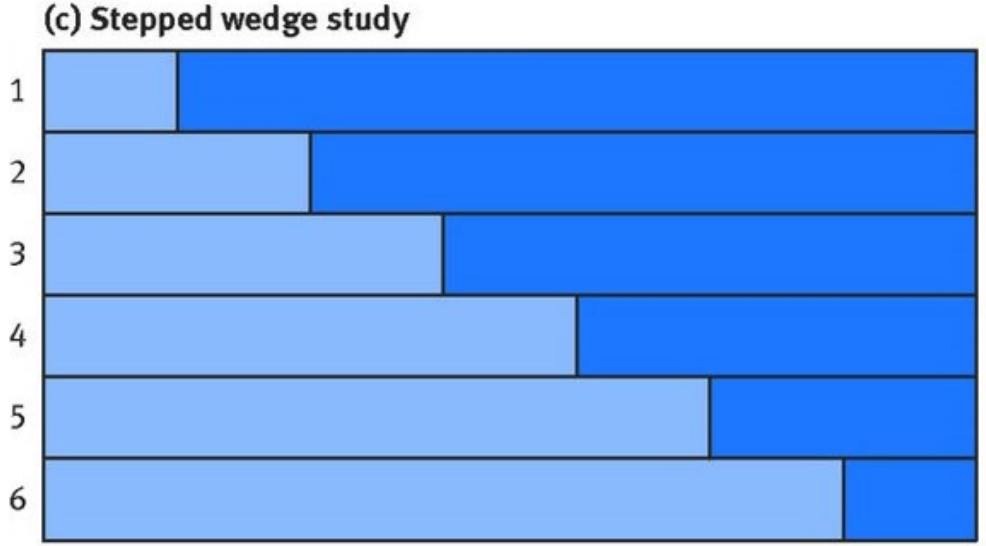
How Can MROQC Improve the Field?

- MROQC is already **very** strong
- Can you add a few more outcomes, like survival?
  - This could be done manually or via linkages with other databases (e.g. SEER-Medicare)
  - These other databases might allow you to get codes for other important interventions (e.g surgical procedures, certain prescriptions, admissions)
- Since you have outcomes collected, doing trials becomes very easy and inexpensive

How Can MROQC Improve the Field?

- Re-irradiation:
  - Could you look at outcomes based on amount of forgiveness used/cumulative dose constraints?
  - Could you do a cohort study where different centers use different levels of forgiveness?
  - Could you do in a randomized way?





Western

Beyond Re-Irradiation

- There are several important questions for which your group could generate evidence that could change the standard of care
  - Lung Cancer:
    - Should we prioritize heart dose vs. lung dose vs. balanced approach?
  - Head and Neck Cancer
    - Do we really need to cover our PTVs with the full 70 Gy, or could we compromise the PTV as long as CTVs are covered?

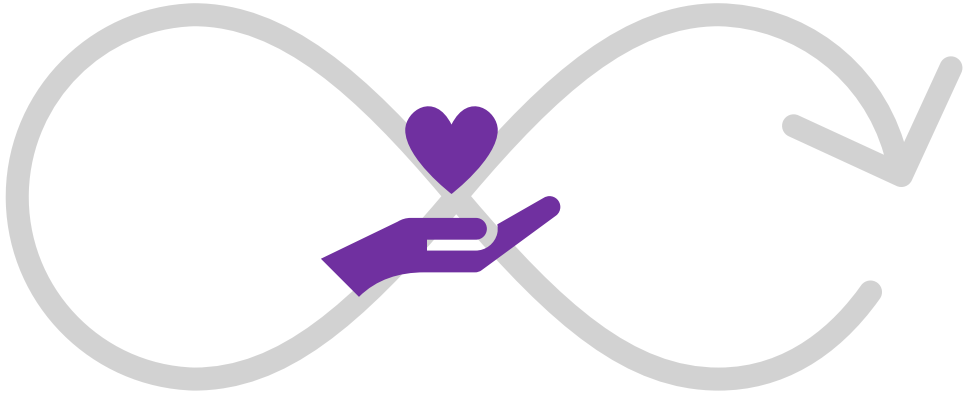
Take Home Messages

- Re-irradiation has become much more common
- There are numerous sources of uncertainty:
  - *De novo* treatment dose constraints
  - Registration/dose accumulation
  - Amount of repair per organ
  - Effects of fraction size, systemic therapy, and other biologic factors (e.g. diabetes)
- Consult the site-specific guidelines that can help. Allowing some repair makes sense biologically and is supported by literature
- **High-quality prospective data from large datasets is needed!**

Enhancing quality through continuous improvement in reirradiation

Donna Murrell, PhD MSc MCCPM
Medical Physicist, London Health Sciences Centre

David Palma, MD PhD MSc FRCPC
Radiation Oncologist, London Health Sciences Centre



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