Australasian College of Physical Scientists & Engineers in Medicine

ACPSEM CPD Endorsed Activity

MIRSIG

ASMIRT APPROVED CPD PROGRAM
Appellation Code: SGHCCC-001544-2020

The ACPSEM Medical Image Registration Special Interest Group (MIRSIG) Online Webinars

This seminar (1200, Tue 4th August 2020) is chaired by Michael Jameson

- Talk 2: **Training and Using Image Registration Clinically**

Presented by Laurel Schmidt

Learning objectives

- **Identify the changing roles of RTs and Med Physicists with Image Registration**
- **Identify what is needed for a training program for staff with image registration**
- **Recognise the requirements for setting up an image registration training database in your department's software**
- **Be aware of a safe approach to implement new technology based on a risk vs benefit approach**

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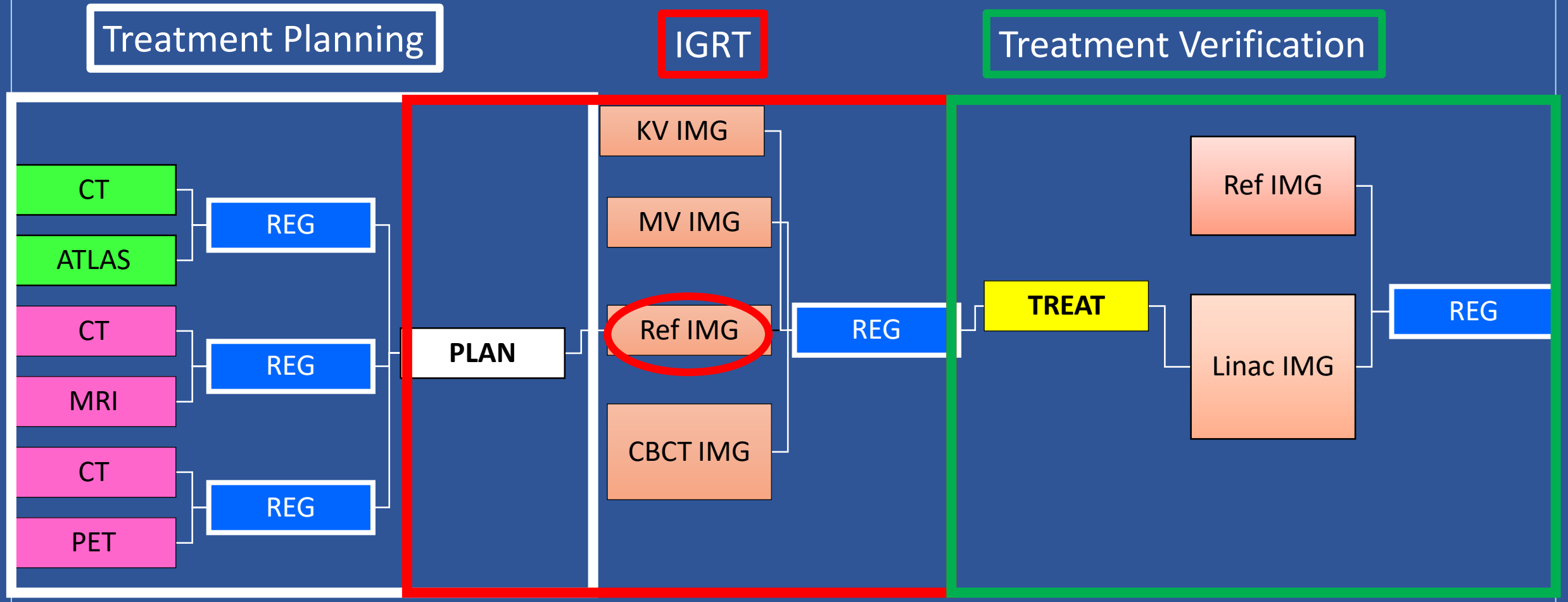
Training for Using Image Registration Clinically

ACPSEM / MIRSIG Education Webinar Series

August 2020

Presented by Laurel Schmidt

Image Registration in Radiotherapy



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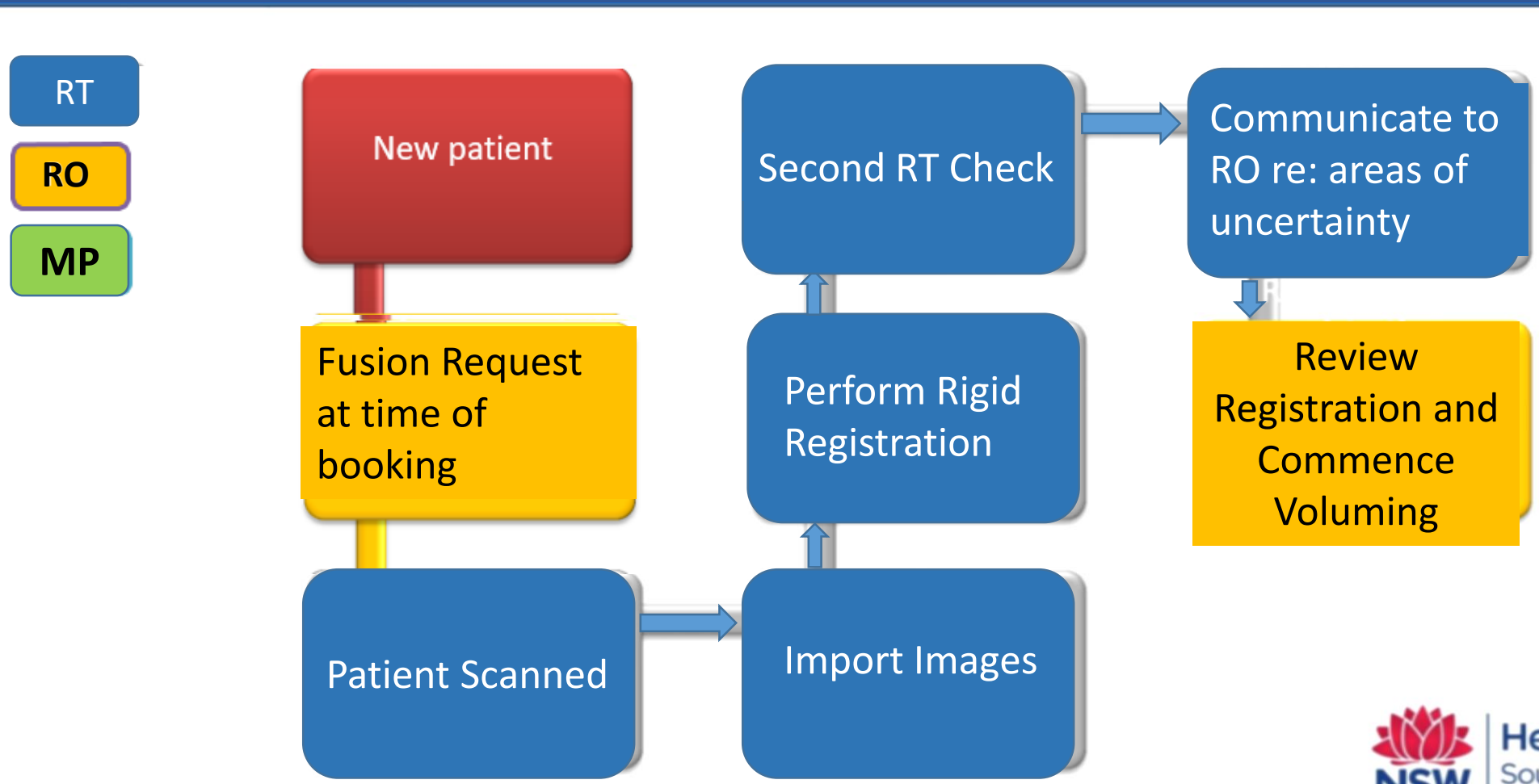
Clinical Workflow



NSW GOVERNMENT Health
South Western Sydney Local Health District

Slide courtesy of Callie Choong

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Roles and Responsibilities with Image Registration

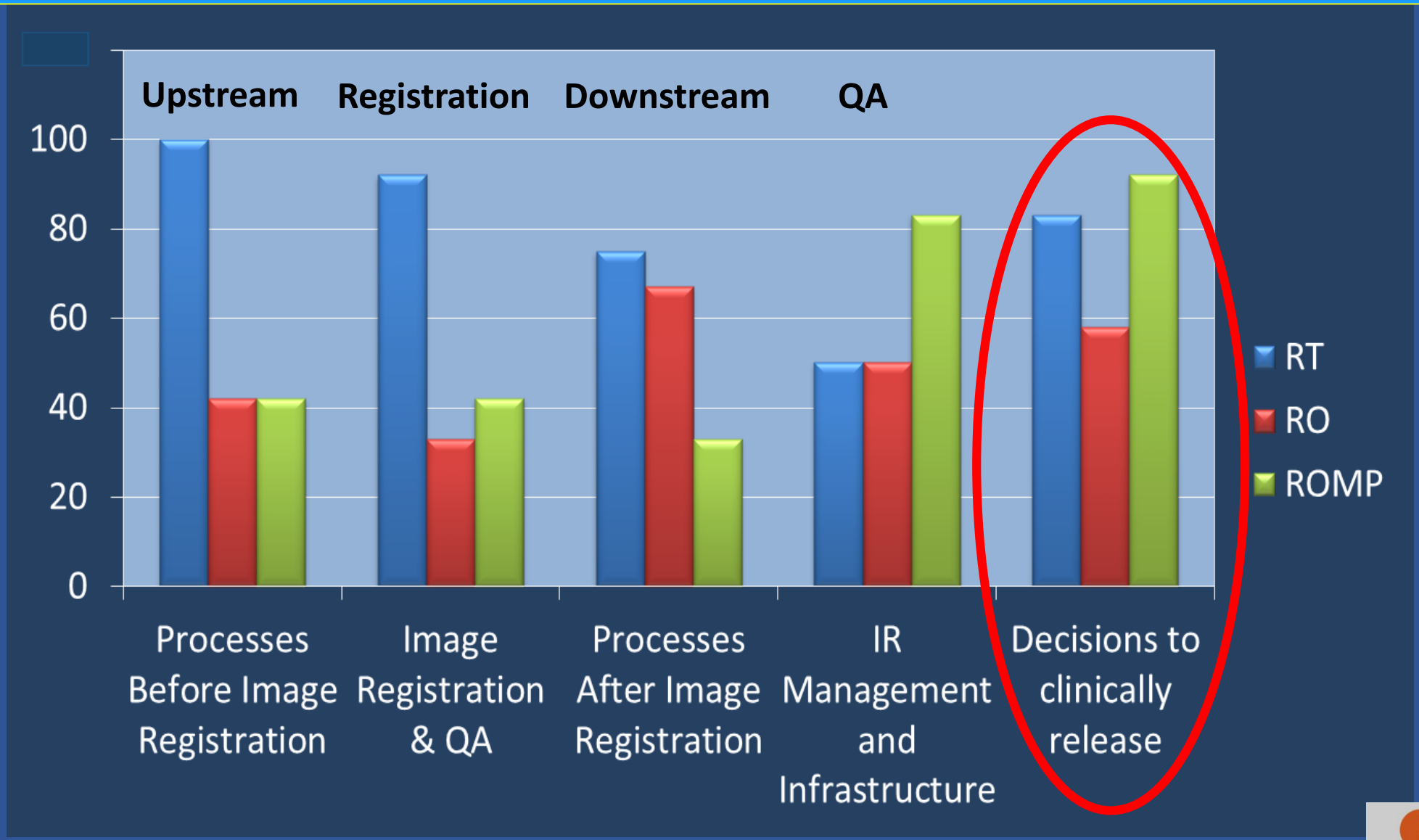

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Image Registration in Radiotherapy

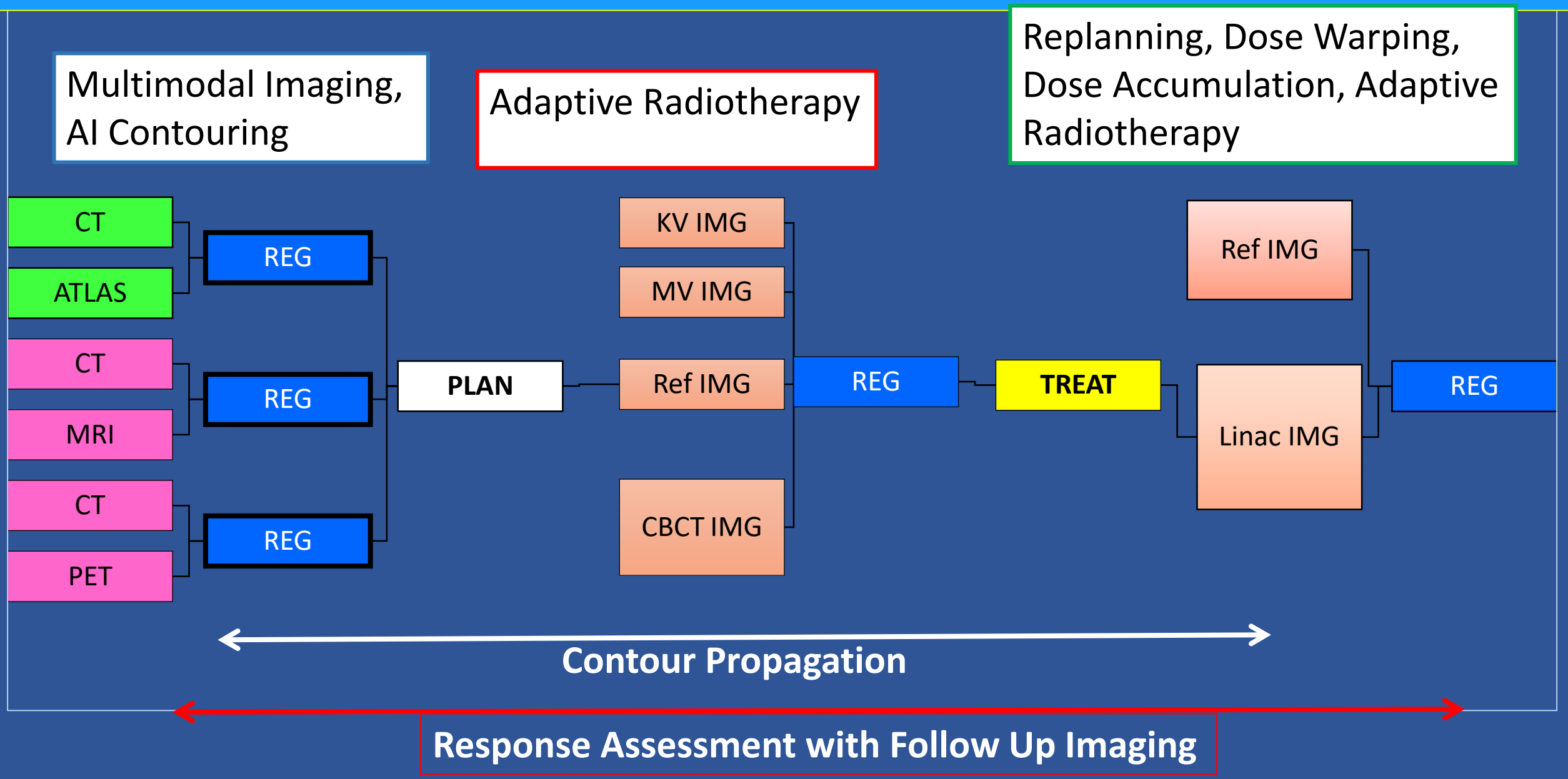

Image Registration Roles

Med Physics:
Software – Validation, verification and QA

New Responsibilities for Med Physicists:

- DIR QA – Quantitative Analysis
- PET - CT DIR (and MR – CT DIR)
- Adaptive Radiotherapy
- Dose accumulation
- Response Assessment

Image Registration Roles

Radiation Therapists:

- Upstream – Image dataset acquisition
- Registration Verification
- Downstream – exporting and confirming registration in RTPS

New Responsibilities for RTs:

- QA for PET
- Synthetic CT creation from CBCT to assess need for replans
- Contour propagation
  - Rescans
  - Retreatment
- Response Assessment

Adaptive Radiotherapy

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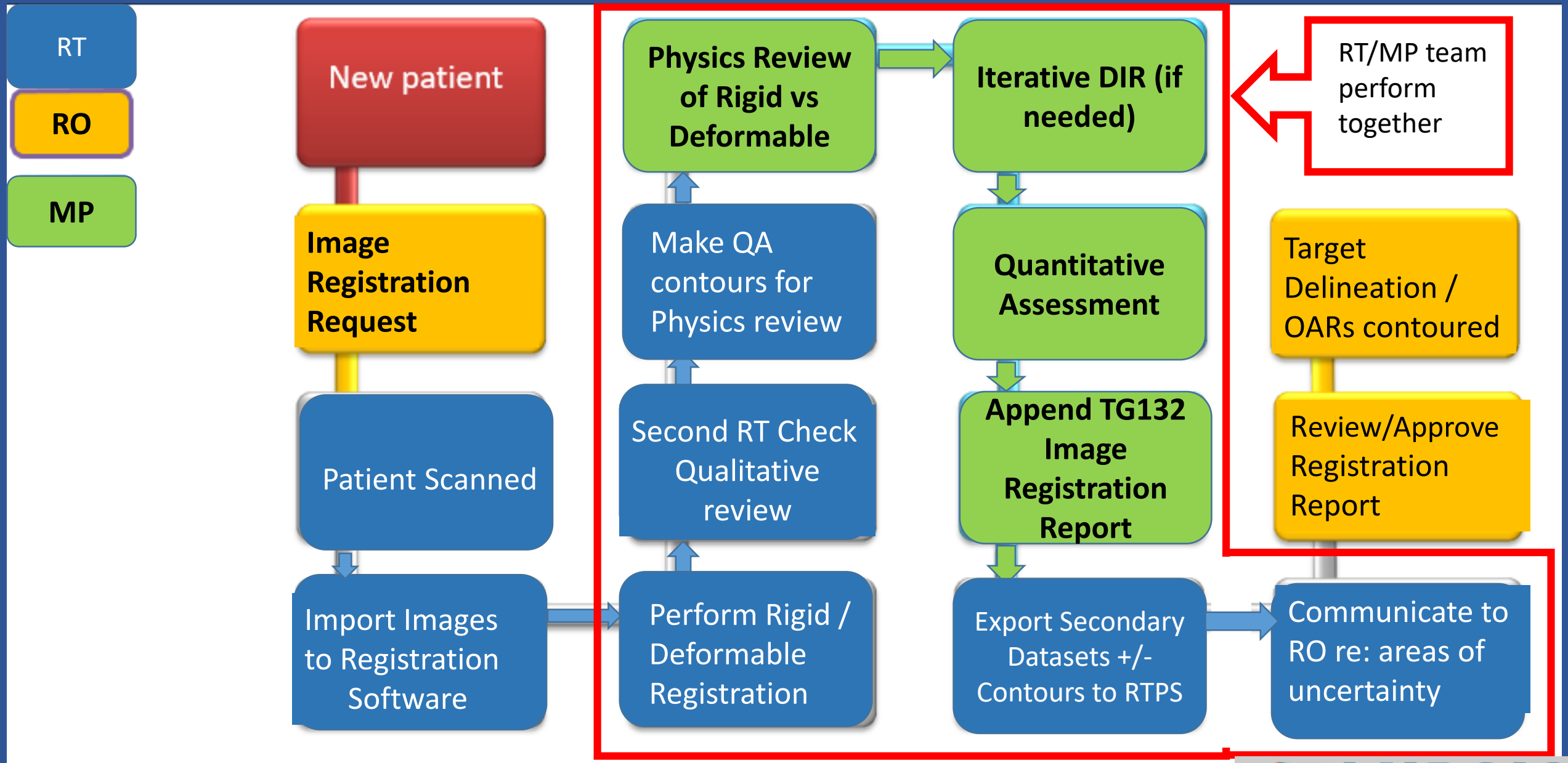
RT
RO
MP
New patient
Image Registration Request
Patient Scanned
Import Images to Registration Software
Perform Rigid / Deformable Registration
Second RT Check Qualitative review
Make QA contours for Physics review
Physics Review of Rigid vs Deformable
Iterative DIR (if needed)
Quantitative Assessment
Append TG132 Image Registration Report
Export Secondary Datasets +/- Contours to RTPS
Communicate to RO re: areas of uncertainty
Review/Approve Registration Report
Target Delineation / OARs contoured
RT/MP team perform together

Training Approach

- Limited formal training available
  - Vendor / Software Specific

- Site visits and discussions with experienced departments
  - "How-to training" for software (pros and cons)
  - Critical analysis to assess registration – how to rectify sub-optimal results

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Education & Training

- Training and education for all staff groups is required
  - Understand the QA processes
  - Increases safety
  - Decreases time required for registration

- Training for RIR and DIR is important
  - DIR used clinically should have a team approach to QA

Golden Rule #1: Good RIR needed for Good DIR

Golden Rule #2: The amount of QA reflects the risk of the task

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Education & Training

Champions / Superusers (Train the Trainer approach)

Background theory – physics and RT

Start with basics and build as knowledge levels increase

Read: TG132 and Deforming to Best Practice

K.Brock, et al Use of image registration and fusion algorithms and techniques in radiotherapy: Report of the AAPM Radiation Therapy Committee **Task Group No. 132** Med. Phys. 44(7) July 2017

Jeffrey Barber, et al **Deforming to Best Practice**: Key considerations for deformable image registration in radiotherapy (In Press) Journal of Medical Radiation Sciences

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Education & Training

Champions / Superusers (Train the Trainer approach)

Develop Competency Based Package

- Understand how DIR works and the basic physics
- Quiz with certificate
- Watch vendor training videos
- Perform cases with competent staff – know when to ask for a second check
- Set up a training database with practice cases to compare results

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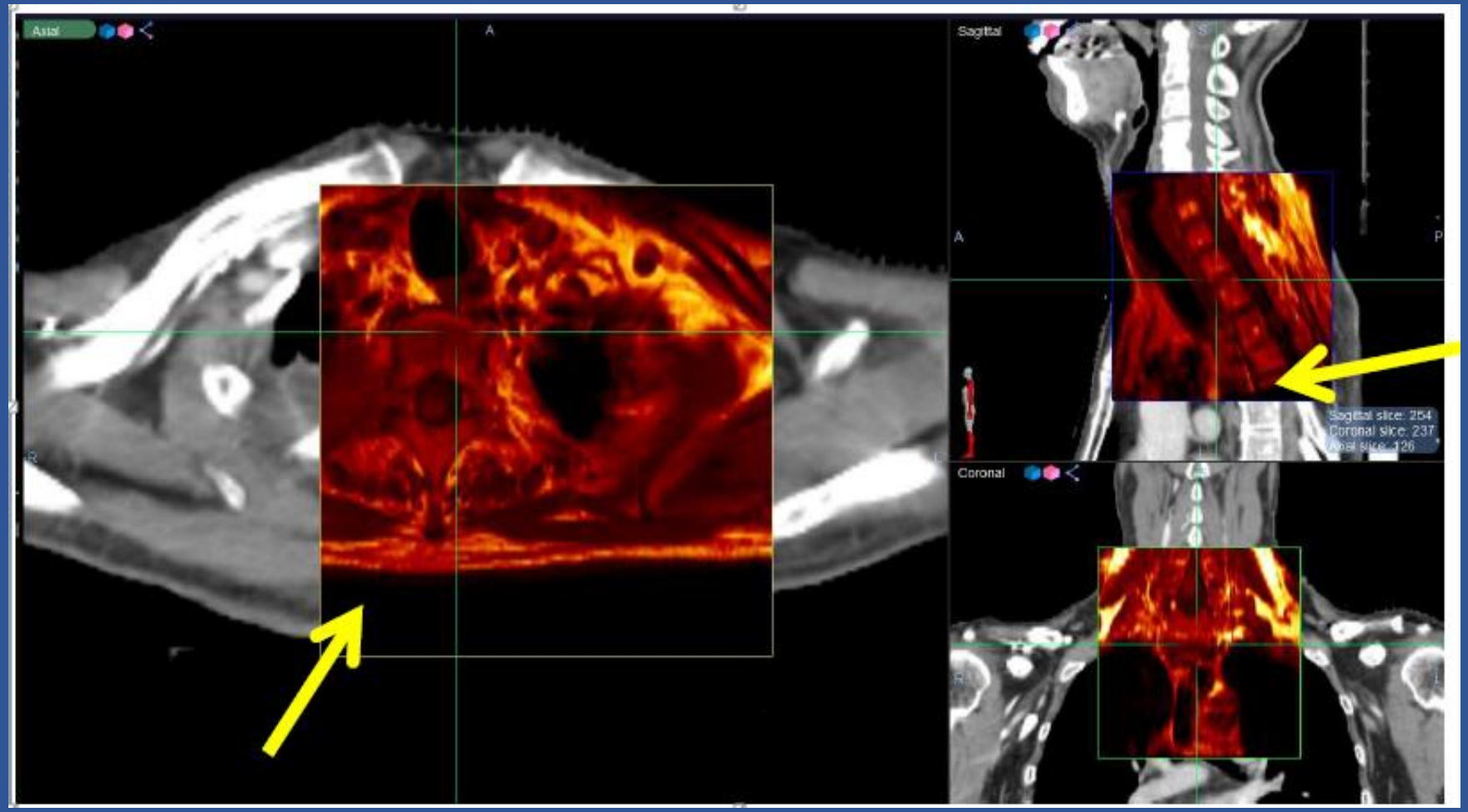
Competency Training Database

MR – CT and PET –CT registrations

Positional Changes

Anatomical Changes

- Weight Gain / Loss
- Surgery
- Chemotherapy



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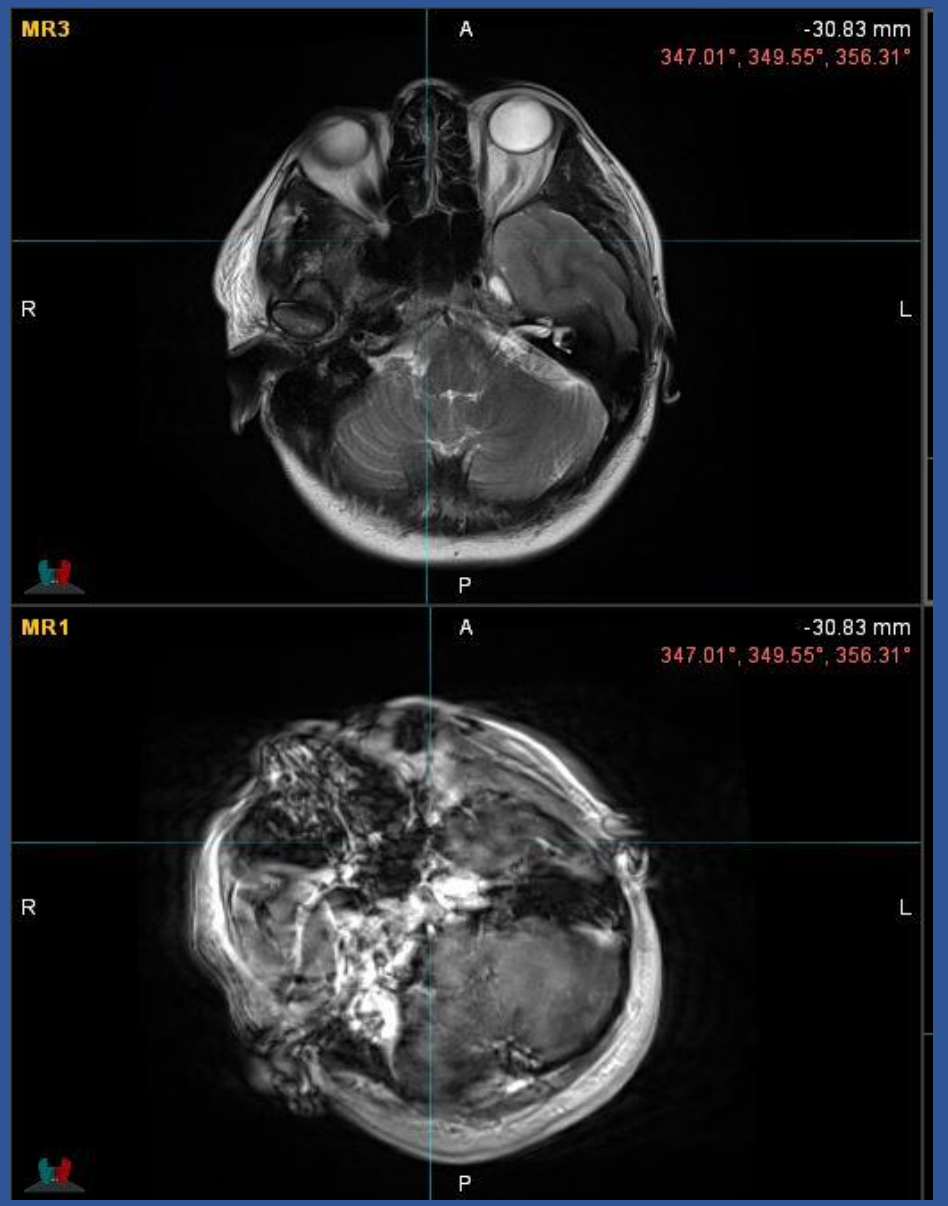
Competency Training Database

- Artefact
- Motion
- Image Quality
- Missing Data



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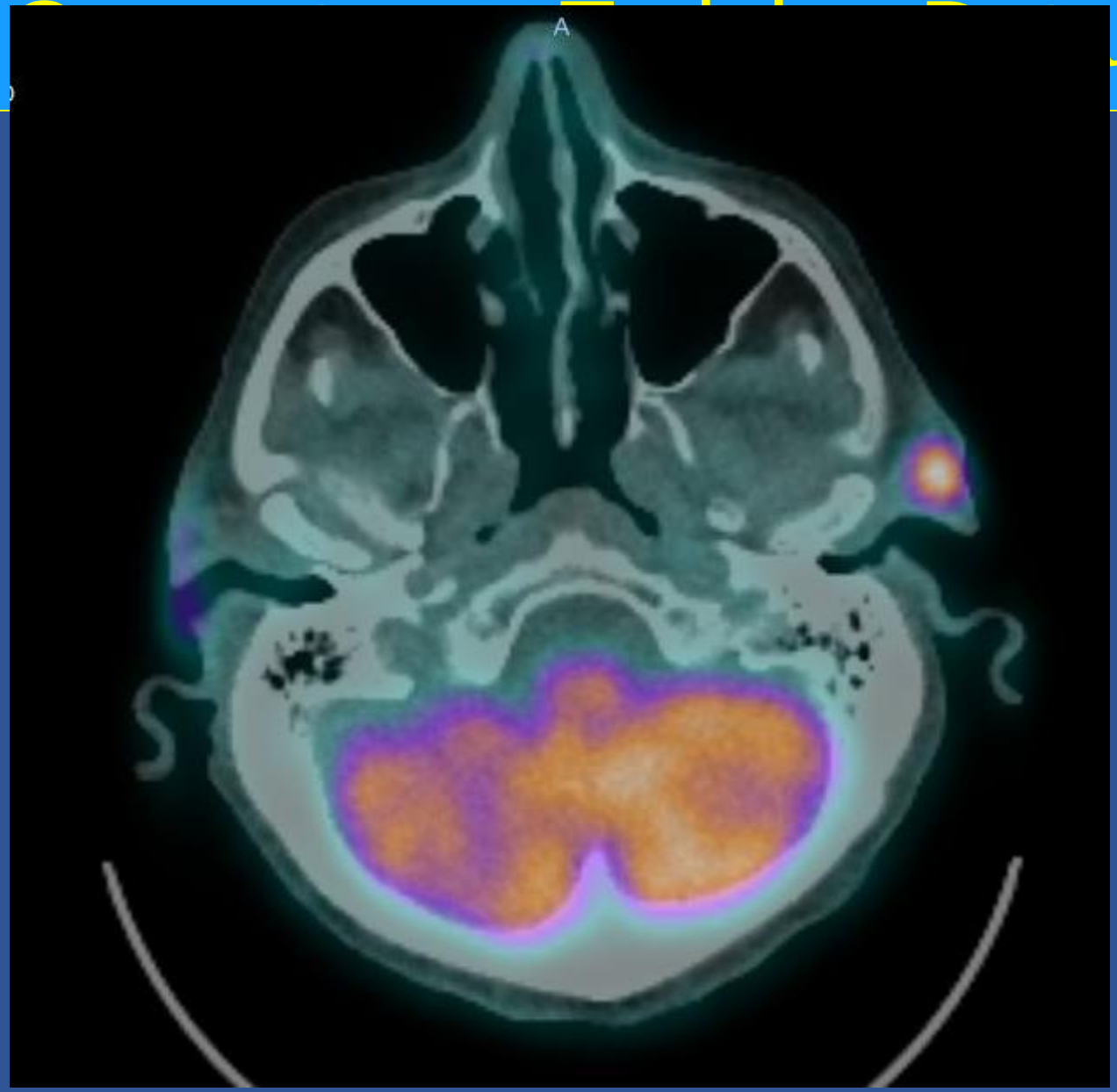
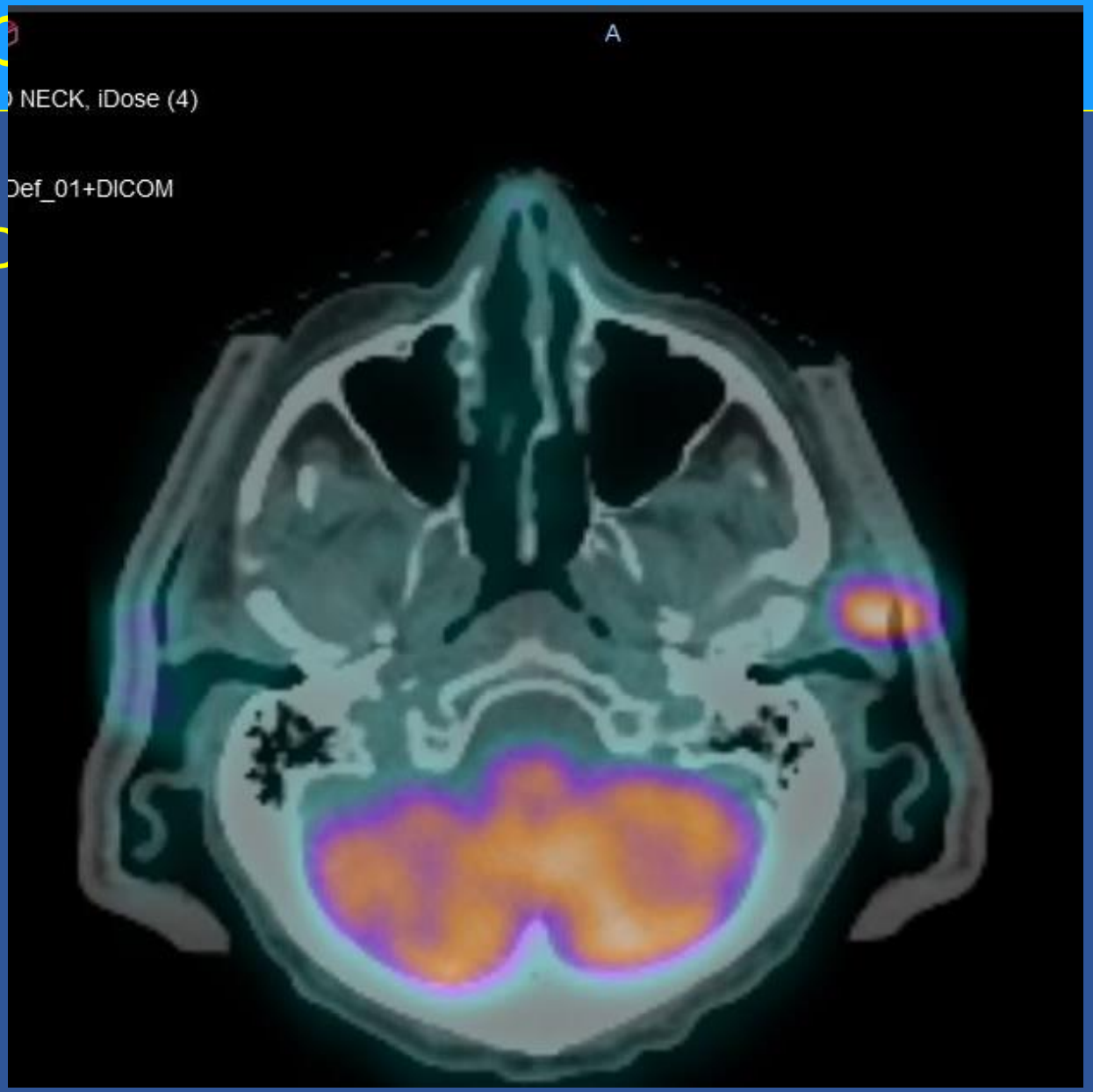


Nuc Med CT and PET



DIR Planning CT – PET with Bolus

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Releasing New Technology

INCREASING RISK
INCREASING AMOUNT OF QA

CONTOURS
- Contour Propagation for Replans
- AI / Machine based Deep Learning
- Response Assessment

ADAPTIVE RADIOTHERAPY
- Replanning
- Plan of the Day

DOSE ACCUMULATION
DOSE WARPING

Med Physicists and
RT Superusers collaborate
to validate / verify

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Releasing New Technology

St George Cancer Care Experience

Johnson Yuen and Anna Ralston – **RABBIT**

Risk and **B**enefit **B**alance **I**mpact **T**emplate

Break up a problem into processes with image registration and how we can **optimise workflow** and have **quality control** so that **Benefits** outweigh **Risks**

The RABBIT focuses on solution to achieve benefits

The RABBIT helps manage risks & uncertainties (**TG100)**

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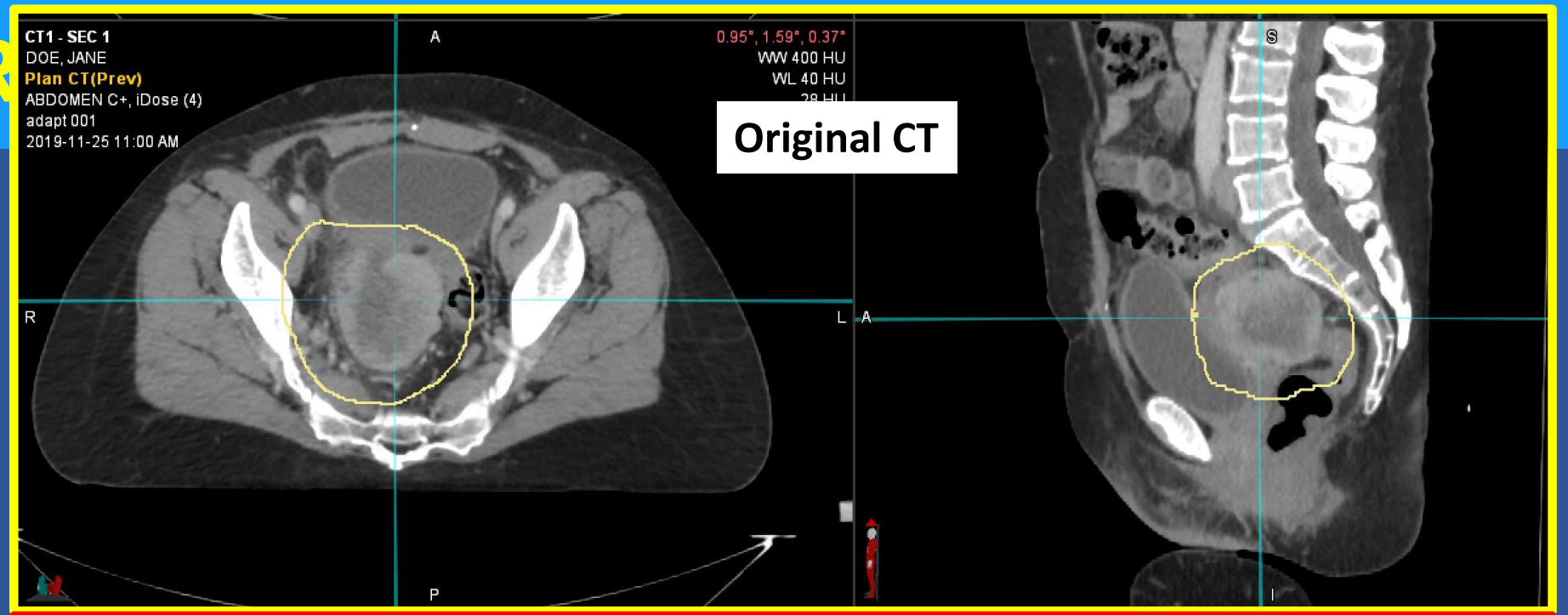
Releasing New Technology

St George Cancer Care Experience

The RABBIT is used to **clinically implement technology**

-What to think about
-Balancing trade-offs – QA/Safety vs Feasibility
-Best way to implement **and actually do it**

End goal: everyone (RO, RT, Physics) implements and jointly agrees to clinically release technology -with as much benefits and as little risks as possible


CT1 - SEC 1
DOE, JANE
Plan CT(Prev)
ABDOMEN C+, iDose (4)
adapt 001
2019-11-25 11:00 AM
0.95°, 1.59°, 0.37°
WW 400 HU
WL 40 HU
Original CT
A
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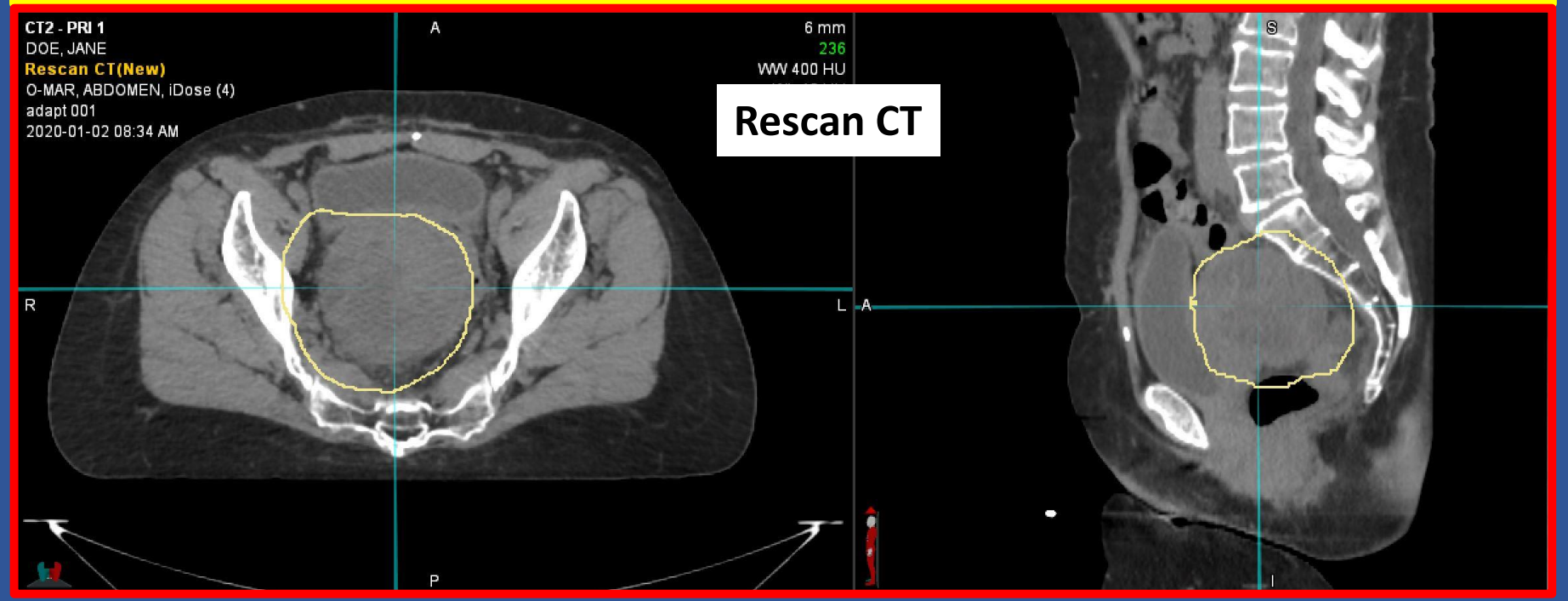
CT2 - PRI 1
DOE, JANE
Rescan CT(New)
O-MAR, ABDOMEN, iDose (4)
adapt 001
2020-01-02 08:34 AM
6 mm
236
WW 400 HU
Rescan CT
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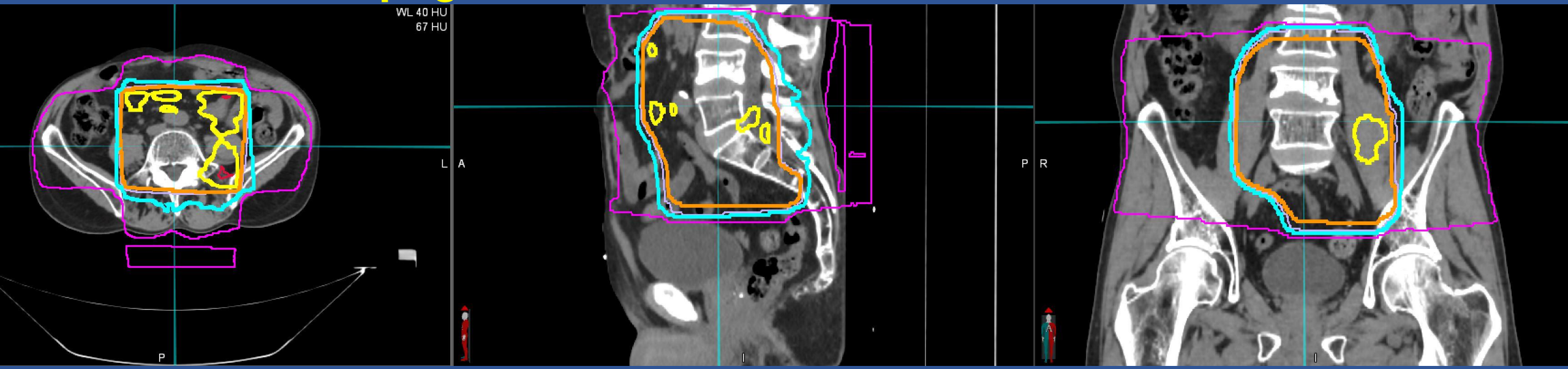
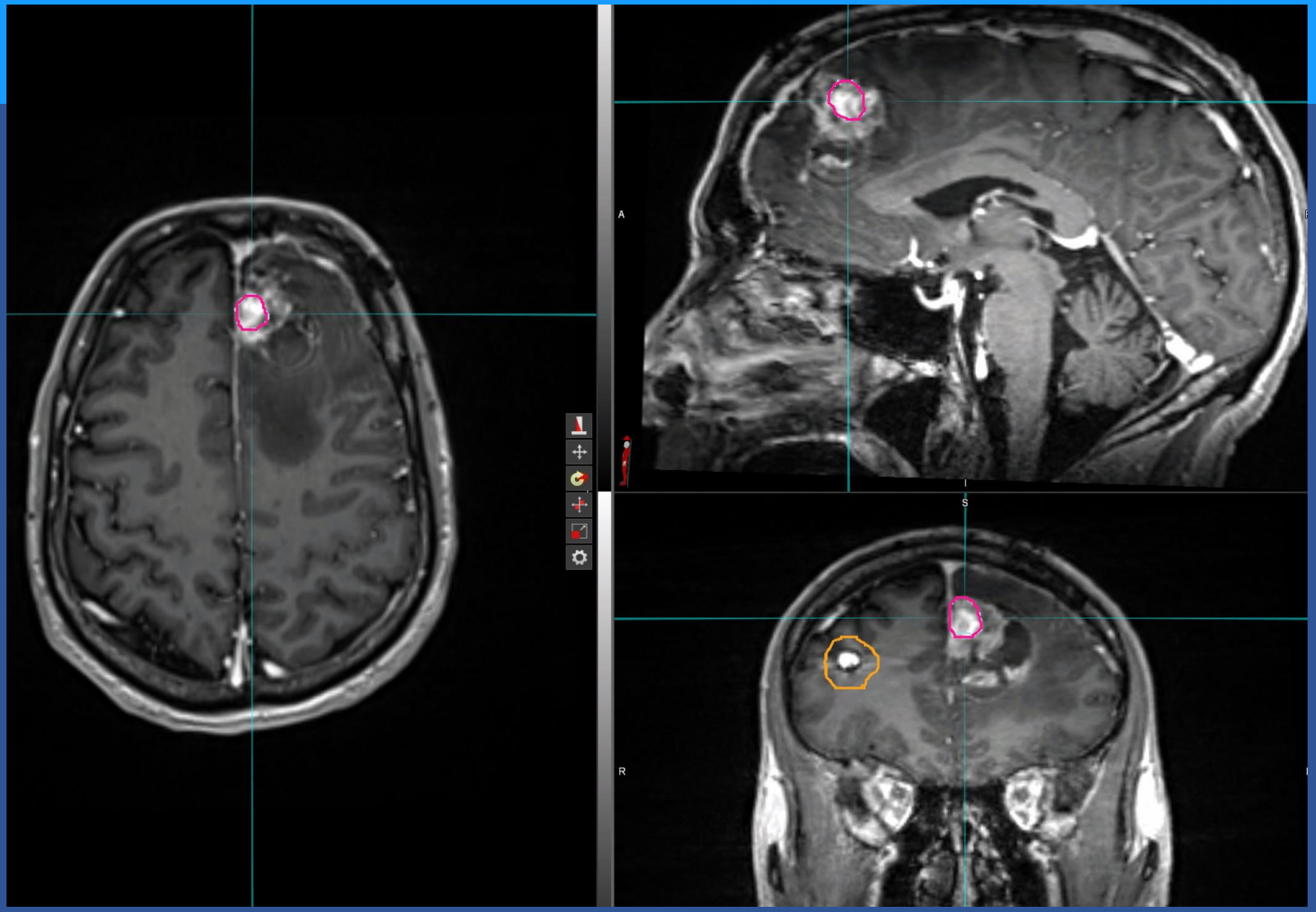
Releasing New Technology

- **Contour Propagation**
  - **Low Risk** -
    - Assess to see if Replan is required (PTVs)
    - Uses patient's own contours
    - Adds contours to a rescan
  - **High Benefit** - Decreases time for Replans

Releasing New Technology

- Contour Propagation

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Summary

- Roles and responsibilities are changing for Image Registration
- Clinical Workflows are changing
- Training staff in image registration
  - Site visit
  - Practice with a training datasets
  - CBA
- Release new technologies based on risk vs benefit

Acknowledgements

- Johnson Yuen
- Joel Poder
- Anna Ralston
- Callie Choong

The ACPSEM Medical Image Registration Special Interest Group (MIRSIG) Online Webinars

Questions and Answers from the August 2020 Webinar Chaired by Michael Jameson (Talk 2 by Laurel Schmidt)

Question 1: When you implemented a training package did you do individual or small group training?

Answers:
We started with identifying a small group to have vendor training with our image registration software. Our physicist created and validated workflows that would simplify the image registration process. We created a training database to practice on and compared our results.
Then we began training RTs that were rostered in planning and the physics staff that would be involved. As the software updates and our techniques change we update our processes and give refresher training to the staff.

Comment on Deforming to Best Practice paper. This is now available online
https://doi.org/10.1002/jmrs.417

Question 2: Is creating a dedicated RT for a fixed term e.g. 2 years the most effective way of getting a DIR program under way in a centre.

Answers: …
Having a dedicated RT is a great way to get new techniques released clinically in a department. At least 1 year is needed for the position to get a real grasp of all the aspects of image registration – especially for more complex tasks like DIR. Rotating to a new RT after the set time allows for a handover period and continuity in the processes that have been introduced.
The dedicated RT position also is a great way to develop the Super-Users in a centre that can troubleshoot.