Why Smart AAPM and COMP Members Do Dumb Things: Introduction to Cognitive Bias

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Henry Ford Health System

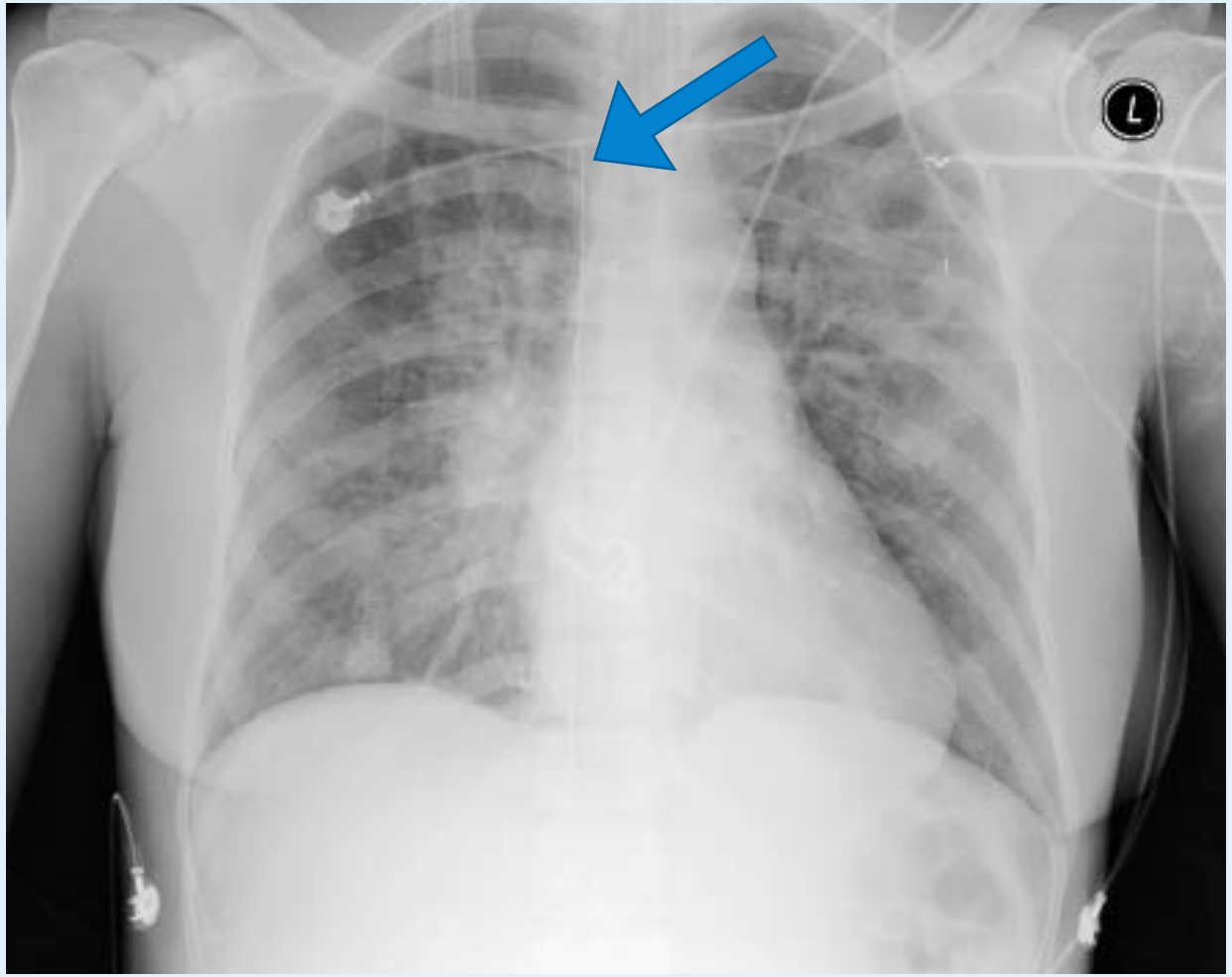
Why should physicists care about cognitive bias?

→ Medical errors aren’t solely caused by bad/dumb people

Cognitive biases have contributed to many sentinel events reported to The Joint Commission

Cognitive Biases in Healthcare, Quick Safety, The Joint Commission, October 2016

Unintended retention of foreign objects



Lum *et al*. Misplaced Femoral Line Guidewire, *Acad Emerg Med*, July 2005

satisfaction of search

+

inattentional blindness

Cognitive biases have contributed to many sentinel events reported to The Joint Commission*

- Unintended retention of foreign objects (satisfaction of search, inattentional blindness)
- **Wrong site surgeries (confirmation bias)**

http://www.outpatientsurgery.net/issues/2014/02/zero-tolerance-for-never-events

*Cognitive Biases in Healthcare, Quick Safety, The Joint Commission, October 2016

Cognitive biases have contributed to many sentinel events reported to The Joint Commission*

- Unintended retention of foreign objects (satisfaction of search, inattentional blindness)
- Wrong site surgeries (confirmation bias)
- **Overexposures (automation bias, confirmation bias, ascertainment bias, etc.)**

*Cognitive Biases in Healthcare, Quick Safety, The Joint Commission, October 2016

Cognitive biases have contributed to many sentinel events reported to The Joint Commission*

- Unintended retention of foreign objects (satisfaction of search, inattentional blindness)
- Wrong site surgeries (confirmation bias)
- Overexposures (automation bias, confirmation bias, ascertainment bias, etc.)
- **Patient falls, diagnostic errors, wrong-patient errors, etc.**

*Cognitive Biases in Healthcare, Quick Safety, The Joint Commission, October 2016

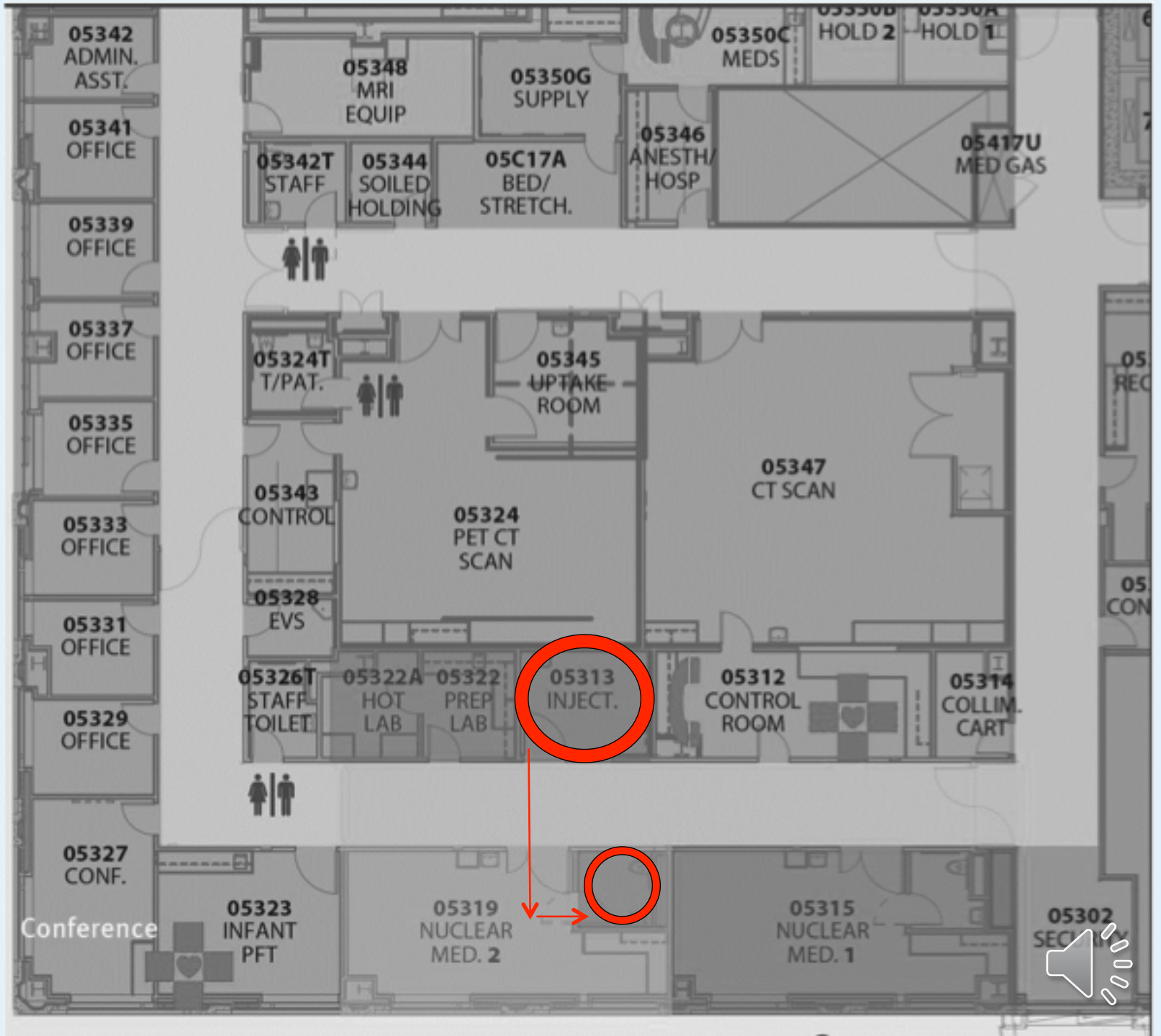
^{131}I Contamination Event

- Administered 27 mCi by mouth in gel capsule form to 7-year-old patient with metastatic thyroid cancer
- Patient had severe dysphagia (trouble swallowing) post-thyroidectomy → fear of swallowing pills
- Patient was observed by four people (radiologist, nuclear medicine technologist, endocrine nurse, child life specialist) and “swallowed” the pill

- After child “successfully” swallowed pill, RSO and parents entered treatment room
- Child used the restroom

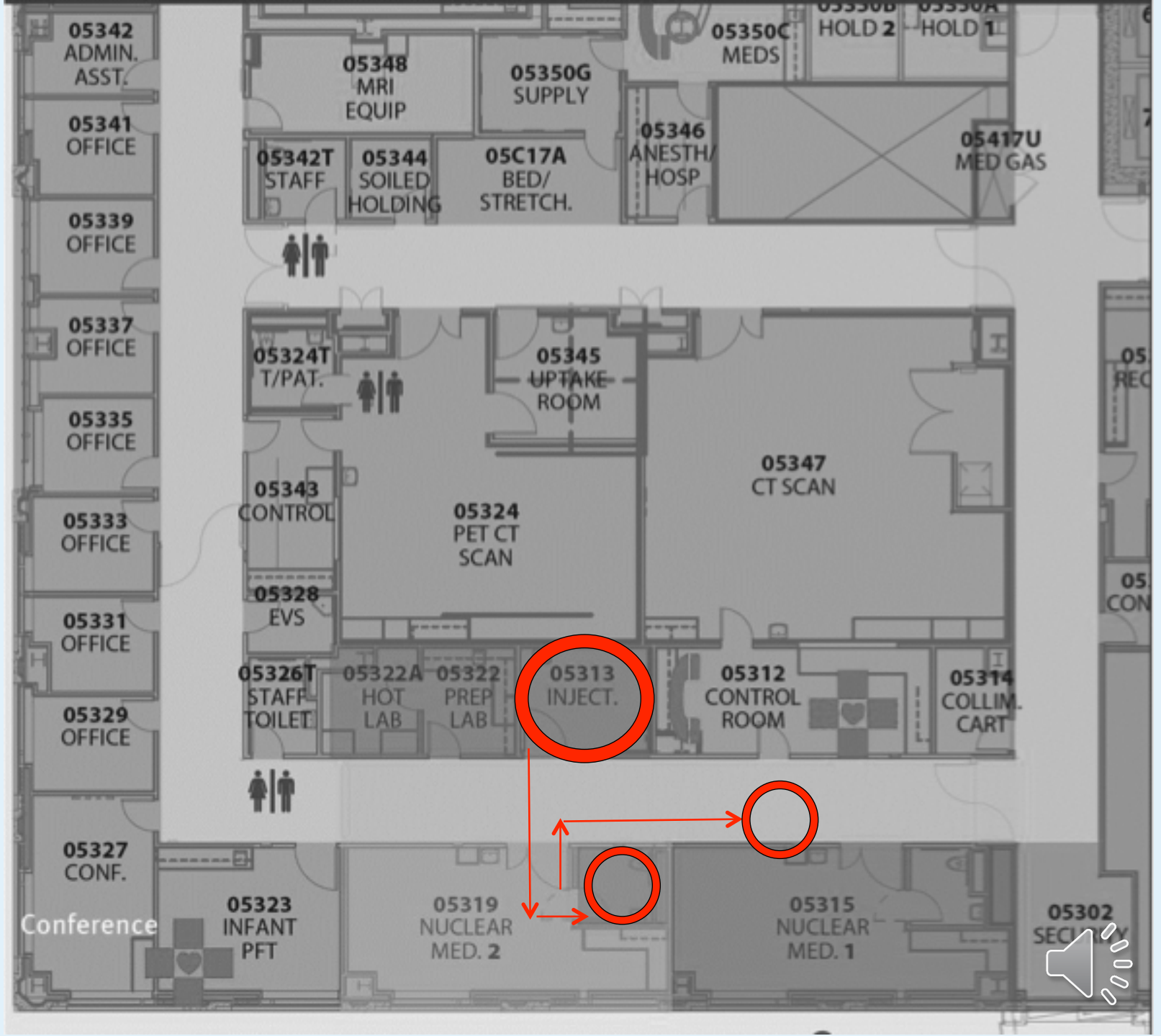
AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- After child left the room, staff noticed that radiation was still present
- Thoughts: patient swallowed capsule or hid it
- Reality: patient crushed the capsule → contamination



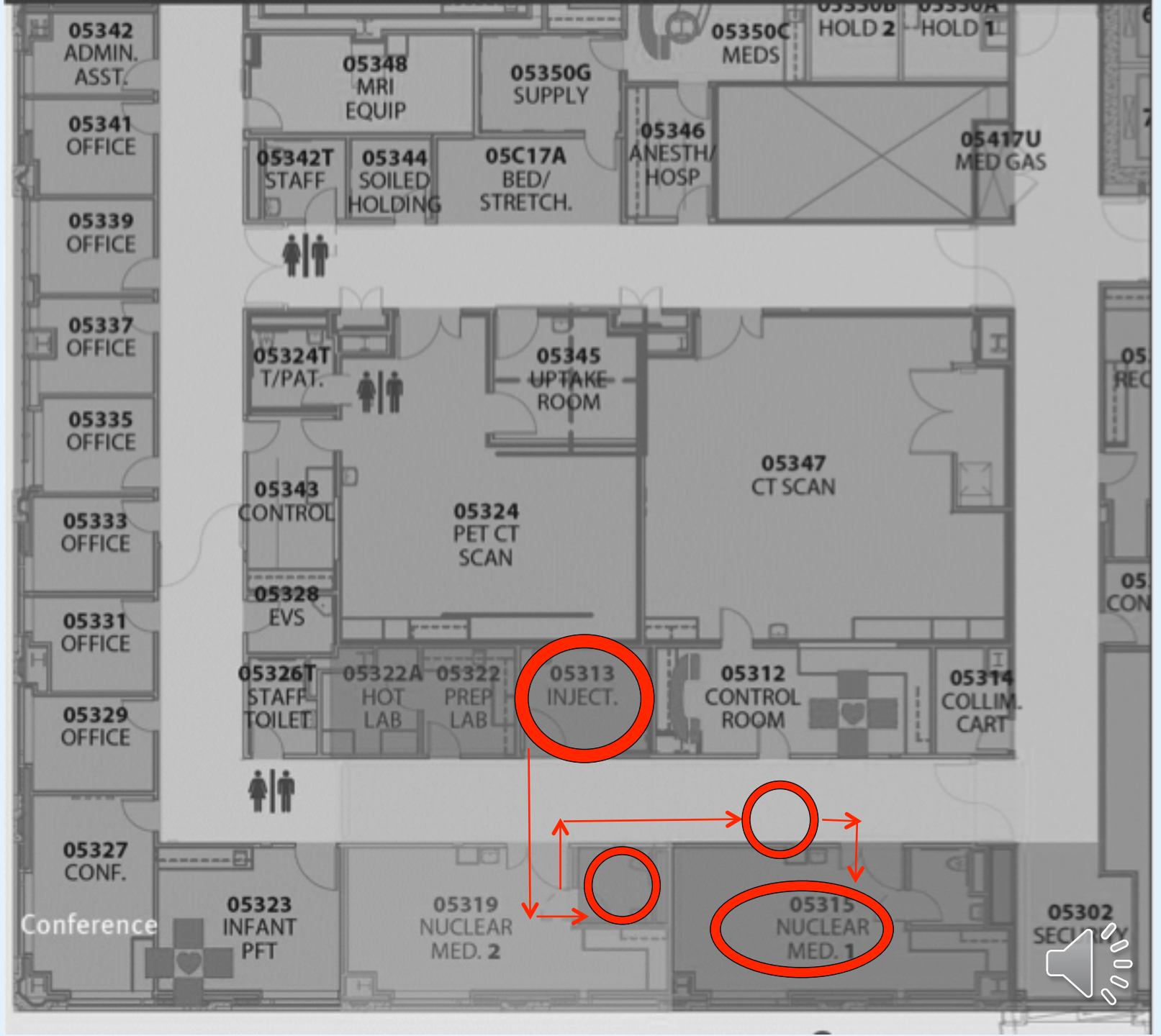
AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- RSO performed a radiation measurement of child at 1m in hallway. Dose appeared to correspond with administered dose



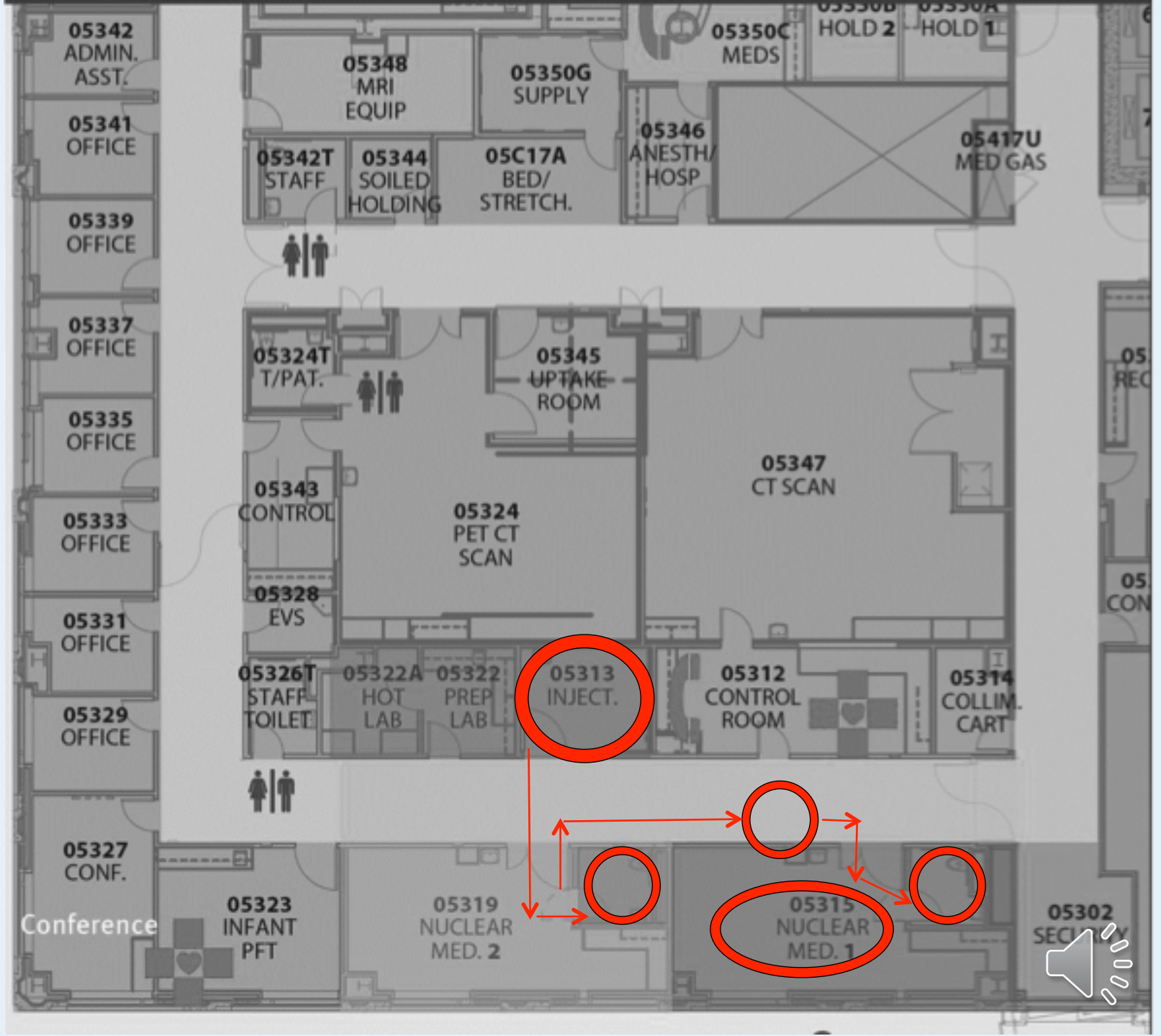
AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- Patient moved to gamma camera to establish pill had been swallowed



AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- Moved to hot lab

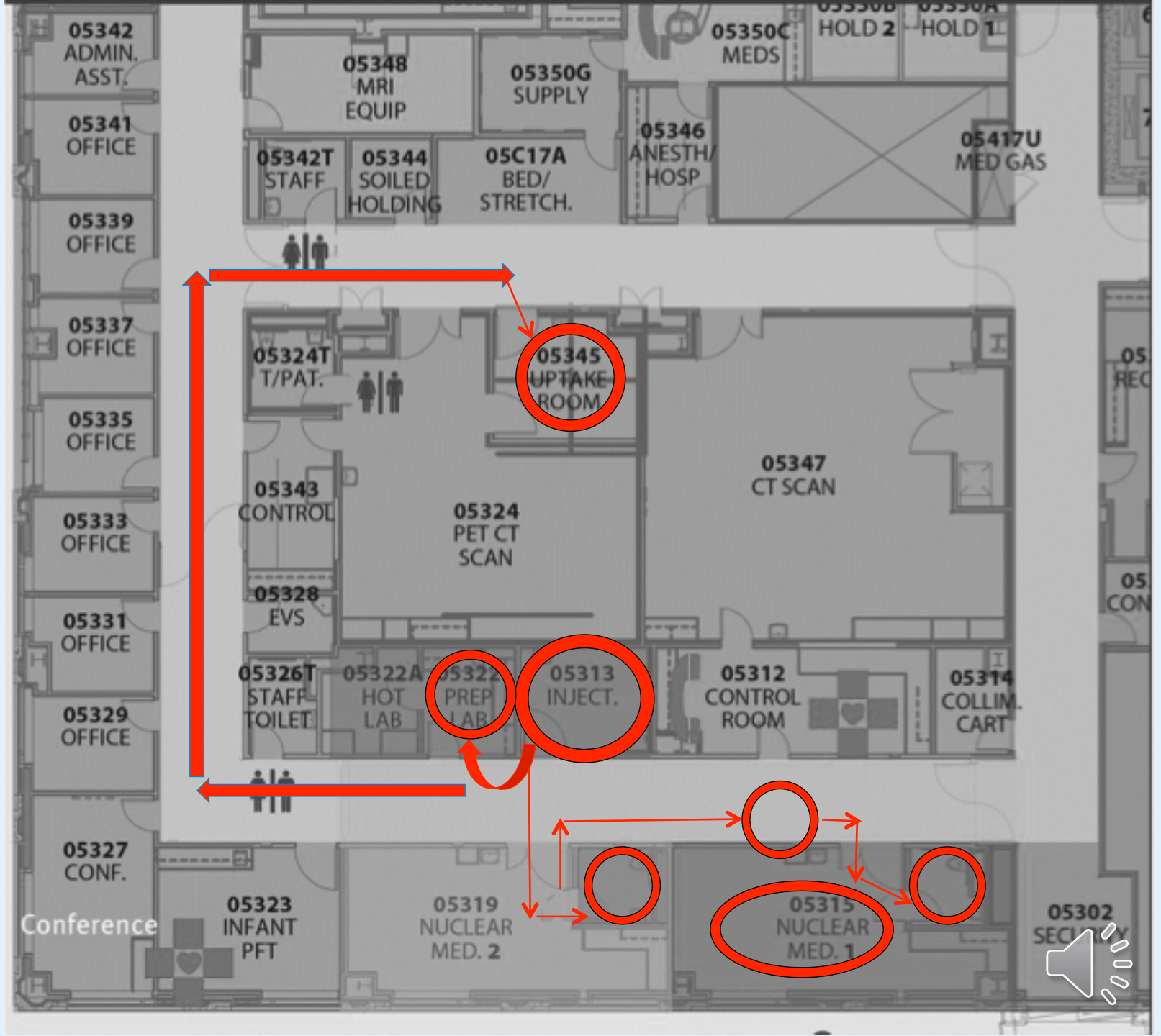


AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- Moved items behind the PET/CT shield

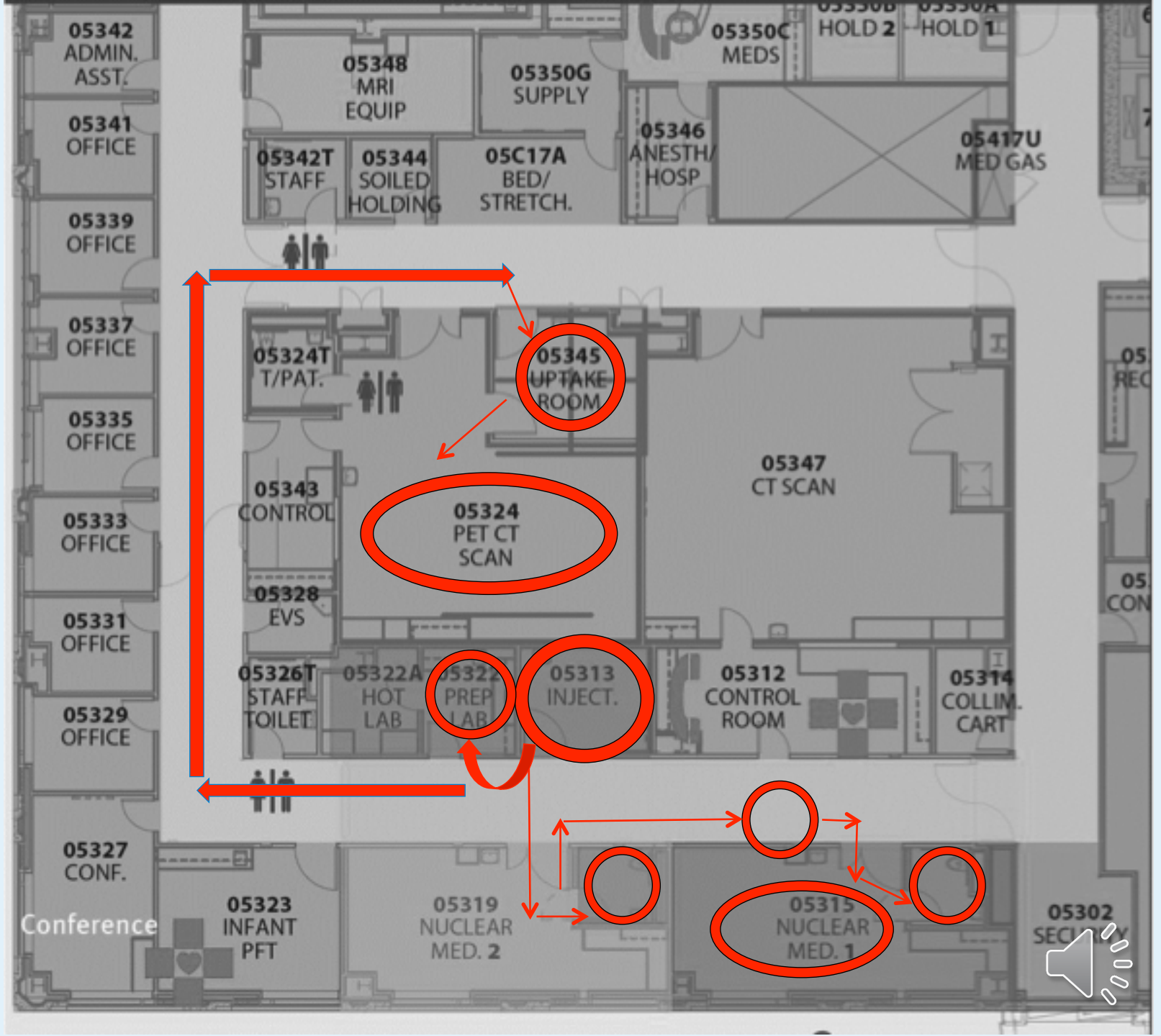
AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- Staff finally recognized that they themselves were contaminated



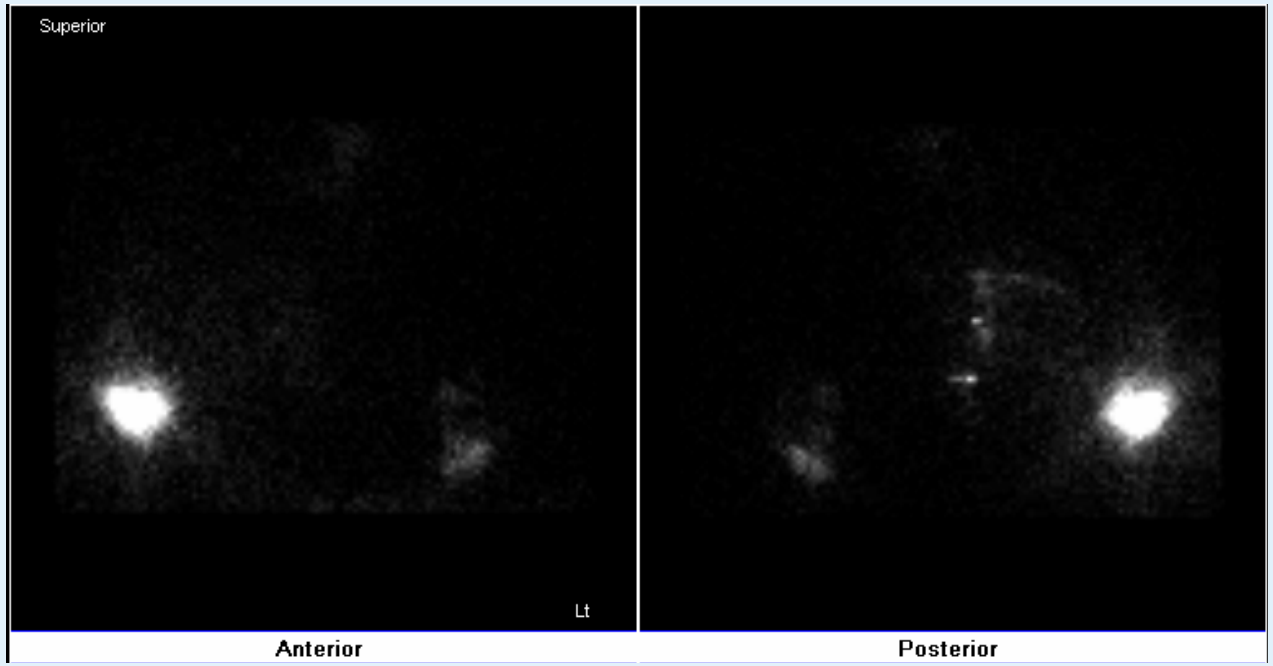
AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- Staff moved into PET/CT to access sink and wash isotope from the skin
- Only at this time did the staff become aware that pill was dissolved and spread throughout the environment



AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

- Planar anterior and posterior gamma camera images show activity primarily in the right hand



AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children:

Consequences of Radioiodine Spill

- Exposed 8 staff members who required daily bioassay for several weeks
- Contaminated over 2,000 square feet of space
- Lost the use of multiple rooms for 81 days
- Damages and decontamination charges exceeding $50,000

AAPM 2017 talk: Christina Sammet, Radioiodine Safety in Children: A Root Cause Analy

Biases Present in This Event

- **Anchoring bias**: Remaining fixed to one's initial impression

- **Confirmation bias**: noticing/seeking evidence that confirms a specific hypothesis rather than seeking evidence that contradicts it

Smart physicists can make errors

- Several specialists involved
- Well-intentioned efforts
- Rules were followed
- Influenced by cognitive biases

Introduction to Cognitive Bias in Decision Making and the Impact on Patient Safety

Derek Brown, PhD
Associate Professor and Director of Education and Training
Radiation Medicine & Applied Sciences

UC San Diego Health

RETHINKING MEDICAL PHYSICS

Cognitive Errors in Healthcare

Why should we care about cognitive errors?

- They occur frequently in healthcare
- They can have significant negative impacts for our patients

Let's take a closer look at:

- What we mean by cognitive error
- Some of the factors that predispose us to making cognitive errors

What is Cognitive Error?

Cognitive error is a thought process mistake that occurs during sensemaking

- **Thought process** – carefully considering something, or a series of conclusions
- **Sensemaking** – figuring out what's going on

Cognitive Error Example

Task

Treat a lung tumor using respiratory gating

Outcome

Treatment misadministration

- Multiple lesions
- Largest lesion identified as target (it is the easiest one to see)
- One of the smaller lesions is the intended target

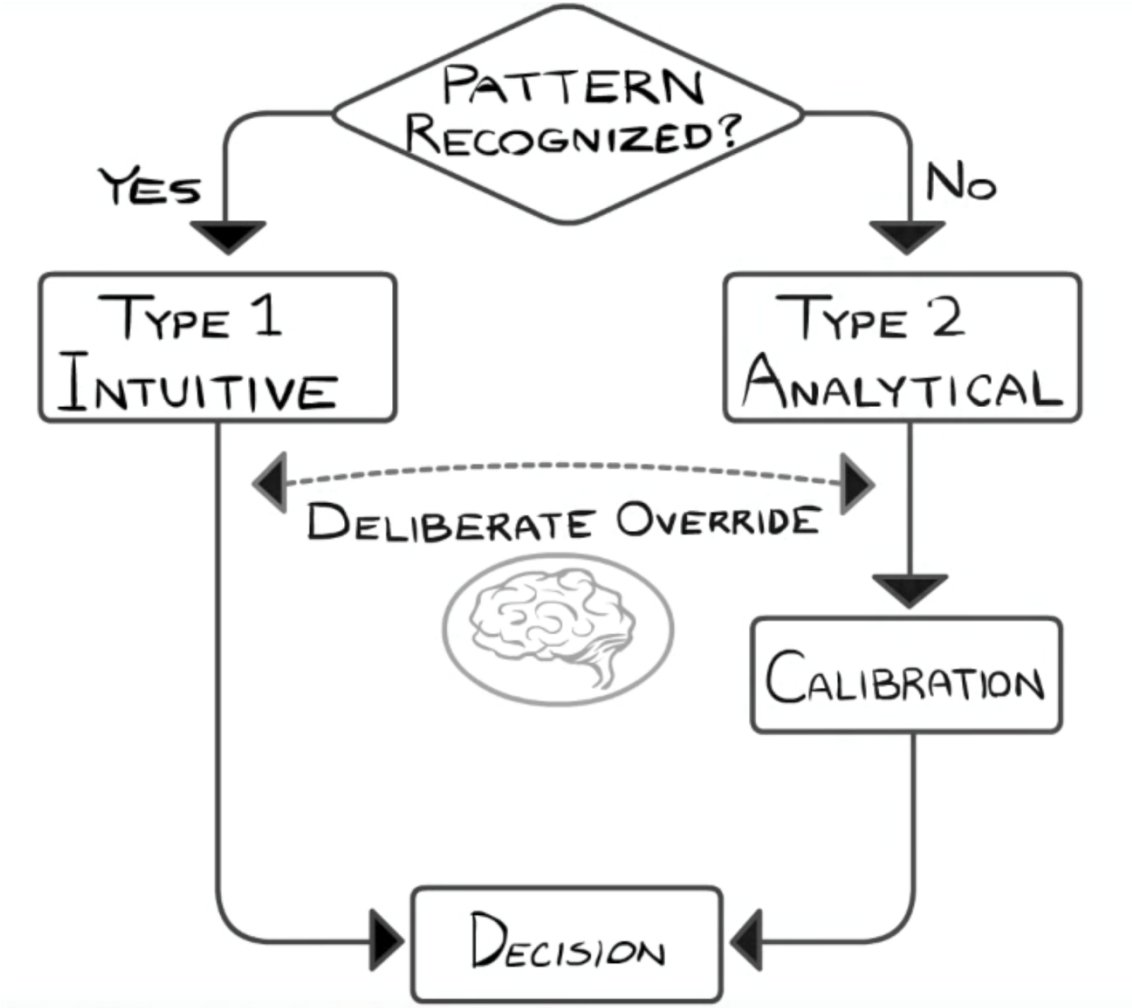
How do we think?

Type 1 thinking

- Fast and efficient
- Governed by heuristics
- Use very little mental effort

Type 2 thinking

- Deliberate and analytical
- Can be used to override type 1 decisions



Marjorie Stiegler, MD. "Understanding and Preventing Cognitive Errors in Healthcare.

Cognitive Error Example

Task

Treat a lung tumor using respiratory gating

Outcome

Treatment misadministration

- Multiple lesions
- Largest lesion identified as target (it is the easiest one to see)
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Predisposing Factors

What factor predispose us to cognitive error?

- **Person Factors**
  - Cognitive loading/fatigue/stress/feelings towards patients/colleagues
- **System Factors**
  - Workflow design/task complexity/time constraints
  - Poorly designed/integrated or inaccessible IT
  - Distractions, interruptions, noise, poor lighting

Rudeness

How does rudeness impact performance?

- **Riskin et al (Pediactrics, Sep 2015) studied this**
  - Randomized 24 NICU teams
  - Exposed to either rude or neutral comments
  - Assessed based on diagnostic and procedural performance

Rudeness

How does rudeness impact performance?

- **Results**
  - Composite diagnostic and procedural performance scores were lower for members of teams exposed to rudeness
  - Rudeness alone explained nearly 12% of the variance in diagnostic and procedural performance

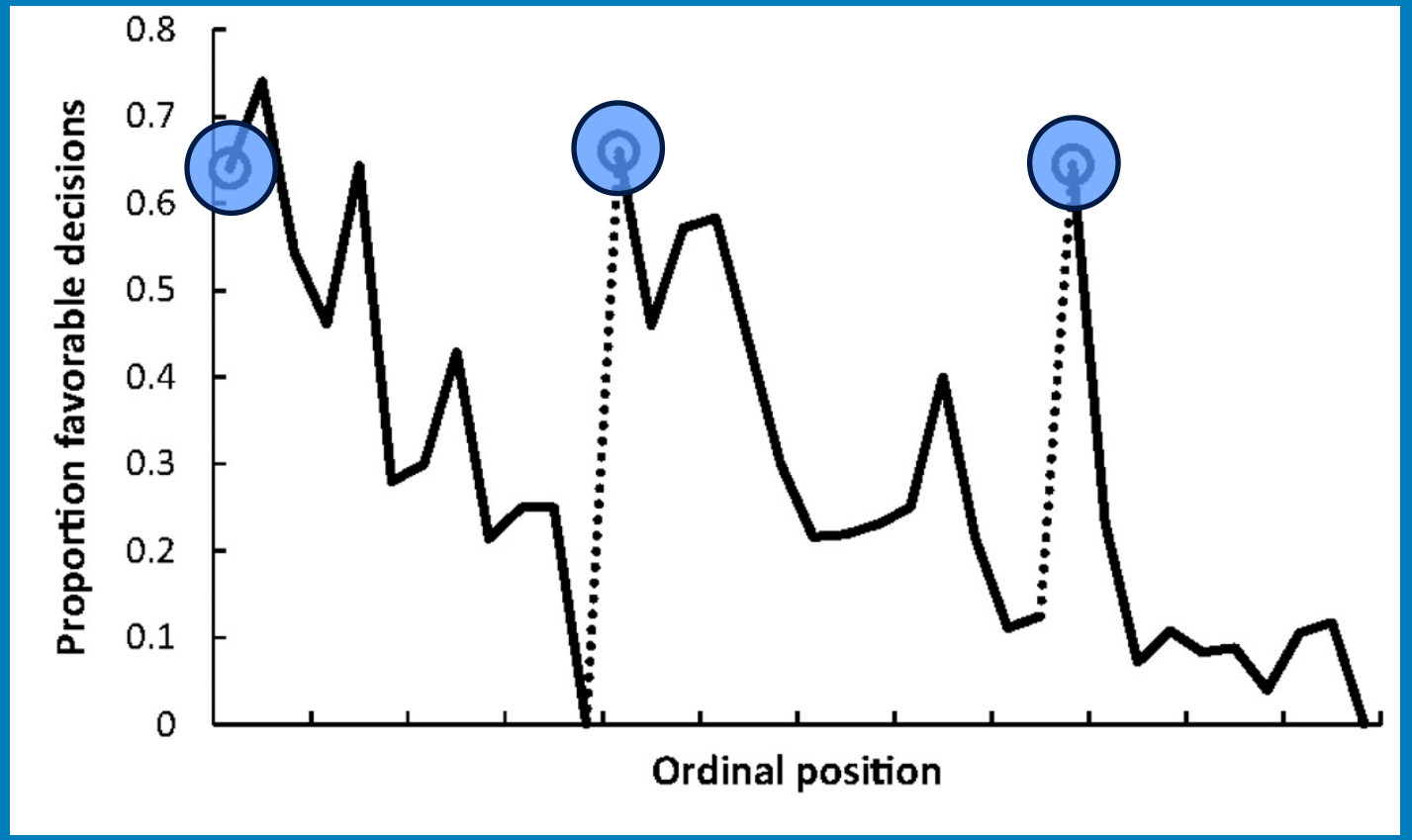
Fatigue

How does fatigue impact performance?

- **Danziger et al. (PNAS 2011) studied this**
  - Retrospective review of 1,112 parole rulings over 10 months
  - Decisions made by 8 judges
  - Deliberations are split into three sessions with two food breaks in between session

Fatigue

Proportion of rulings in favor of the prisoners by time of day



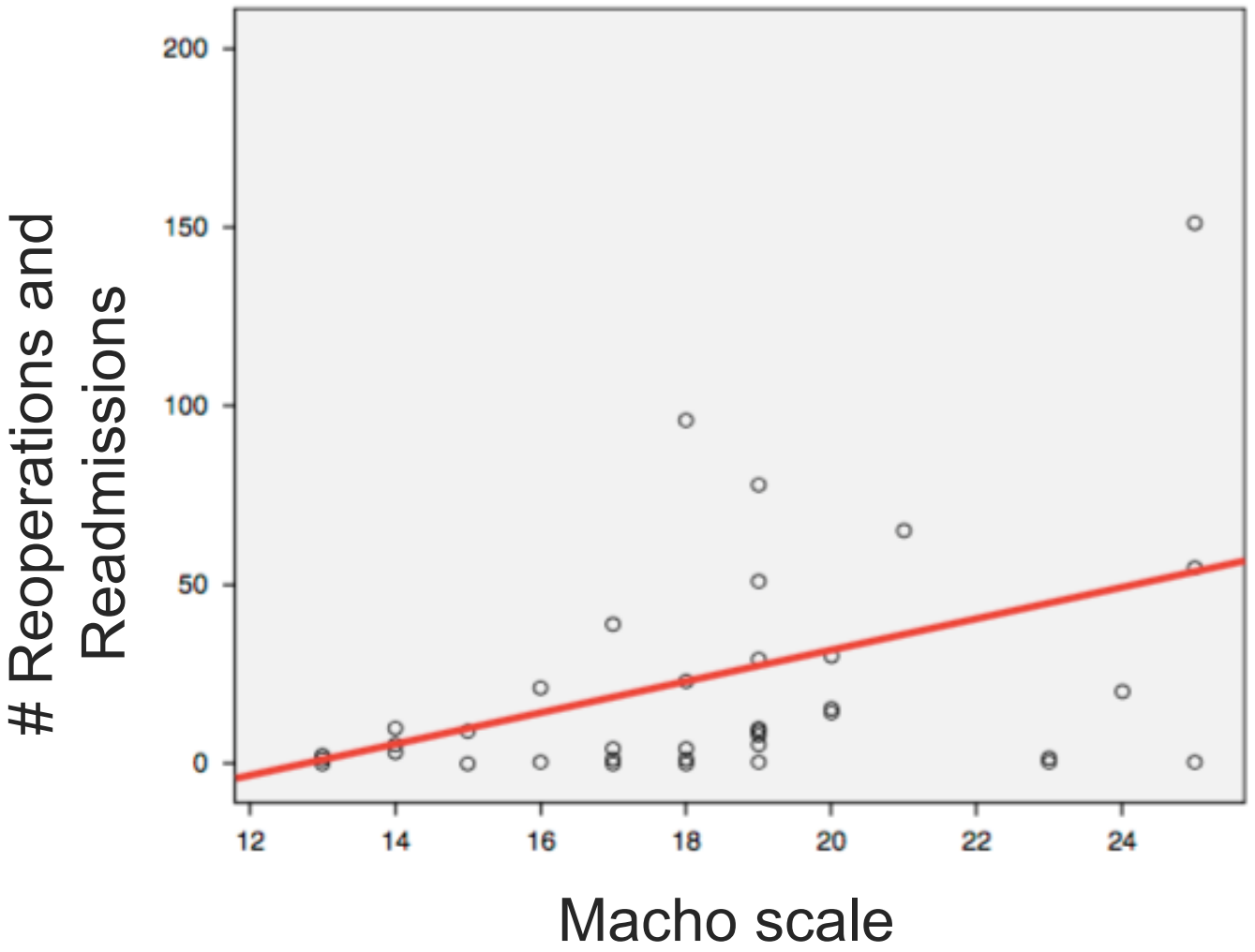
Attitude

How does attitude impact decision making?

- **Kadzielski et al. (Clin Orthop Relat Res, 2015) studied this**
  - Prospective review of 31 orthopedic surgeon reoperation/readmission rates
  - Surgeon's attitudes assessed using validated aviation psychology tools
  - Examined correlation between attitude and reoperation/readmission rate

Attitude

- They found a correlation between macho attitudes and reoperation/ readmission rate
- Macho attitude alone accounted for 19% of variance



Attitude

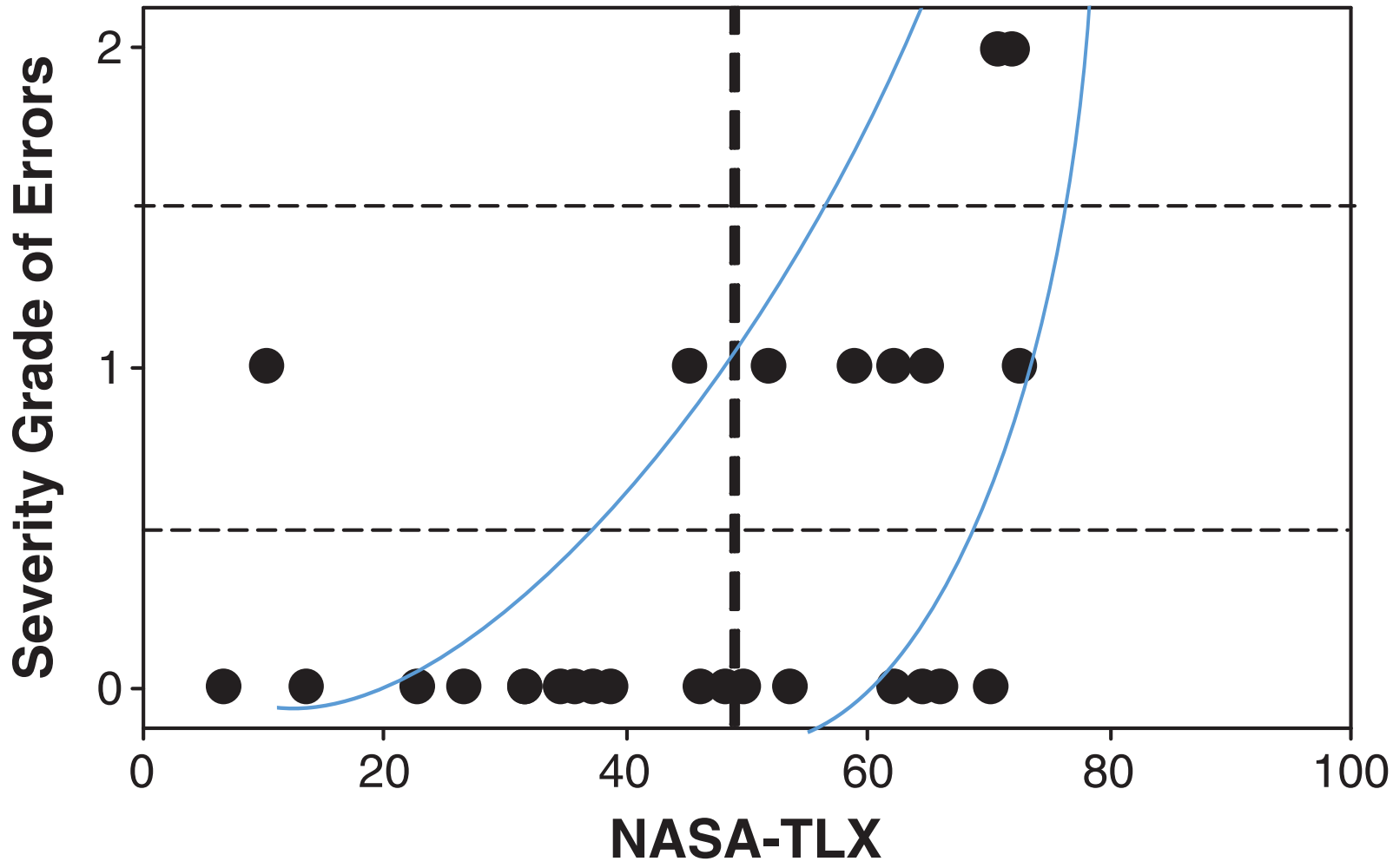
What is a macho attitude?

- **Authors define a macho attitude as:**
  - Being found in pilots who continually try to prove themselves better than others
  - They tend to be overconfident and attempt difficult tasks for the admiration it gains them

How does this translate to rad onc?

- **Mazur et al. (2014) studied this**
  - Prospective – 9 physicians planned 3 cases each
  - Perceived workload assessed using NASA-TLX tool
  - Performance based on severity of errors
  - Examines relationship between perceived workload and performance

How does this translate to rad onc?



Grade 2: Moderate: Altered the intended treatment, but not likely to have a meaningful clinical impact

Grade 1: Mild: No direct clinical consequence expected

Grade 0: No error

Decision making is precarious at best

Hopefully we've convinced you that decision making is a precarious affair, at best!

- How can you recognize when you are making a bad decision?
- Remember, being wrong feels the same as being right
- Step 1 – know the more common cognitive biases

UC San Diego Health

RETHINKING MEDICAL PHYSICS

Collaborators

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Ashley Rubenstein, PhD
Todd Pawlicki, PhD

Cognitive biases you may have met before

Todd Pawlicki, PhD
Professor and Vice Chair
Radiation Medicine & Applied Sciences

UC San Diego Health

RETHINKING MEDICAL PHYSICS

Disclosures

Founding Partner

TreatSafely Foundation

Image Owl, LLC

Textbooks

Quality and Safety in Radiotherapy

Hendee's Radiation Therapy Physics (4th Ed)

The Human Condition

Impact of the Human Condition

The New York Times

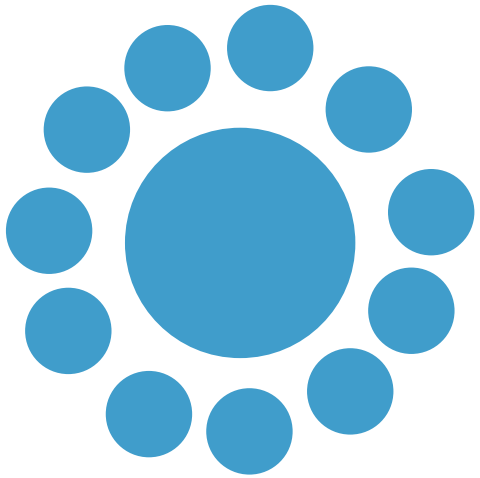
Radiation Offers New Cures, and Ways to Do Harm

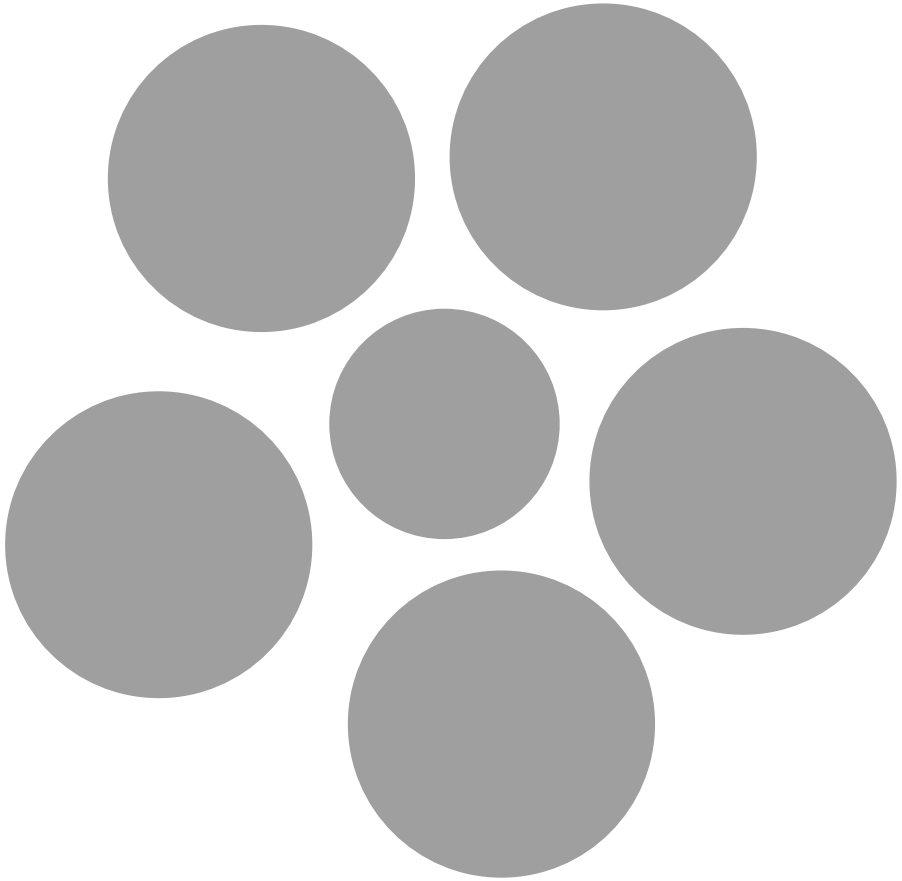
By WALT BOGDANICH JAN. 23, 2000

As Scott Jerome-Parks lay dying, he clung to this wish: that his fatal radiation overdose — which left him deaf, struggling to see, unable to swallow, burned, with his teeth falling out, with ulcers in his mouth and throat, nauseated, in severe pain and finally unable to breathe — be studied and talked about publicly so that others might not have to live his nightmare.

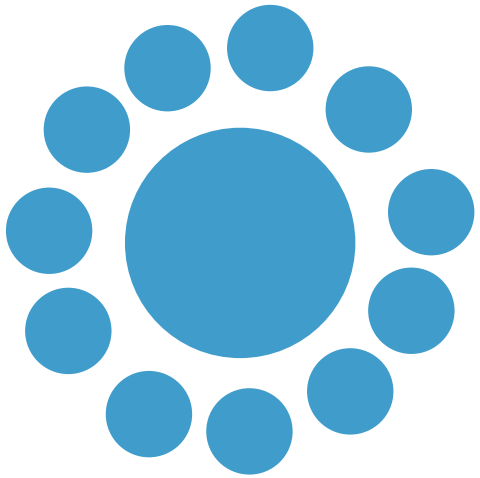
Type 1 Thinking

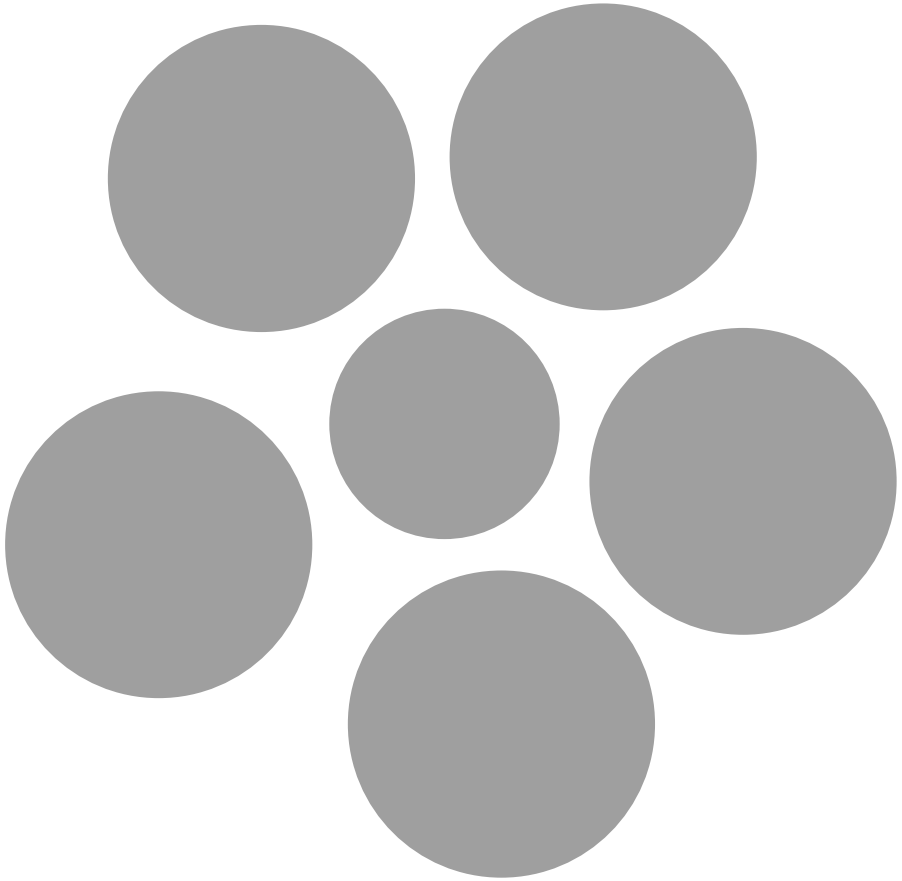
Context is Everything





Our Biases are Implied





Implicit Bias

A characteristic of Type 1 thinking that represents categories as norms and prototypical examples.

Implicit Bias

Research supports a relationship between patient care and MD bias in ways that could perpetuate health care disparities.

PERSPECTIVE

Physicians and Implicit Bias: How Doctors May Unwittingly Perpetuate Health Care Disparities

Elizabeth N. Chapman, MD[1,5], Anna Kaatz, MA, MPH, PhD[4], and Molly Carnes, MD, MS[1,2,3,4,5]

[1]Department of Medicine, University of Wisconsin-Madison, Madison, WI, USA; [2]Department of Psychiatry, University of Wisconsin-Madison, Madison, USA; [3]Industrial & Systems Engineering, University of Wisconsin-Madison, Madison, USA; [4]Center for Women's Health Research, University of Wisconsin-Madison, Madison, USA; [5] William S. Middleton Memorial Veterans Hospital Geriatric Research Education and Clinical Center, Madison, WI, USA.

Anchoring Bias

An overemphasis on early information that impacts subsequent decisions.

Forms of Anchoring Bias

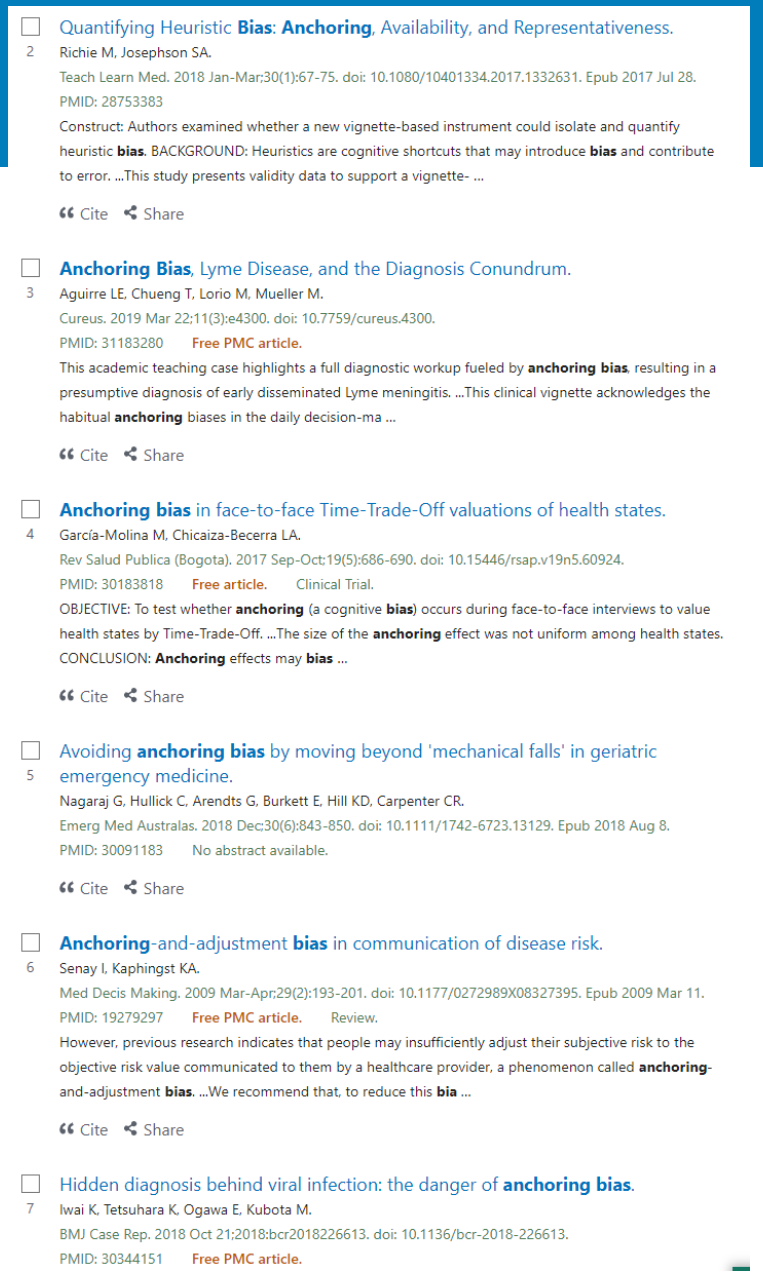
Priming effect – Type 1 Thinking

Deliberate process of adjustment – Type 2 Thinking

Anchoring Bias

Related to MD Decisions

Tendency to fixate on specific features of a presentation too early in the diagnostic process, and to base the likelihood of a particular event on information available at the outset.



2 Quantifying Heuristic **Bias**: **Anchoring**, Availability, and Representativeness.
Richie M, Josephson SA.
Teach Learn Med. 2018 Jan-Mar;30(1):67-75. doi: 10.1080/10401334.2017.1332631. Epub 2017 Jul 28.
PMID: 28753383
Construct: Authors examined whether a new vignette-based instrument could isolate and quantify heuristic **bias**. BACKGROUND: Heuristics are cognitive shortcuts that may introduce **bias** and contribute to error. ...This study presents validity data to support a vignette- ...
Cite Share

3 **Anchoring Bias**, Lyme Disease, and the Diagnosis Conundrum.
Aguirre LE, Chueng T, Lorio M, Mueller M.
Cureus. 2019 Mar 22;11(3):e4300. doi: 10.7759/cureus.4300.
PMID: 31183280 Free PMC article.
This academic teaching case highlights a full diagnostic workup fueled by **anchoring bias**, resulting in a presumptive diagnosis of early disseminated Lyme meningitis. ...This clinical vignette acknowledges the habitual **anchoring** biases in the daily decision-ma ...
Cite Share

4 **Anchoring bias** in face-to-face Time-Trade-Off valuations of health states.
García-Molina M, Chicaiza-Becerra LA.
Rev Salud Publica (Bogota). 2017 Sep-Oct;19(5):686-690. doi: 10.15446/rsap.v19n5.60924.
PMID: 30183818 Free article. Clinical Trial.
OBJECTIVE: To test whether **anchoring** (a cognitive **bias**) occurs during face-to-face interviews to value health states by Time-Trade-Off. ...The size of the **anchoring** effect was not uniform among health states. CONCLUSION: **Anchoring** effects may **bias** ...
Cite Share

5 Avoiding **anchoring bias** by moving beyond 'mechanical falls' in geriatric emergency medicine.
Nagaraj G, Hullick C, Arendts G, Burkett E, Hill KD, Carpenter CR.
Emerg Med Australas. 2018 Dec;30(6):843-850. doi: 10.1111/1742-6723.13129. Epub 2018 Aug 8.
PMID: 30091183 No abstract available.
Cite Share

6 **Anchoring**-and-adjustment **bias** in communication of disease risk.
Senay I, Kaphingst KA.
Med Decis Making. 2009 Mar-Apr;29(2):193-201. doi: 10.1177/0272989X08327395. Epub 2009 Mar 11.
PMID: 19279297 Free PMC article. Review.
However, previous research indicates that people may insufficiently adjust their subjective risk to the objective risk value communicated to them by a healthcare provider, a phenomenon called **anchoring**-and-adjustment **bias**. ...We recommend that, to reduce this **bia** ...
Cite Share

7 Hidden diagnosis behind viral infection: the danger of **anchoring bias**.
Iwai K, Tetsuhara K, Ogawa E, Kubota M.
BMJ Case Rep. 2018 Oct 21;2018:bcr2018226613. doi: 10.1136/bcr-2018-226613.
PMID: 30344151 Free PMC article.

A Simple Task

Take 3 sec to review the poker hand, then calculate the sum by doubling the value of each card (aces are worth 11).

3

2

1

Answer

Take 3 sec to review the poker hand, then calculate the sum by doubling the value of each card (aces are worth 11).

Answer: 50 = (2*5) + (2*4) + (2*3) + (2*2) + (2*11)

Follow-up “Safety Related” Question

Did you find any anomalies with the poker hand?

Inattentional Blindness

When your attention is otherwise engaged, you sometimes fail to notice a salient and fully visible, but unexpected object or event.

Psychol Sci. 2013 September ; 24(9): 1848–1853. doi:10.1177/0956797613479386.

"The invisible gorilla strikes again: Sustained inattentional blindness in expert observers"

Trafton Drew, **Melissa L. H. Vo**, and **Jeremy M. Wolfe**

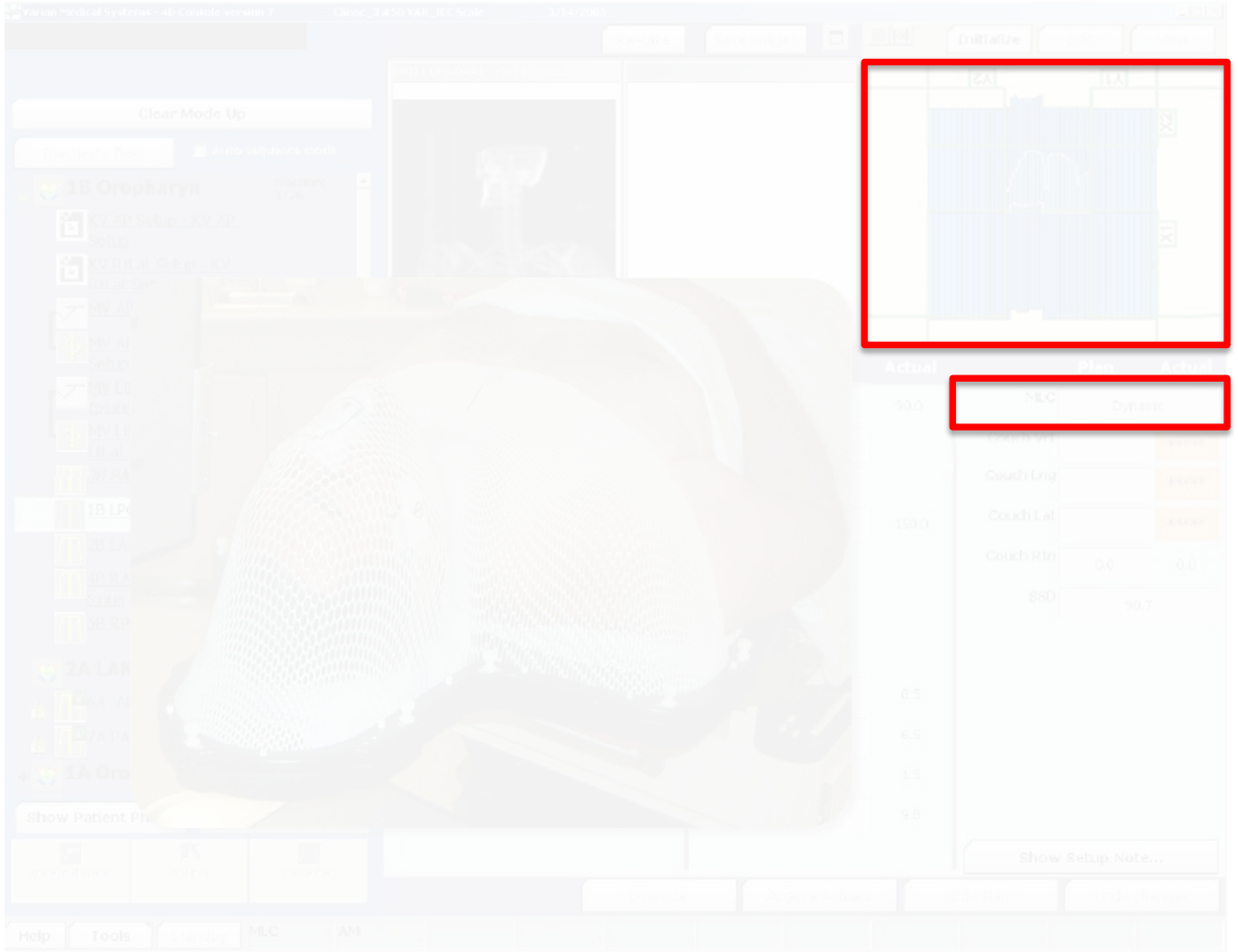
https://www.youtube.com/watch?v=qHUJ6seBoCg

United Airlines Flight 173

A United Airlines Douglas DC-8 similar to the one involved in the crash

Accident	
Date	December 28, 1978
Summary	Fuel exhaustion due to pilot error (lack of situational awareness) and maintenance error with landing gear
Site	Near Portland International Airport, Portland, Oregon, U.S. 45.5225°N 122.499722°W
Aircraft type	McDonnell-Douglas DC-8-61
Operator	United Airlines
Registration	N8082U
Flight origin	John F. Kennedy International Airport, New York City
Stopover	Stapleton International Airport, Denver, Colorado
Destination	Portland International Airport, Portland, Oregon
Passengers	181
Crew	8
Fatalities	10 (2 crew, 8 passengers)
Injuries	24
Survivors	179

Rad Onc Example



The New York Times

Biases That Impact Causal Analysis

Hindsight Bias

Tendency to view the event as being more predictable than it really was.

Confirmation Bias

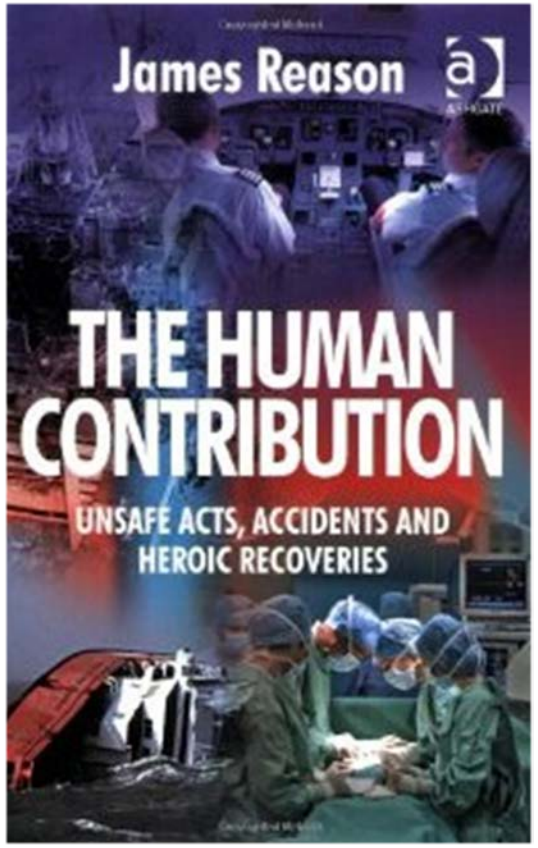
Jump to a conclusion, then look for evidence to support it.

Error Detection/Recovery is a Skill

We need to educate ourselves.

Biases can work in our favor.

When an accident is eminent, people can also make a miraculous recovery.



Summary

Be aware of our biases

- Anchoring
- Implicit
- Inattentional
- Confirmation
- Hindsight
- and many (many) more

The Next Presentation

UC San Diego Health

RETHINKING MEDICAL PHYSICS

Collaborators

Suzanne Evans, MD
Ashley Rubenstein, PhD
Derek Brown, PhD

Disclosure

- I have no financial disclosures relevant to this presentation
- Unrelated disclosures:
- Stipend for Executive Editor, Practical Radiation Oncology
- Stipend for membership Radiation Oncology Healthcare Advisory Council, analysis arm of Radiation Oncology Incident Learning System
- Both total <$3000


DON'T
BELIEVE
EVERYTHING
YOU
THINK

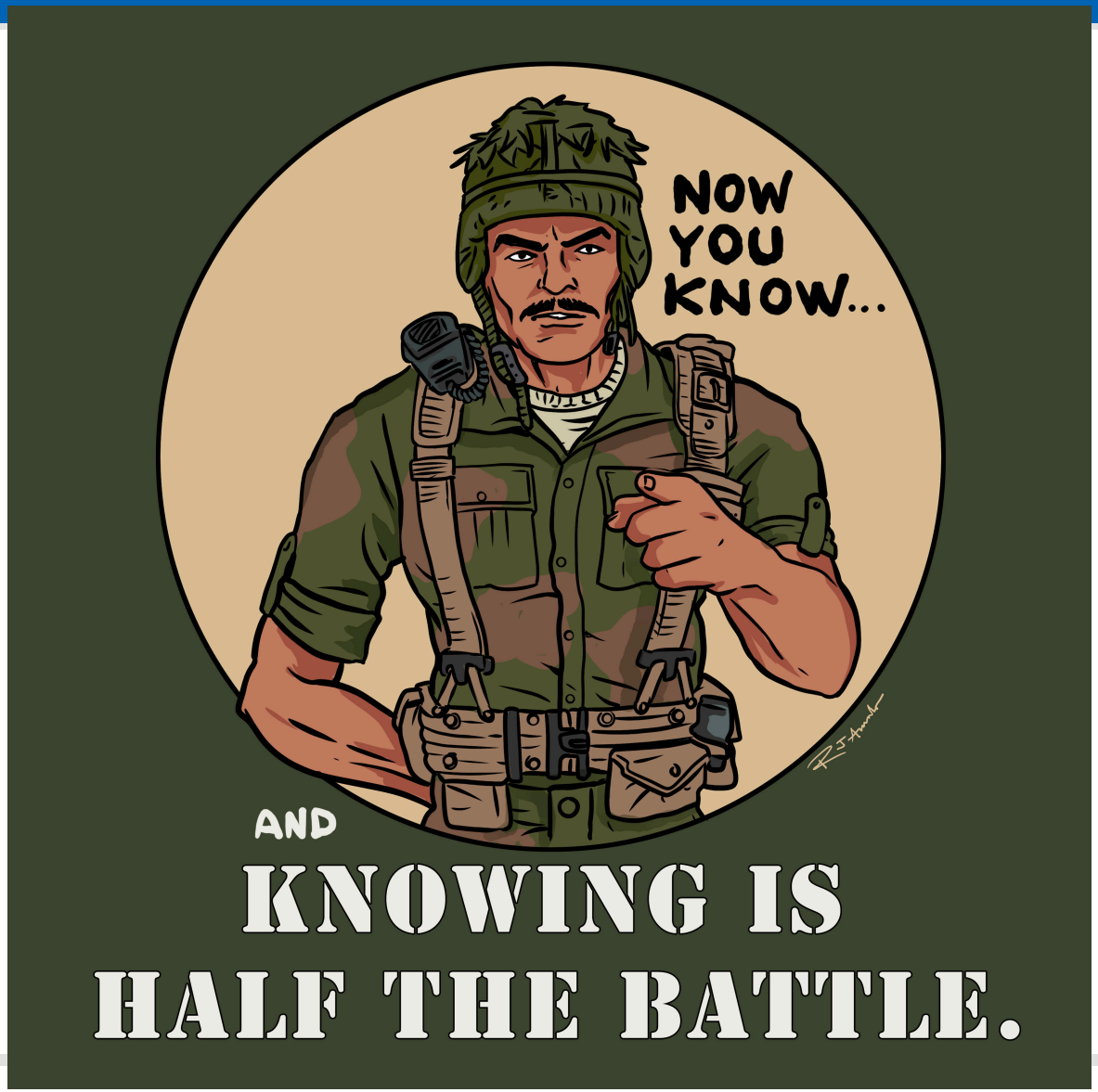
Cognitive Debiasing

- Techniques to limit the impact of bias on your decision making
- Cognitive forcing strategies

How do we Address Bias?

- Limit predisposing conditions as discussed:
- optimize workflow/ health information technology
- Eat
- Avoid fatigue (sleep!)
- Avoid cognitive overload/repetitive decision making if possible
- Be aware when you are vulnerable (allostatic overload!)

G.I. Joe Fallacy



nature human behaviour

ARTICLES

https://doi.org/10.1038/s41562-019-0686-3

Committees with implicit biases promote fewer women when they do not believe gender bias exists

Isabelle Régner[1*], Catherine Thinus-Blanc[1], Agnès Netter[2], Toni Schmader[3,5] and Pascal Huguet[4,5*]

Whether gender bias contributes to women's under-representation in scientific fields is still controversial. Past research is limited by relying on explicit questionnaire ratings in mock-hiring scenarios, thereby ignoring the potential role of implicit gender bias in the real world. We examine the interactive effect of explicit and implicit gender biases on promotion decisions made by scientific evaluation committees representing the whole scientific spectrum in the course of an annual nationwide competition for elite research positions. Findings reveal that committees with strong implicit gender biases promoted fewer women at year 2 (when committees were not reminded of the study) relative to year 1 (when the study was announced) if those committees did not explicitly believe that external barriers hold women back. When committees believed that women face external barriers, implicit biases did not predict selecting more men over women. This finding highlights the importance of educating evaluative committees about gender biases.

- https://implicit.harvard.edu/implicit/takeatest.html

Religion IAT

Skin-tone IAT

Gender-Science IAT

Weapons IAT

Weight IAT

Presidents IAT

Transgender IAT

Race IAT

Asian IAT

Sexuality IAT

Age IAT

Arab-Muslim IAT

Native IAT

Gender-Career IAT

Disability IAT

- Committees with a stronger science=male association exhibited the largest decrease in selecting women (a lower log-transformed AI ratio) if those committees also had weaker beliefs that external barriers hold women back
- Implicit gender bias was unrelated to selection decisions in those comi whose members believed that ge disparities in science can be due external barriers

Knowing is part of it!

External resources to cognitively unload

- Review practice guidelines (ASTRO, NCCN)
- Access decision support techniques (review up to date work up for _____ symptom)

External resources to cognitively unload

- Systematic Approach:

Figure 1. Example of a perceptual error. Anteroposterior radiograph of the chest of a 4-year-old boy. The presence of a swallowed coin within the esophagus was missed twice by a skilled pediatric radiologist. The clinical history provided did not mention the possibility of a swallowed coin.

External resources to cognitively unload

- **Contours:** Review target volumes and OARS
- **Beam Arrangements/Fields:** Appropriate and reasonable
- **Coverage:** Evaluate on graphic plan and DVH
- **Heterogeneity/Hot Spots:** Value and location
- **Organs at Risk:** Review specified constraints, corresponding isodose lines on plan, and DVH
- **Prescription:** Total dose, dose per fraction, and image guidance

Cognitive unloading: checklists

TAC 289.227 Compliance Checklist

289.227	Requirements for Fluoroscopic X-Ray System	Status
m1A II	X-ray production must be prohibited until barrier (usually imaging system) is in place	Pass
m1C III	Means must be provided for stepless adjustment of collimators	Pass
m1C III	Minimum field size at maximum SID is < 5 x 5 cm for collimators	Pass
m2	Deadman type foot or hand switch is required for X-ray activation	Pass
m3B II III	**High level controls:**	Pass
	Special means must be used for activation	Pass
	Continuous manual activation is required	Pass
	Continuous audible signal must be produced	Pass
m3D	Medical physicist must perform periodic measurement of entrance exposure rate	Pass
m3D I	Entrance exposure rates must be tested annually and after repair	FYI
m3D II	Results must be posted where fluoroscopist can reference them during fluoroscopy	Pass
	Results of previous fluoroscopy inspection are posted.	Yes
	Results of this inspection are posted.	Yes
m5	kVp/mA must be continuously indicated at control or fluoroscopist's position	Pass
	Minimum Source to Skin Distance:	
m6A I	38 cm for stationary units	NA
m6A II	30 cm for mobile units	Pass
m6B	20 cm for units used for specific surgical applications	NA
m7A I; m7B III II	Means shall be provided to preset the cumulative on-time of the fluoroscope to 5 min or less	Pass
m7A II; m7B IV	When 5 minutes expire an audible signal must exist for 2 seconds until auto reset	Pass
m8A	Scatter radiation drapes of > 0.25 Pb must be in place on column console except when not possible	NA
m8B I	When m8A is not possible, personnel aprons must be 0.35 mm Pb equivalent	FYI
m8B II	When m8A is not possible, the field size must be minimized by collimation	FYI
m8B III	When m8A is not possible, operating & safety procedures must state this and personnel to respond appropriately	FYI

Make sure you don’t shut down prematurely!

- Rule of three- When considering a diagnosis or treatment option, force yourself to fully consider 3 options.

Make sure you don’t shut down prematurely!

- Rule out worst case scenario: make sure a serious (but perhaps unlikely) possibility is considered

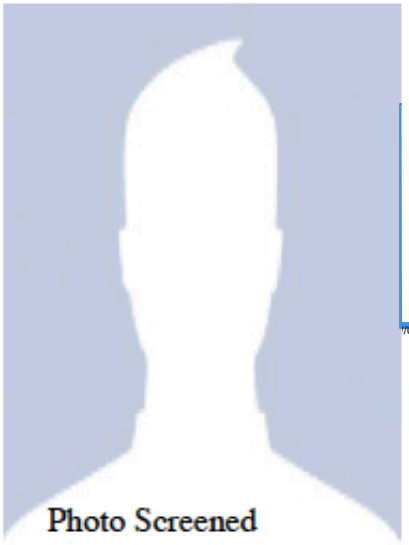
Make sure you don’t shut down prematurely!

- Consider the opposite strategy: Reverse what you think, and go over the data and see if it stills fits as well as you think it does.

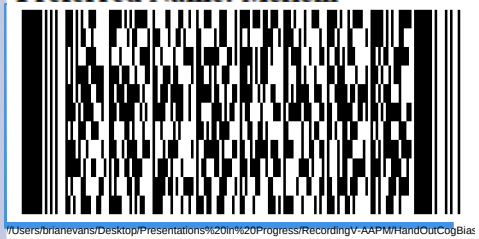
Make sure you don't shut down prematurely!

- Exposure Control: Limit exposure to information that might influence judgment before your impression is formed

Advanced (Radiation-Oncology, 1089430A0 (Advanced))



AAMC ID [redacted]
Full Name: Mokhtech, Meriem
Preferred Name: Meriem



Most Recent Medical School:
University of Florida College of Medicine
Location: Gainesville, FL, USA
Graduation Date: 05/2018
Degree Type: MD

Participating in the NRMP Match:
Yes
Participating as a Couple in NRMP:
No

Citizenship: U.S. Citizen

Most Recent Residency: None

Make sure you don’t shut down prematurely!

- Premortem/prospective hindsight: Pretend a bad outcome has happened. Now, look back at your decision, and try to identify the tell tale signs that would indicate you were on the wrong path

Other strategies

- For affective bias: Acknowledge your bias to yourself. Then, run the case by a colleague or two. Give them just the facts, and leave out the rest to gauge your clinical judgment
- Summarize aloud: list the basic tenets of the case to its minimum components, and see if this makes the path more clear.

RED TEAMS!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HOT STUFF
ANDERSON
"OK, let me play advocate for a minute..."

RED TEAMS!

- Try it yourself: When preparing for your next presentation, instead of asking (yourself, your helpers) “Is my presentation ok,” ask, “What can you find wrong with my presentation?”

- Not advocating indecision, or lack of confidence, but rather that one take a moment to focus on flaws of one’s choices before going ahead with those choices.

- Disconfirmation and considering the opposite often takes less time than the confirmation, basking in one’s own glory, listening to “yes-men” and “preaching to the choir” that otherwise occurs..

Other strategies

- Recalibration: When bias is anticipated, the decision maker may recalibrate

Other strategies

- Group decision strategy- Crowd Wisdom: Chart Rounds!

Conclusions:

- Bias is everywhere!

- Be self aware
- Cognitively unload
- When all else fails, consider the opposite!

Thank you!!