Hands On Workshop
Simulated Error Training for Physics Plan Reviews

University of Colorado
Anschutz Medical Campus

Leah Schubert, Ph.D.

Hands-On Workshop: Simulated Error Training for the Physics Plan Review

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P Johnson


G Kim


J Faught

Presentations

10:30 AM ***Introduction to Simulated Error Training*** - L Schubert, Presenting Author
10:50 AM ***Overview of the WGPE Simulation Data Sets*** - P Johnson, Presenting Author
11:10 AM ***Hands On Session – Cases 1 & 2*** - G Kim, Presenting Author
11:50 AM ***Hands On Session – Cases 3 & 4*** - J Faught, Presenting Author

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Introduction to Simulated Error Training

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Conflict of Interest Disclosure

I have no conflicts of interest related to this presentation

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Learning Objectives for this Presentation

- Introduce the concept of simulated error training
- Present educational techniques on which simulated error training is based
- Describe early uses of simulated error plans in our field
- Identify applications to develop, assess, and improve physics plan reviews

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What is Simulated Error Training?

- Method to practice error detection in situations where the occurrence of error is low
- Well suited for physics plan reviews

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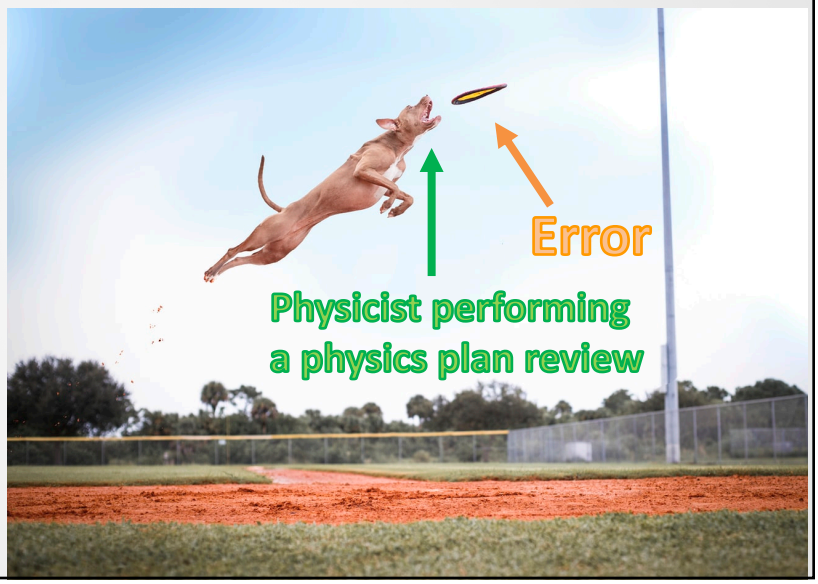
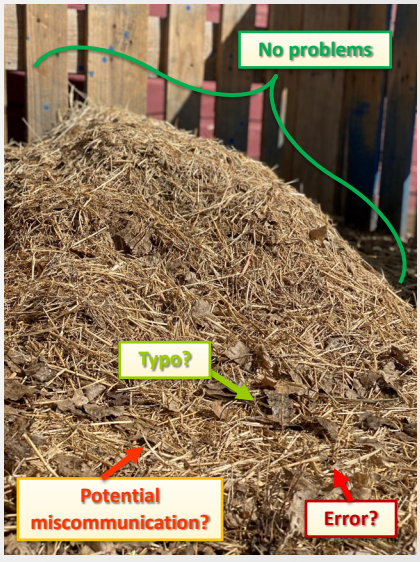
What is Simulated Error Training?

- What does it mean to be *good* at performing a physics plan review?
- You catch errors
- Experience in catching rare, potentially hazardous errors



Why Can it be Hard to Catch Errors?

- Physics plan reviews, needles in a haystack
- Complexities in the planning process
- Errors, potential to cause mistreatment, plan quality, documentation compliance
- Subtle to detect, surprising manifestations
- How do we know we can catch these errors?



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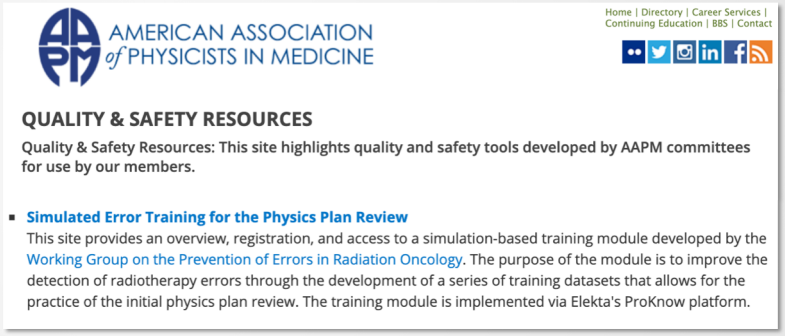
Development of Simulated Error Training

- AAPM WGPE developing
- Simulate real treatment plans with known errors embedded
- Based on AAPM TG-275



https://www.aapm.org/QualitySafety/ErrorTraining.asp

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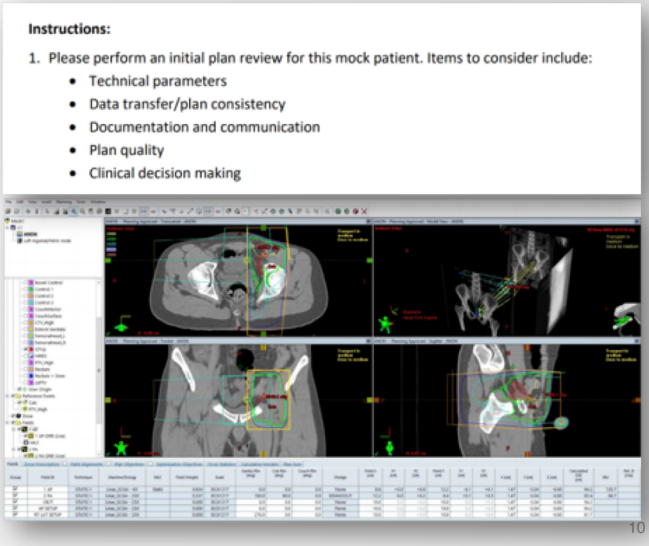
Simple Concept of Simulated Error Training

- How to use the simulated error plans
- Perform physics plan reviews
- Assess performance



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Interest in Simulated Error Training

- Survey of Program Directors of CAMPEP-accredited therapy physics residency programs
- Determine the current state of residency training in physics plan reviews
- Most common training methods in use
  - Observe staff physicists performing plan reviews (96%)
  - Perform supervised plan reviews (93%) (either for training or clinical practice)
  - Use a checklist (80%)

Schubert, et. al "The current state of physics plan review training in medical physics residency programs in North America," PRO 2019

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Interest in Simulated Error Training

- Simulation plans with embedded errors to train residents
  - Currently using: 19%
  - *Would* use: 71%
- Largest difference out of all of the training methods presented
- High interest for residency programs

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Challenges to Implementation

- Resource intensive
  - Anonymize patients
  - Re-create plans
  - Embed errors
  - Re-export and write up the chart documents
  - Updates and maintenance

- Pool resources as a group

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Education Basis for Simulated Error Training

What is the Basis of Simulated Error Training?

- Based on educational techniques
- Simulation-based education
  - Aviation, military fields
  - Medical education
- Deliberate practice
  - Method of improving performance
  - Applies to any field, in and out of the workplace

Flight simulator exhibit at the McConnell Science Museum, Grand Junction CO

University of Colorado Center for Advancing Professional Excellence (CAPE)

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Simulation-Based Education in Medicine

- Simulates real-life scenarios in a low risk environment
- Allows one to acquire and practice clinical skills without using real patients
- Training and assessment
- Examples in medicine
  - Simulation centers in medical schools
  - Physical exams, code response, IV placements
  - IV placements, cardiac arrest response

Simulated intensive care room with high fidelity mannequin
University of Colorado Center for Advancing Professional Excellence (CAPE)

McGaghie, et. al "Revisiting 'A critical review of simulation-based medical education research: 2003–2009'" Medical Education 2016
Seaton et. al, "Exploring the extent to which simulation-based education addresses contemporary patient safety priorities: A scoping review" Collegian 2019

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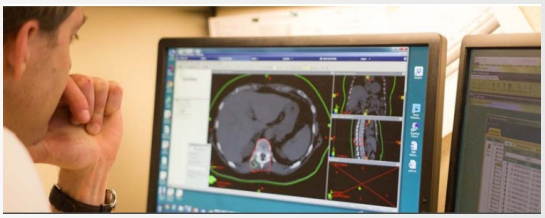
Simulation-Based Education in Radiation Oncology

- Use in the radiation oncology field
  - Training for emergency on-call treatments
  - Communication and interpersonal skills
  - Radiation oncologist plan reviews

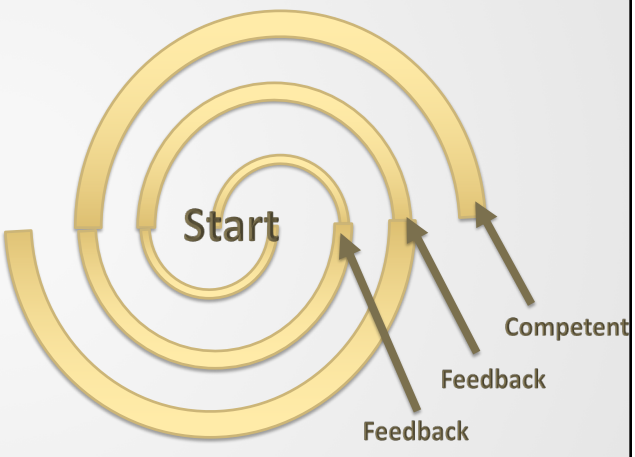


- Embedded errors can potentially happen in real life
- Ability to assess and improve performance without risk to the patient

Mazur, et. al "Improving Radiation Oncology Providers' Workload and Performance: Can Simulation-based Training Help?" PRO 2017
Brown, et. al "Multidisciplinary Medical Simulation: A Novel Educational Approach to Preparing Radiation Oncology Residents for Oncologic Emergent On-Call Treatments" IJROBP 2014
Ju, et. al "Assessing Interpersonal and Communication Skills in Radiation Oncology Residents: A Pilot Standardized Patient Program" IJROBP 2014

Deliberate Practice

- Technique to improve performance – reach expertise
- Different than just practicing
- Structured with feedback
- Identify weaknesses and course-correct
- Simulated error training – multiple mock data sets with answer keys



Early Experience with Simulated Error Plans

Measure Error Detection Rate of Practicing Physicists

- Gopan et. al published early experience
- Aimed to prospectively measure detection rate
- 8 physicists performed reviews on 6 plans with embedded errors
- Errors were detected in 67% of reviews [58-75% CI]
- Range from more easily caught (planned dose) to not well caught (incorrect CT dataset)
- First to quantify the error detection rate of physics plan reviews

Gopen, et. al "Utilizing simulated errors in radiotherapy plans to quantify the effectiveness of the physics plan review" Med Phys 2018

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Facilitate Education and Measure In-House Checklist

- Mayo Arizona simulated error plan suite
  - to facilitate education of new staff and residents
  - to measure the efficacy of an in-house electronic checklist
- 20 simulated error plans were created (21 errors embedded)
- 9 physicists reviewed over a 5 week period
- Useful to inform guidelines for physics plan reviews and further develop checklist

Error Category	Group Detection Rate
Bolus Correct	88.89%
Contours Correct	44.44%
Planning Approach	100.00%
Rx Dose/Fxs	88.89%
Rx Location	77.78%
Bolus Selected	88.89%
SPC Consult Present (4DCT)	100.00%
SPC Contains All Info	100.00%
Plan Approval Document Correct	66.67%
Field Names	100.00%
Bolus Documentation	88.89%
Gate Info	77.78%
Isocenter Shift	100.00%
DRR Quality	66.67%
Proper Tolerance Table Selected	88.89%
Table Coordinates the Same for All Fields	88.89%
Ref Point Equals Rx Dose	88.89%
Secondary Dose Matches Rx	100.00%
Total Dose Correct	100.00%
Correct Number of Sessions	100.00%
Imaging Matches Orders	100.00%
Average	88.36%

Geyer, et. al "Initial physics chart check: A tool to improve error detection" presentation at the 2017 Arizona AAPM Chapter Meeting

Courtesy Courtney Buckey and Ed Clouser

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Residency Training Curriculum

- University of Colorado – primary tool for resident training curriculum
- 5 simulated error plans (23 embedded errors)
- Goal: fundamental skills to develop a method
- Focus on ways to enhance robustness
- Need to adapt according to changes in technology and processes
- Skills to perform a plan review in current clinic
- Create, evaluate, adapt plan review to any clinic

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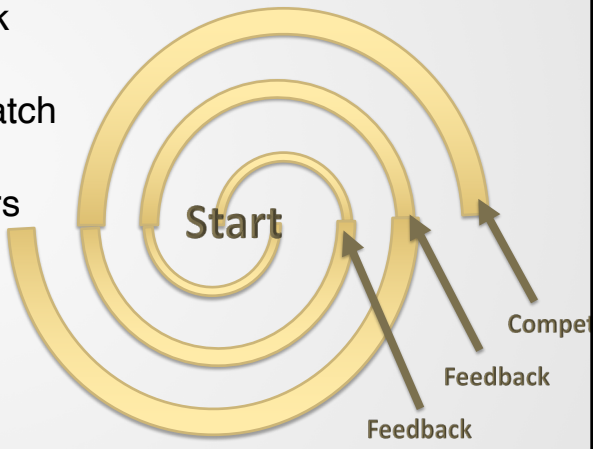
Deliberate Practice with Resident Training

- Mechanics of how to perform a check
- Discuss what they caught or didn't catch
- Ways of viewing plans to detect errors
- Formulate personal best practices maximizing detection ability



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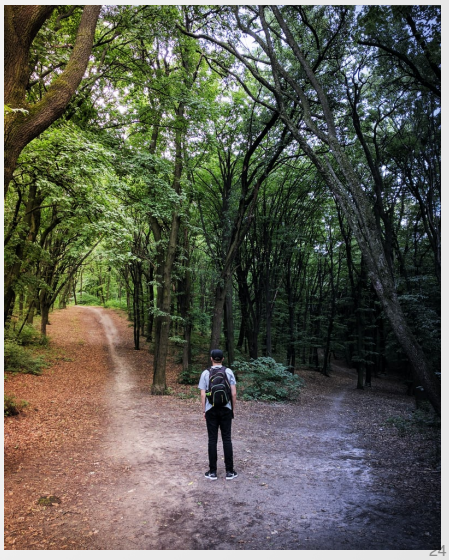
Simulated Error Plans for Additional Resident Training

- Simulated error plans for decision making skills about what to do *after* errors are detected
- Spectrum of issues that can be found
- Spectrum of possible responses
- Real world examples to discuss
- Decision-making framework



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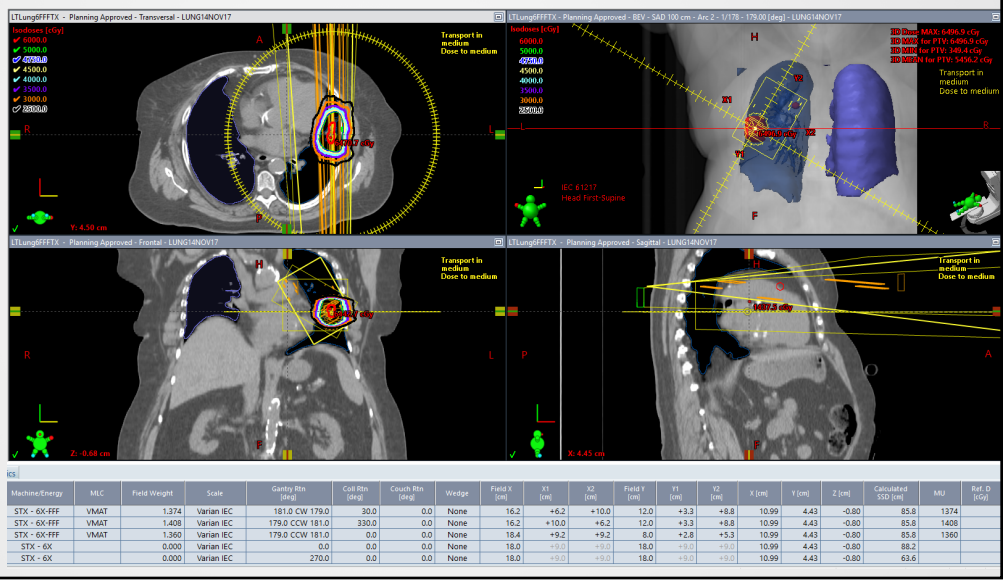
Impact of Simulated Error Plans in Resident Training

- Put new skills to the test
- Motivating for residents
- Engaging



Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	Calculated SSD [cm]	MU	Ref. D [cGy]
STX - 6X-FFF	VMAT	1.374	Varian IEC	181.0 CW 179.0	30.0	0.0	None	16.2	+6.2	+10.0	12.0	+3.3	+8.8	10.99	4.43	-0.80	85.8	1374	
STX - 6X-FFF	VMAT	1.408	Varian IEC	179.0 CCW 181.0	330.0	0.0	None	16.2	+10.0	+6.2	12.0	+3.3	+8.8	10.99	4.43	-0.80	85.8	1408	
STX - 6X-FFF	VMAT	1.360	Varian IEC	179.0 CCW 181.0	0.0	0.0	None	18.4	+9.2	+9.2	8.0	+2.8	+5.3	10.99	4.43	-0.80	85.8	1360	
STX - 6X		0.000	Varian IEC	0.0	0.0	0.0	None	18.0	+9.0	+9.0	18.0	+9.0	+9.0	10.99	4.43	-0.80	88.2		
STX - 6X		0.000	Varian IEC	270.0	0.0	0.0	None	18.0	+9.0	+9.0	18.0	+9.0	+9.0	10.99	4.43	-0.80	63.6		

How Can Simulated Error Training Be Used in My Clinic?

How Can Simulated Error Training Be Used in My Clinic?

- Various uses from early experiences
  - Robustness of current plan review practices
  - Efficacy of new tools
  - Foundation of training curriculum
- Audience
  - Residents
  - New and existing staff physicists

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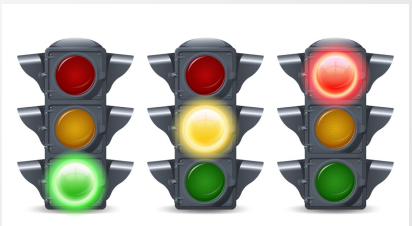
Training and Competency Assessment

- Initial training
  - Residents: develop and fine-tune their method
  - New staff physicists: differences in software and equipment
- Ongoing training
  - New programs added, changing equipment/software vendors, significant software updates
  - Practice accreditation needs
- Competency assessment – initial and ongoing
  - Method to objectively assess



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Conclusions

- Being developed by AAPM WGPE
- Training tool based on established educational techniques
- Early experiences
- Several potential applications

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Thank you!