

Building a Better Safety Net: The Role of SGRT for Patient Safety

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Disclosures

None.

Current Clinical Trends

- Hypofractionation for many disease sites
- Adaptive RT



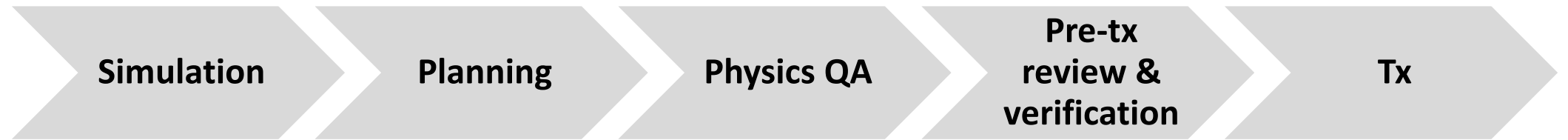
- ➡ Higher doses and increased complexity
- ➡ Lower tolerance for errors during each tx session

Applications of SGRT

- **Patient positioning**
 - Posture corrections
- **Patient monitoring**
 - “virtual immobilization”
- **Gated delivery**
 - Breath hold



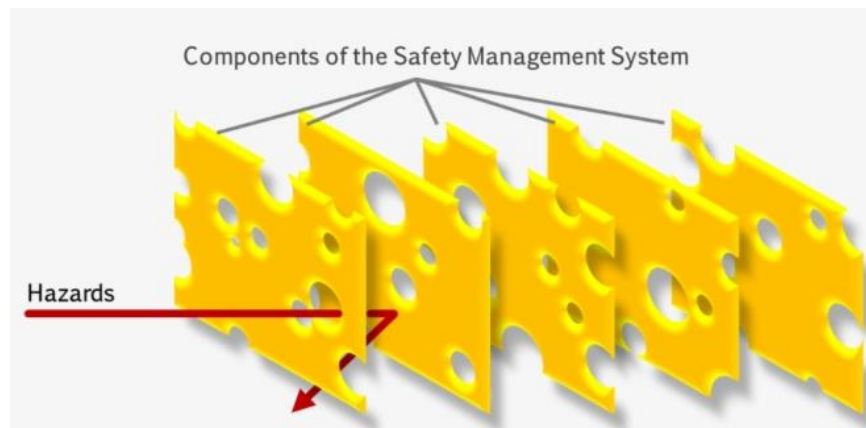
Building a Better Safety Net



Standardization of workflows and procedures

Physics checks

SGRT



Q: How many errors make it to the tx room and how effective is SGRT in detecting them?

Incident Learning Systems



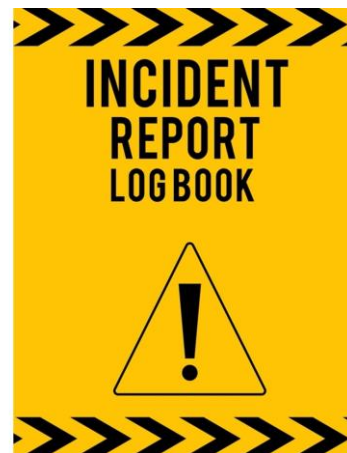
Regional ILS:
AvIC, Skåne region in South Sweden



International ILS:
SAFRON (Safety in Radiation Oncology)

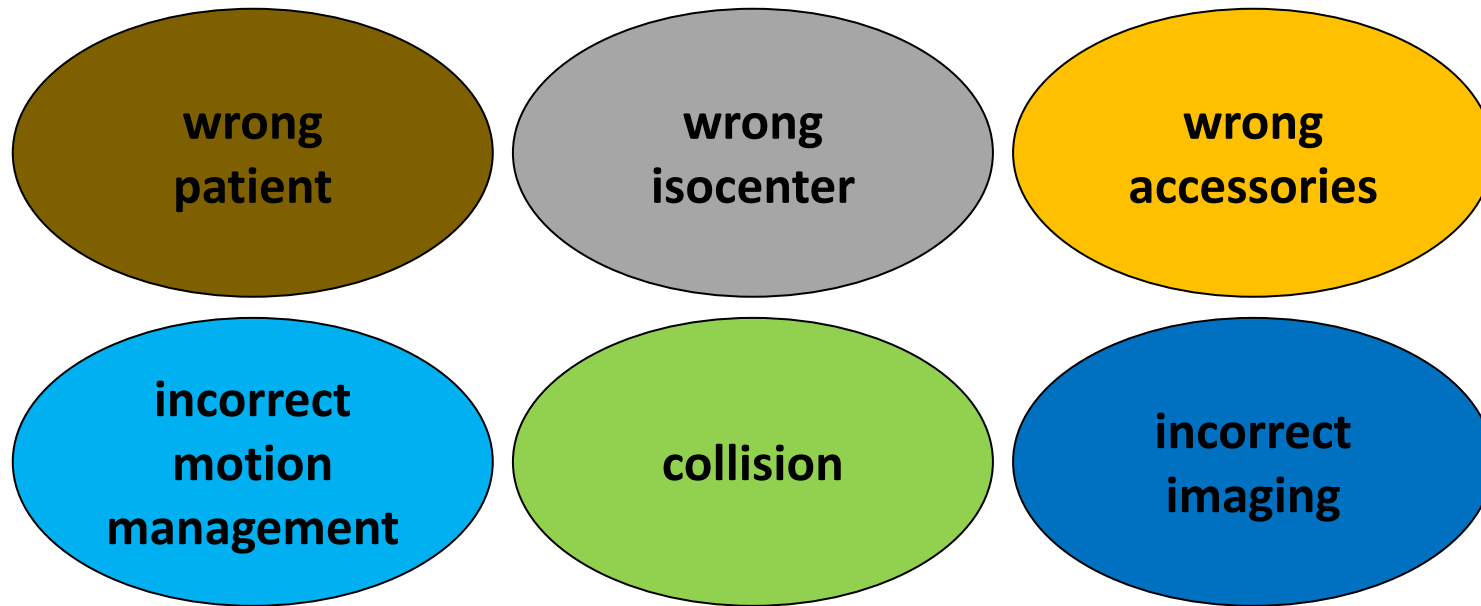


Departmental ILS:
CSI, University of Washington



ILS search

1. Identified the most common errors that could have been prevented with SGRT



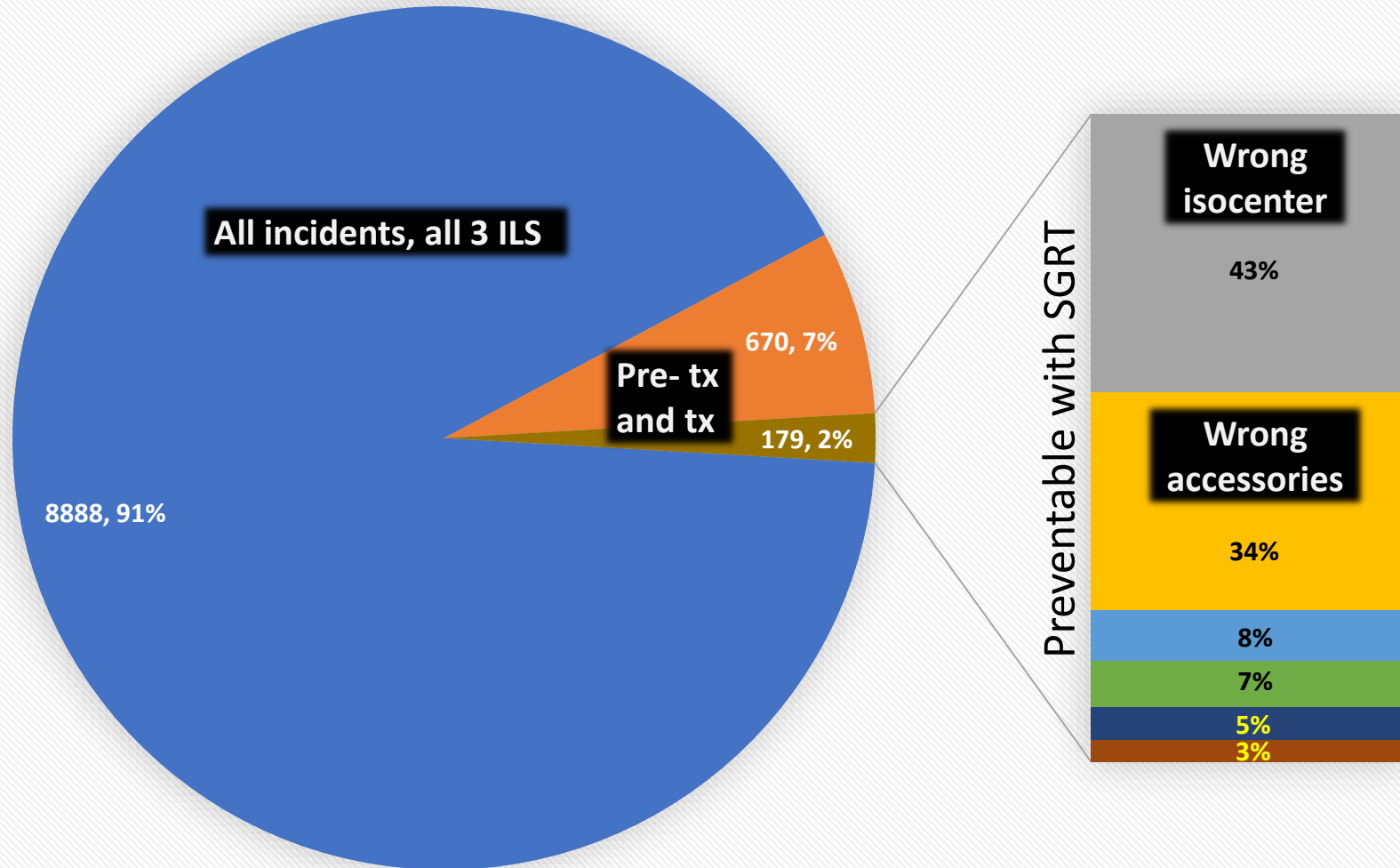
ILS search

2. Reviewed incidents in the past 5 years and assigned to relevant incident categories if considered “*avoidable by means of SGRT*”.

Incident Categories	Filter/keyword/tag		
	SAFRON	UW-ILS	AviC
Wrong patient	Patient ID, exchange, swap, wrong patient, identification	Patient info, wrong patient, identification	Patient ID, identification, wrong patient
Wrong isocentre	Patient Positioning, Use of Reference Marks, Setting of Couch Position, Isocenter, SSD, angle	Isocenter concerns, Isomark/ vsim, Localization, Multiple site treatment, Patient setup, Lasers, Site setup, bbs, Tattoo, Reference Mark	Positioning deviation, wrong positioning, isomark, tattoos, matching of verification images, reference marks, iso shift
Wrong accessories	Immobilization devices, Use of shaping devices, Treatment Accessories, Treatment delivery, Bolus, board, immobilization device, Leg/ arm/ neck, vacbag, pillow, tilt	Treatment device, Bolus, immobilization, Setup position, Site Setup	Immobilization device, immobilization method, bolus, patient setup
Incorrect motion management	4D, motion, gating, breath hold, DIBH, 4DCT, breathing	4DCT, Breath hold, ABC, Calypso, Wrong Scan	DIBH, 4DCT, gating, baseline, gating window, Sentinel, Catalyst
Collision	Hit, collision, couch angle	Collision, angle, clearance	Collision, couch angle
Incorrect imaging	Tilt, CBCT, site, rotation, gating, 4D coordinates	CBCT, Imaging, 4DCT, wrong dataset	CBCT, verification imaging, wrong dataset
SGRT	SGRT, surface, Vision, AlignRT, Catalyst, Sentinel, C-Rad, OSMS	N/A	SGRT, surface, Vision, AlignRT, Catalyst, Sentinel, C-Rad, OSMS

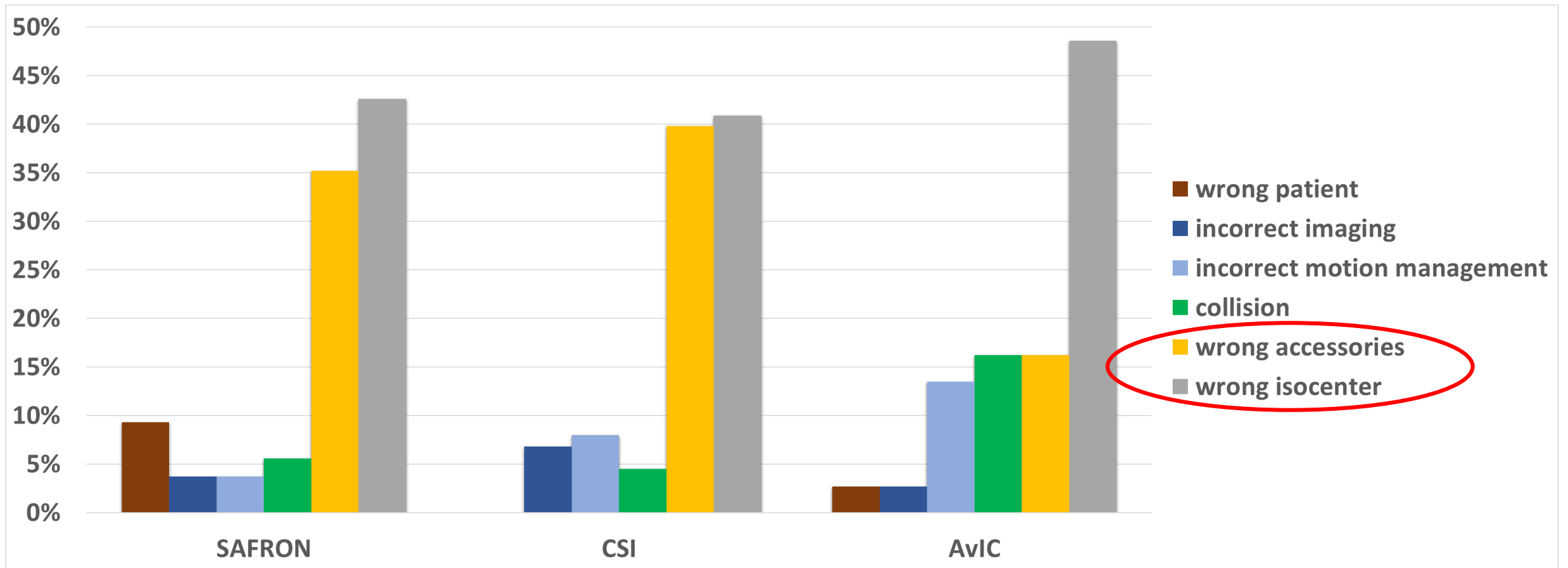


Results - ILS combined

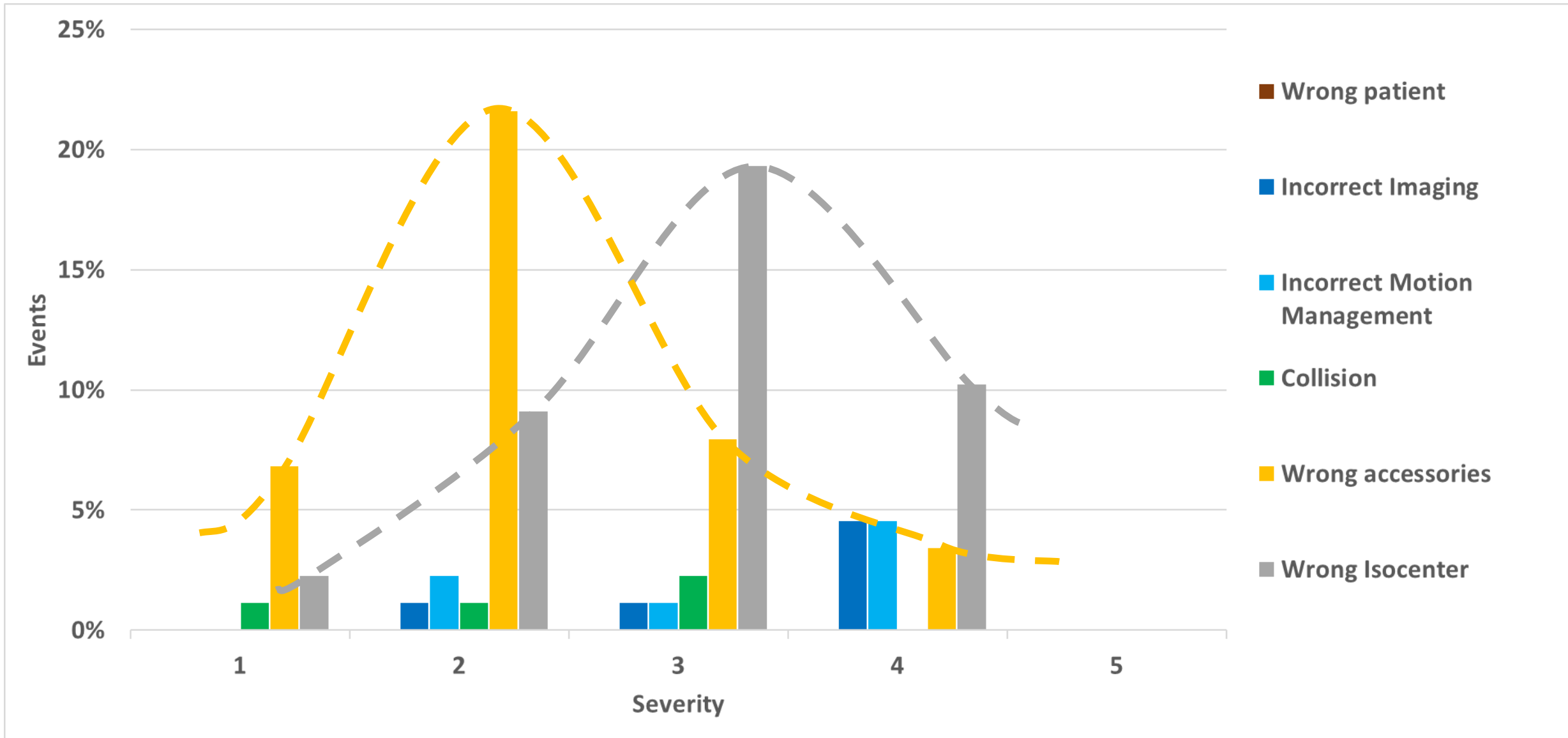


- Total (9737)
- Not avoidable with SGRT
- wrong isocenter
- wrong accessory
- incorrect motion management
- collision
- incorrect imaging
- wrong patient
- Preventable with SGRT

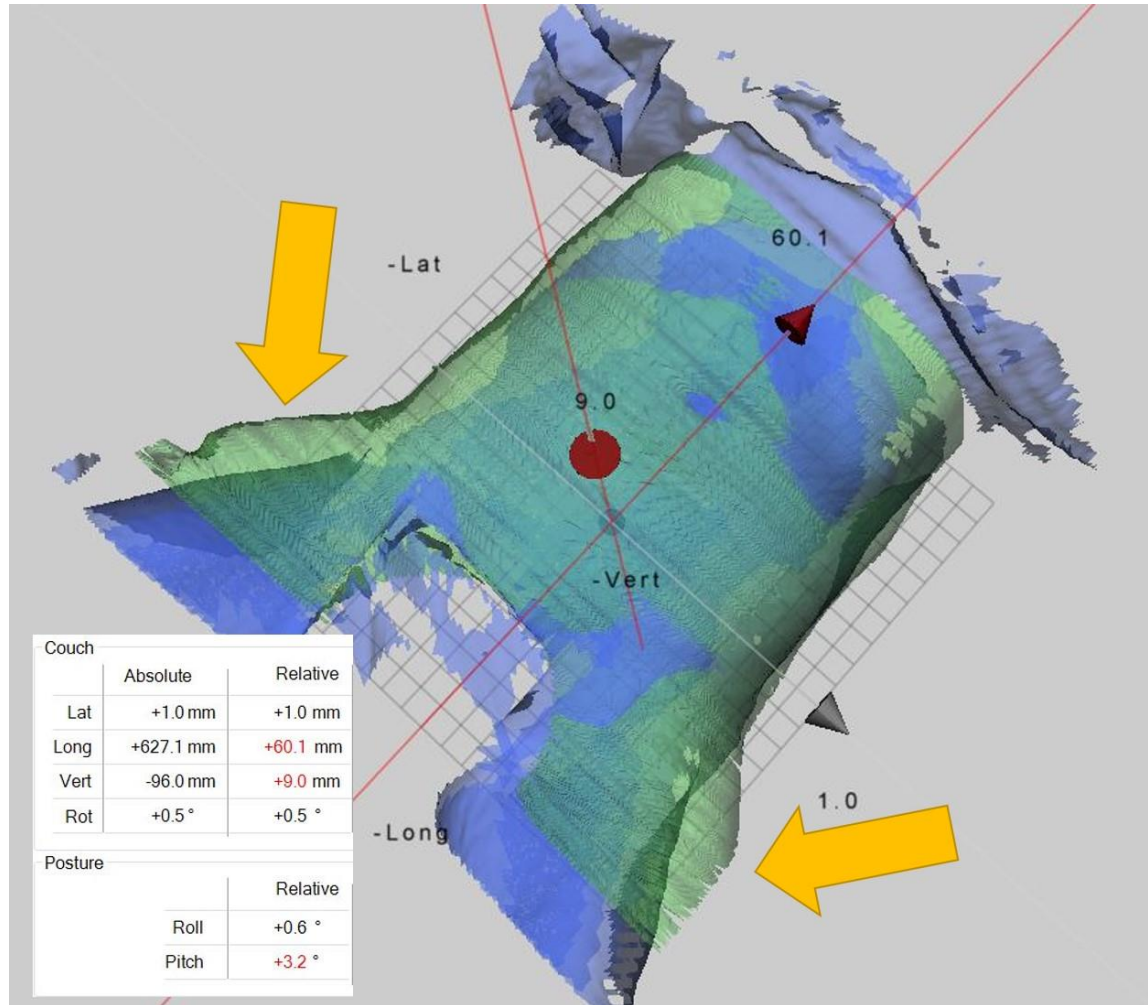
Results - by ILS



Severity Analysis (UW)

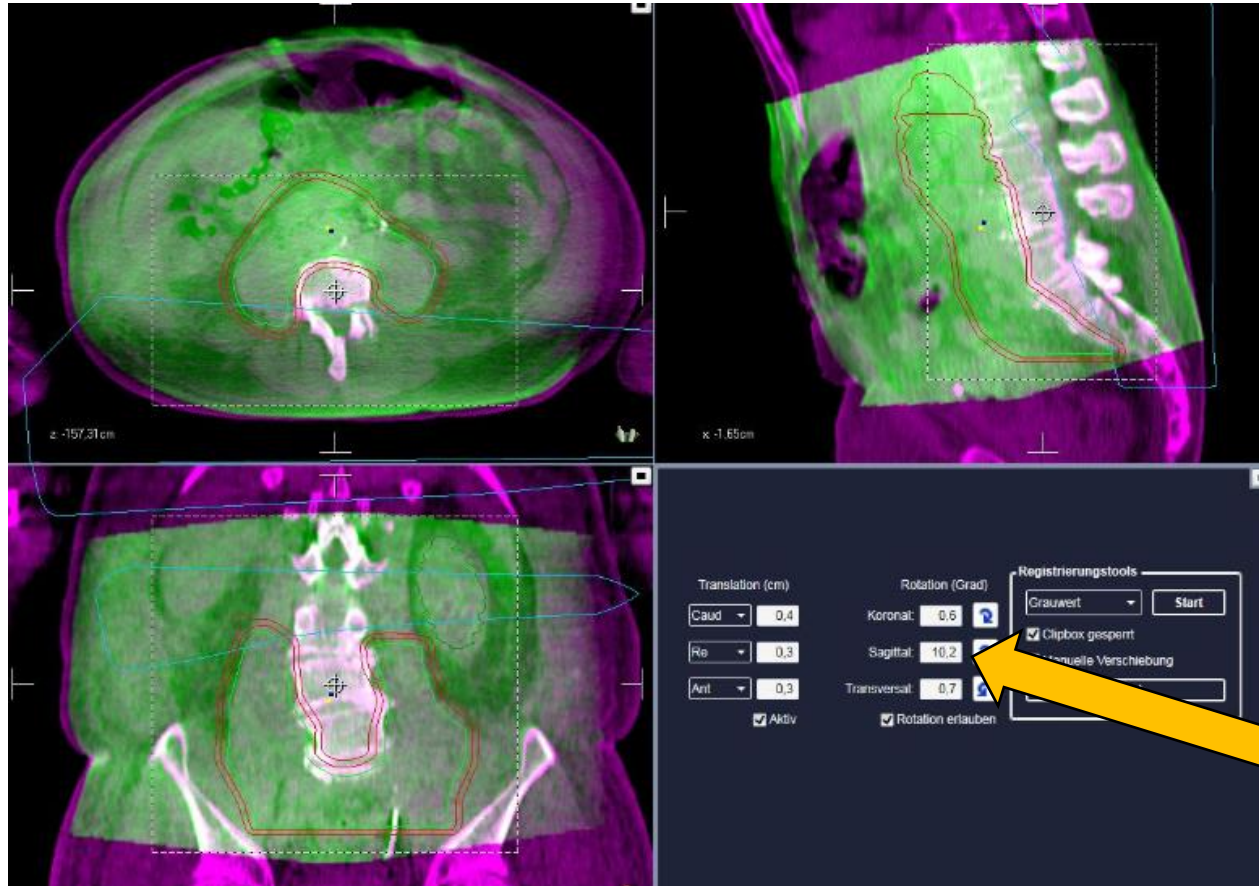


Case Study 1 - isocenter



- Tx with 2 isocenters, separated by 5cm in sup/inf.
- Torso and abdominal region appear to be aligned correctly.
- Large field-of-view clearly shows misalignment indicated by yellow arrows.
- Near-miss occurred because two sets of marks were placed on the patient's skin and wrong set of marks was used for positioning.

Case Study 2 - immobilization



- Patient required non-standard immobilization.



- CBCT detected a 10° pitch error.
- Correct pitch would have been detected with SGRT prior to CBCT imaging.

10° pitch error

Case Study 3 – motion management



- Patient moved her right arm to head during treatment.
- Treatment was automatically interrupted when SGRT detected motion and triggered a beam hold.

Summary

- 21% of reported errors during pre-tx & tx could have been prevented with SGRT.
- Actual number is not known as “*we don’t know what we don’t know*”.
- Wrong isocenter & accessories were most preventable incidents with SGRT.
- Isocenter misalignments generally have higher severity.

👉 But: SGRT also introduced new failure modes!

Incidents caused by SGRT (AvIC)

- 14% (5/37) were caused by SGRT
 - SGRT related isocenter events were less severe and mostly workflow related, e.g.:
 - Missing or incorrect reference surface
 - Tx executed in FB instead of BH
- 👉 SGRT systems would benefit from better integration in overall clinical workflow!

Reference

Radiotherapy and Oncology 163 (2021) 229–236



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Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com



Original Article

The role of surface-guided radiation therapy for improving patient safety

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Safety Related Developments Associated with SGRT

- Biometric identification



Silverstein et al.
Med Phys 2017

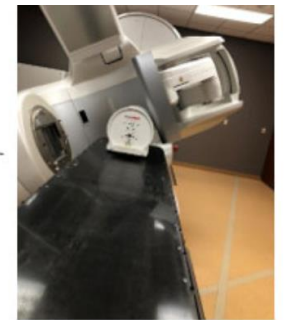
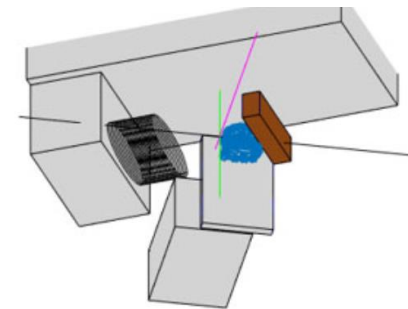


- RFID accessory tracking



Zhao et al.
PRO 2020

- Scene mapping & collision avoidance



N. Islam et al.
J Appl Clin Med Phys 2020

Safety Related Developments Associated with SGRT

- Thermal surface imaging



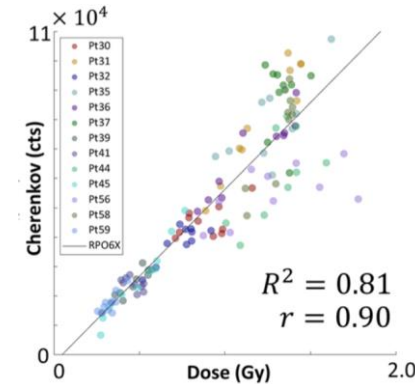
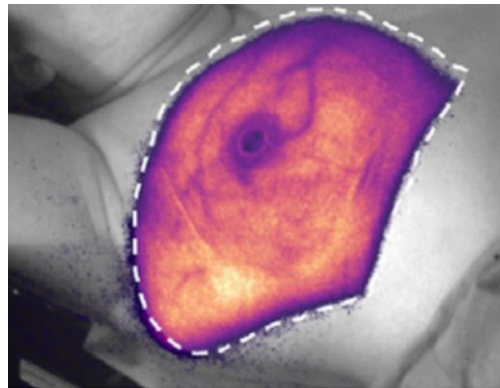
<https://www.brainlab.com>

- Augmented reality



Talbot et al.
Australas Phys Eng Sci Med 2009

- Cherenkov imaging



Hachadorian et al.
Med Phys 2022

Conclusion

- SGRT operates at the end of workflow as an independent observer in the tx room.
- SGRT has unique capabilities and complements other imaging techniques.
- SGRT also introduces new failure modes.
- Many new innovative developments that have the potential to further improve patient safety.

Acknowledgements

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