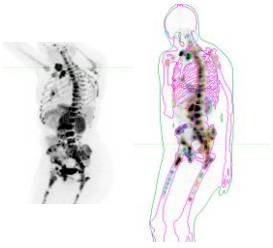
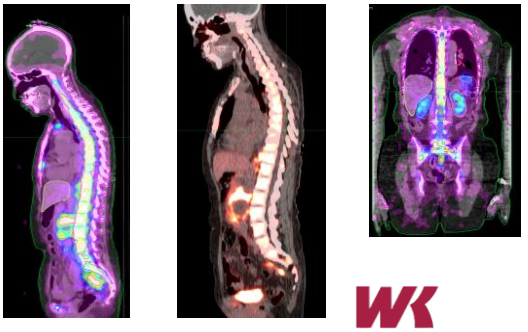
Framework for the integration of Medical Dosimetrist into Theranostic practice





AAMD 51st Annual Meeting

Carlos Palomeque BS, CMD

Willis Knighton Cancer Center

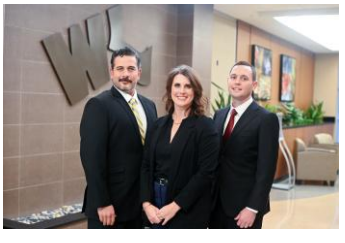
Shreveport, LA

Willis Knighton Health

1

Staff
- 4 RadOnc Physicians
- 5 Physicist
- 2 Physics resident
- 4 Medical Dosimetrists

External Beam Treatment machines:
- IBA ProteusONE
- Accuray Radixact
- 2 Elekta VersaHD



2

Nuclear Oncology Division (March 31 2025)

- 2 Siemens Vision 450 PET/CTs
- 1 GE StarGuide SPECT/CT (9th in US)
- 11 Radiopharmaceutical Infusion Areas

Staffing Nuclear Oncology Division

- 4 RadOncs
- 4 NM Technologists
- 1 Theranostic nurse
- 1 Radiation Safety Officer
- 1 Therapeutic Physicist
- 1 Diagnostic Physicist
- 1 Radiation Dosimetrist (me)
- 2 RTT

3

Willis Knighton Cancer Center

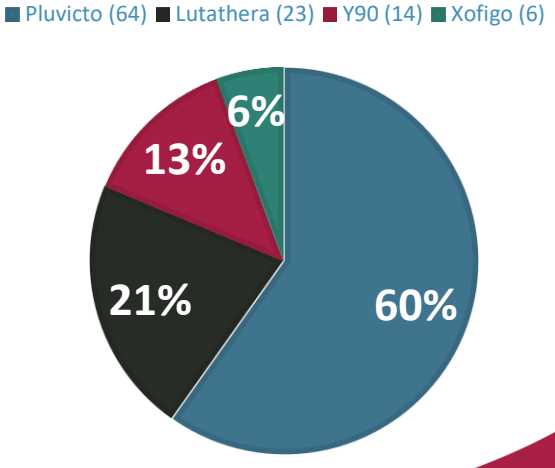
Therapeutic

- **Pluvicto (since 2023)**
- **Lutathera (since 2022)**
- **Xofigo (since 2016)**
- **Y-90 SIRT (since 2012)**
- **I-131 (since 2000's)**

Diagnostic

- **^{18}FDG**
- **^{18}F-PSMA and ^{68}Ga-PSMA**
- **^{64}Cu-DOTATATE and ^{68}Ga-DOTATATE**
- **^{18}F-ES**

RPT (12/2024-12/2025)



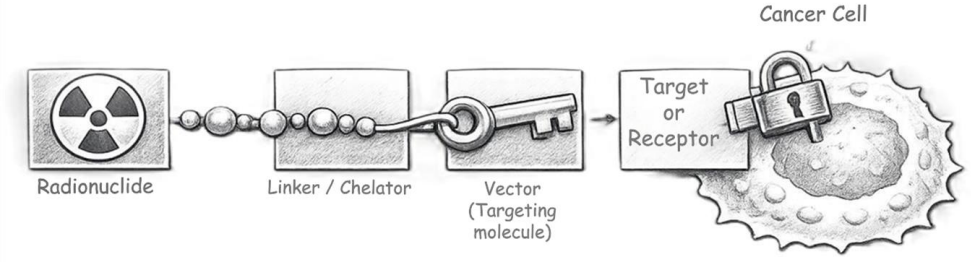
4

Radiopharmaceuticals

5

Radiopharmaceuticals

Radioactive materials emit characteristic radiation
-α, β, γ, Auger Electrons, etc.



6

Radionuclide and vector can be chosen based on purpose and target!

Table 2: Most Common Clinically Used Theranostic Pairs

Pathologic Condition	Theranostic Pair		Target or Mechanism of Action	Emission	Imaging
Metastatic castration-resistant prostate cancer	Diagnostic	^{18}F-DCFPyL ^{68}Ga–PSMA-11	PSMA	β plus	PET
	Therapeutic	^{177}Lu–PSMA-617		β minus or γ	SPECT or planar
Neuroendocrine tumor	Diagnostic	^{64}Cu- or ^{68}Ga-DOTATATE	Somatostatin receptors (SSTRs)	β plus	PET
	Therapeutic	^{177}Lu-DOTATATE		β minus or γ	SPECT or planar
Thyroid cancer	Diagnostic	^{123}I-NaI	Sodium/iodide symporter (NIS)	Electron capture	SPECT or planar
	Therapeutic	^{131}I-NaI		β minus or γ	SPECT or planar
Pheochromocytoma and paraganglioma	Diagnostic	^{123}I-MIBG	Norepinephrine analog	Electron capture	SPECT or planar
	Therapeutic	^{131}I-MIBG		β minus or γ	SPECT or planar
Liver malignancies	Diagnostic	^{99m}Tc-MAA	Takes advantage of tumor hypervascularity	γ	SPECT or planar
	Therapeutic	^{90}Y-microsphere		β minus or β plus*	SPECT (brems-strahlung) or PET
Bone metastases from prostate cancer	Diagnostic	^{99m}Tc-MDP	Chemisorption	γ	SPECT or planar
	Therapeutic	^{223}Ra-dichloride	Calcium analog	α	N/A

Note.—DCFPyL = piflufolastat, MAA = macroaggregated albumin, MDP = methylene diphosphonate, N/A = not applicable, ^{99m}Tc = technetium 99m (metastable).
* A small amount of internal pair production results in β-plus particles used for PET imaging.

doi/10.1148/rg.230097

Targeting cells

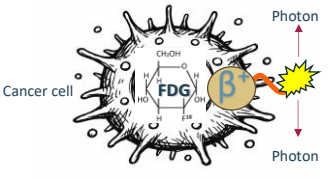
Passive targeting

^{18}F -DG →Fluorodeoxyglucose (Radioactive sugar)
- Enters cells via glucose (sugar) transporters

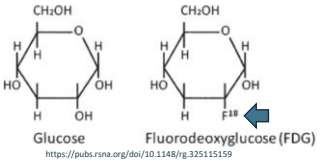
- ^{18}F attached to molecule gets trapped in high (glucose) metabolic cells

- Positron emission (β^+ decay) of ^{18}F which after short distance annihilates with electron

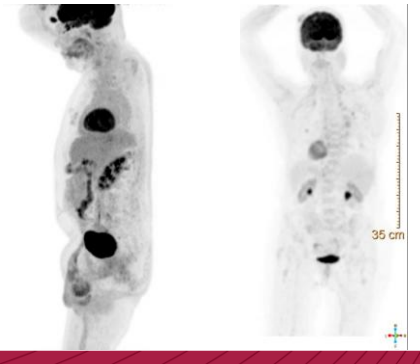
- This event creates two γ photons in opposite directions (180° apart)



FDG



https://pubs.rsna.org/doi/10.1148/rg.325115159

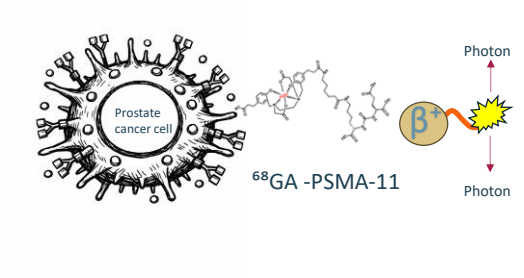


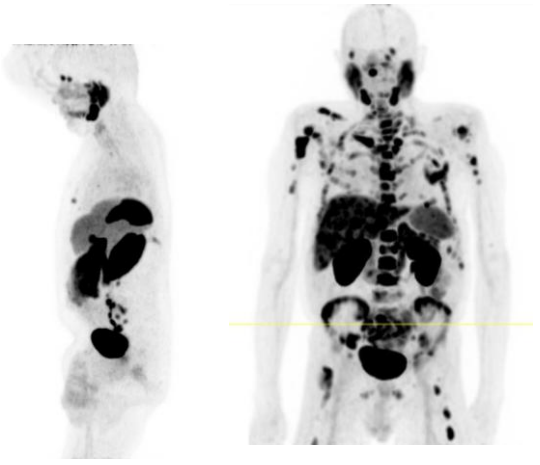
Targeting cells cont.

Active targeting

-^{68}GA Targeted imaging agent
- PSMA expresses itself in prostate cancer cell surface

- PSMA-11 attaches to PSMA protein in surface in cancer cell





9

10

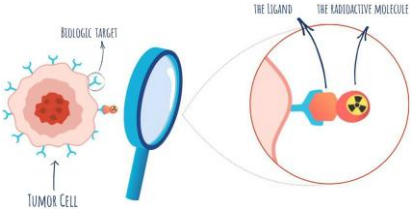
RADIOTHERANOSTICS

RADIO THERA + NOSTICS

Combination of Therapeutic and Diagnostic

Based on PET and Target molecule we can use a therapeutic radionuclide

Radionuclide used can be optimized for cell killing

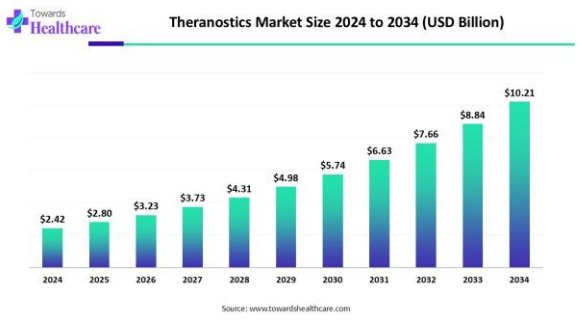


http://jnm.snmjournals.org/content/67/4/494.abstract

11

RADIOTHERANOSTICS Cont.

Steady global grow



North America as the biggest market

12

RADIOTHERANOSTICS Cont.

Toward Personalized Radiopharmaceutical Therapy: Radiobiologic Insights Compared with External-Beam Radiotherapy

Sébastien Pennincky, Wendy Delbart, Magdalena Mileva, Mutaz Kassas, Hugo Levillain, Carlos Artigas, Patrick Flamen and Ioannis Karfis

Journal of Nuclear Medicine May 28, 2026, jnumed.125.271564; DOI: https://doi.org/10.2967/jnumed.125.271564

Lesion Dosimetry for [^{177}Lu]Lu-PSMA-617 Radiopharmaceutical Therapy Combined with Stereotactic Body Radiotherapy in Patients with Oligometastatic Castration-Sensitive Prostate Cancer

Milan Grkovski, Joseph A. O'Donoghue, Brandon S. Imber, George Andt, Cheng Tu, Daniel Lafontaine, Jazmin Schwartz, Maria Thor, Michael J. Zelefsky, John L. Humm and Lisa Bodei

Journal of Nuclear Medicine November 2023, 64 (11) 1779-1787; DOI: https://doi.org/10.2967/jnumed.123.265763

Somatostatin Receptor Imaging and Theranostics – A pictorial review

Jackson Sullivan, Adeel Haq, Aleksandra Krokhmal, Marc Benayoun, Yong Bradley and Turgut bora Cengiz

Journal of Nuclear Medicine June 2025, 66 (supplement 1) 252037;

Impact of the Reference Multiple-Time-Point Dosimetry Protocol on the Validity of Single-Time-Point Dosimetry for [^{177}Lu]Lu-PSMA-I&T Therapy

Sandra Resch, Sibylle I. Ziegler, Gabriel Sheikh, Lena M. Unterrainer, Mathias J. Zacherl, Peter Bartenstein, Guido Böning, Julia Brosch-Lenz and Astrid Delker

Journal of Nuclear Medicine August 2024, 65 (8) 1272-1278; DOI: https://doi.org/10.2967/jnumed.123.266871

An Intrapatient Dosimetry Comparison of ^{177}Lu-rhPSMA-10.1 and ^{177}Lu-PSMA-I&T in Patients with Metastatic Castration-Resistant Prostate Cancer

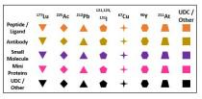
Andreas Rinscheid, Alexander Gäble, Georgine Wienand, Christian Pfob, Alexander Dierks, Malte Kircher, Martin Trepel, Dorothea Weckermann, Constantin Lapa and Ralph A. Bundschuh

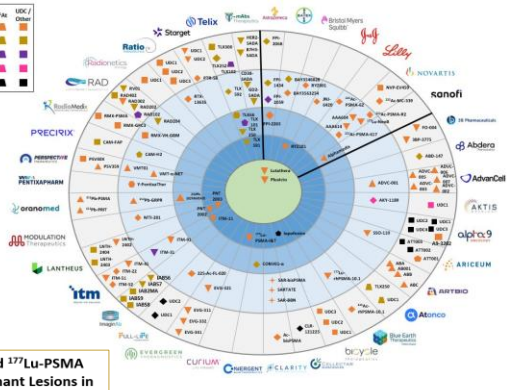
Journal of Nuclear Medicine December 2023, 64 (12) 1918-1924; DOI: https://doi.org/10.2967/jnumed.123.265870

Current Developments in Combining External-Beam Radiotherapy and ^{177}Lu-Labeled PSMA Ligands for Prostate Cancer Treatment

Frederik R. Teunissen, Daniela E. Oprea-Lager, Steffie M.B. Peters, Robert Jan Smeenk, Sandra Heskamp and Johan Bussink

Journal of Nuclear Medicine December 2025, 66 (12) 1852-1858; DOI: https://doi.org/10.2967/jnumed.125.270465





Stereotactic Ablative Radiotherapy and ^{177}Lu-PSMA Radiopharmaceutical Therapy for Dominant Lesions in Metastatic Castration-Resistant Prostate Cancer (StARDom)

Principal Investigator: Chiachien Jake Wang, MD, PhD

Sponsor: Willis Knighton Health

Funded by: N/A

Version Number: 1.0

17 December 2025

13

^{177}Lutetium

^{177}Lu-DOTA-TATE

FDA Approves Lutathera (lutetium Lu 177 dotatate) for Gastroenteropancreatic Neuroendocrine Tumors

January 26, 2018 -- The U.S. Food and Drug Administration today approved Lutathera (lutetium Lu 177 dotatate) for the treatment of a type of cancer that affects the pancreas or gastrointestinal tract called gastroenteropancreatic neuroendocrine tumors (GEP-NETs). This is the first time a radioactive drug, or radiopharmaceutical, has been approved for the treatment of GEP-NETs. Lutathera is indicated for adult patients with somatostatin receptor-positive GEP-NETs.

Novartis Radioligand Therapy Lutathera FDA Approved as First Medicine Specifically for Pediatric Patients with Gastroenteropancreatic Neuroendocrine Tumors

Basel, April 23, 2024 -- Novartis today announced that the U.S. Food and Drug Administration (FDA) approved Lutathera (USAN: lutetium Lu 177 dotatate / INN: lutetium (177Lu) oxodotreotide) for the treatment of pediatric patients 12 years and older with somatostatin receptor-positive (SSTR+) gastroenteropancreatic neuroendocrine tumors (GEP-NETs), including foregut, midgut, and hindgut NETs. This approval makes Lutathera the first therapy specifically reviewed and approved for use in pediatric patients with GEP-NETs.

^{177}Lu-PSMA-617

FDA Approves Pluvicto

FDA Approves Pluvicto (lutetium Lu 177 vipivotide tetraxetan) Targeted Radioligand Therapy for Treatment of Progressive, PSMA-Positive Metastatic Castration-Resistant Prostate Cancer

- FDA also approved complementary diagnostic imaging agent, Locametz, after radiolabeling with gallium-68 for the identification of PSMA-positive lesions[2]
- Metastatic prostate cancer has a 5-year survival rate of less than 30%[3]; mCRPC patients who progress on multiple lines of therapy have limited treatment options

FDA Approves Novartis Radioligand Therapy Pluvicto for Earlier Use Before Chemotherapy in PSMA-Positive Metastatic Castration-Resistant Prostate Cancer

Basel, March 28, 2025 – Novartis announced today that the US Food and Drug Administration (FDA) approved Pluvicto (lutetium Lu 177 vipivotide tetraxetan) for patients with prostate-specific membrane antigen (PSMA)-positive metastatic castration-resistant prostate cancer (mCRPC) who have been treated with an androgen receptor pathway inhibitor (ARPI) therapy and are considered appropriate to delay chemotherapy.

http://www.drugs.com

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^{177}Lutetium

^{177}Lu-DOTA-TATE

β emitter

4 Infusions 8 weeks apart

Targets neuroendocrine tumors

Somatostatin receptor-positive gastroenteropancreatic neuroendocrine tumors (GEP-NETs)

^{177}Lu-PSMA-617

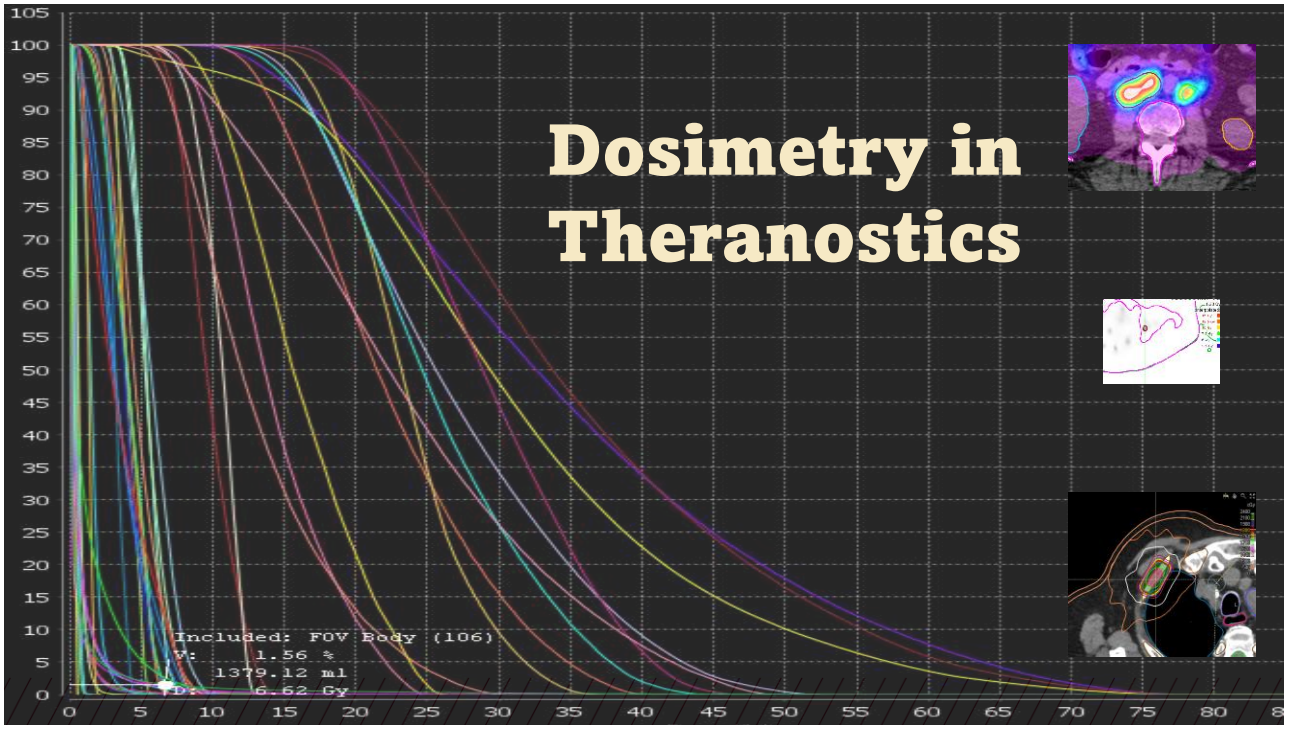
β emitter

6 Infusions 6 weeks apart

Targets prostate cancer

PSMA+ Metastatic Castration Resistant Prostate Cancer (MCRPC)

15



16

How we got here

GE Healthcare
https://www.gehealthcare.com › en-us › insights › ...
Bridging the Gap: Nuclear Oncology in Community Cancer Programs
On March 31, 2025, Willis Knighton Cancer Center in Shreveport, Louisiana, celebrated the launch of their Nuclear Oncology Program, marking a significant milestone for personalized cancer care.

bossierchamber.com
https://business.bossierchamber.com › news › Details › ...
Willis Knighton Health Opens Nuclear Oncology Department
Nuclear oncology, expected to radically change cancer care for patients in the region, is now part of Willis Knighton Cancer Center's comprehensive range of cancer treatment services.

Louisiana Radio Network
https://louisianaradionetwork.com › willis-knighton-opens-new-nuclear...
Willis Knighton opens new nuclear oncology center that promises to ...
Mar 31, 2025 · Willis Knighton Health in Shreveport opens its new seven-million-dollar nuclear oncology department today. Officials say it will radically change cancer treatments for patients in the region.

BUSINESS

Willis Knighton Health officials open new Nuclear Oncology Department in Shreveport

Makenzie Boucher
Shreveport Times
April 2, 2025, 4:04 a.m. CT

17

Dosimetrist meets Theranostic

March – 31 – 2025

Expansion of RadOnc department with the addition of GE StarGuide SPECT/CT and 2 Siemens Vision 450 PET/CT

Nuc-Med Tech? Dosimetrist??? Physicst?

Dosimetry workflow not standardized with protocols or designated staff

Education opportunity for dosimetry staff in Theranostic software

mim

Inclusion of dosimetry as a part of the Theranostic team

18

Why it makes sense

Radiation oncology background

AAMD

MDCB Medical Dosimetrist Certification Board

JRCERT JOINT REVIEW COMMITTEE ON EDUCATION IN RADIOLOGIC TECHNOLOGY

Cross training and education

TPS / Nuclear Med protocols

EBRT Synergy

Better coordination between infusions

Consideration for cumulative dose

All within RadOnc department

19

Challenges

20

Theranostic Workshop

Willis Knighton Health

- April 26 – 2025
- Nuclear Oncology Physics & Dosimetry
- Over 40 attendees from 5 states
- Undergraduate students, medical dosimetrist, medical physicist
- Presentations from board-certified radiation oncologists & physicists
- Interactive dosimetry experience hosted by Voximetry
- Hands-on QA test on GE Healthcare Starguide SPECT/CT
- Lu-177 dosimetry demos in MIM software Sureplan MRT

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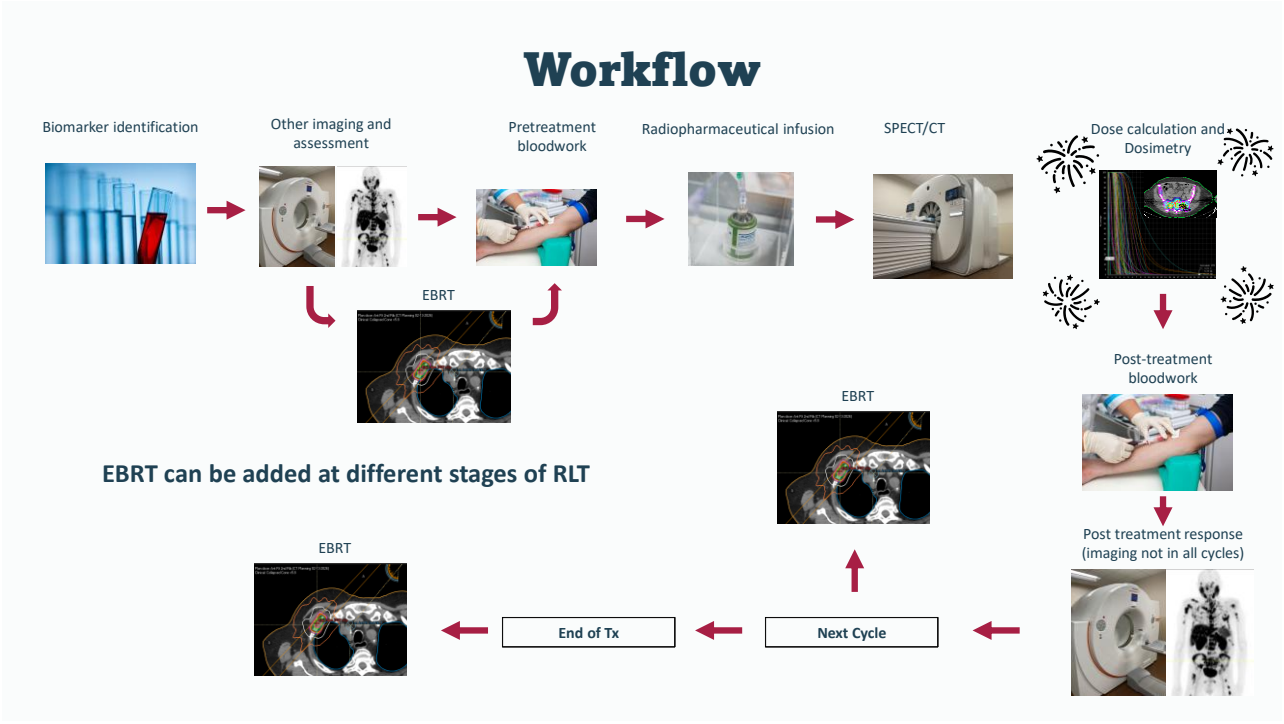
Willis Knighton Health

Nuclear Oncology Fellowship Program

- Started 2025
- Medical physics MS or PhD, Pre-or post-residency
  - Currently 2+1 diagnostic + NM residency exists
  - **NO** accredited 2+1 therapy + NM exist
    - Theranostics expansions in RO space = untrained physicists handling procedures
- Over 20 application
- Currently 1 Fellow in program
- Second program of this type in the country
- Emphasis in theranostics
  - Pathway to board certification in NM (ABSNM or ABR)

22



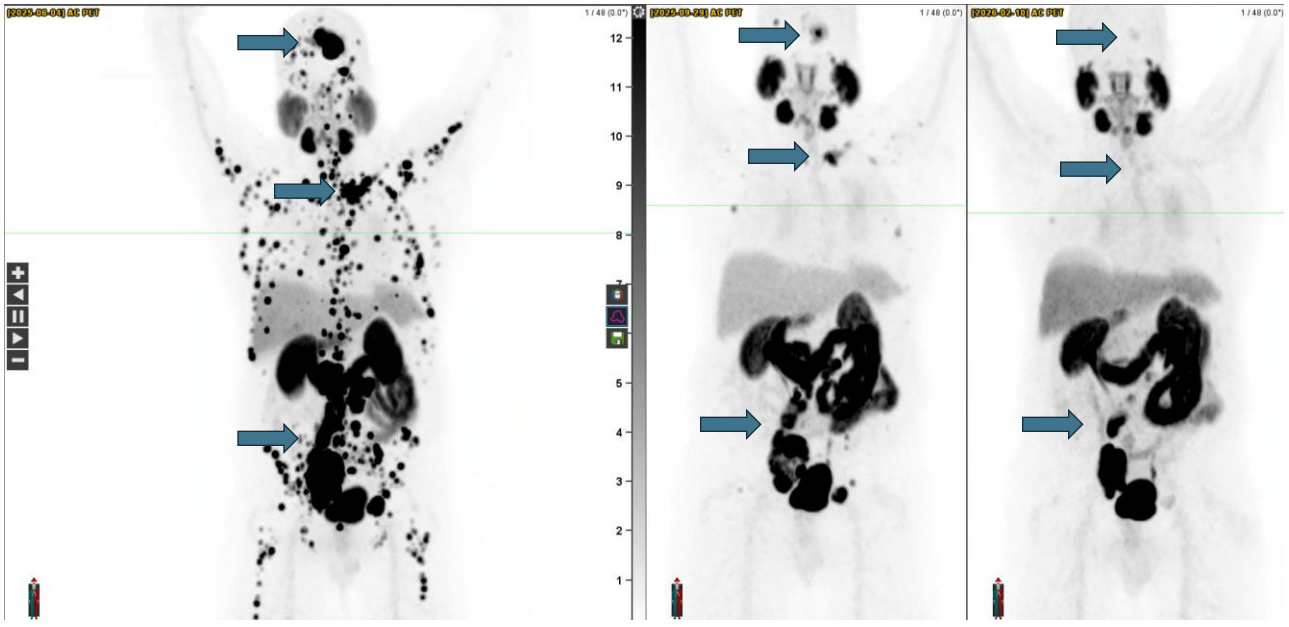
23

Case 1

- 66 year old male
- Metastatic castration resistant prostate adenocarcinoma
- Previous Radiation to prostate and seminal vesicles in 2013
- Disease progression after two androgen pathway and docetaxel
- Received PSMA targeted radiopharmaceutical therapy
- SBRT to retroperitoneal nodal chain between cycles 4 and 5
- PSA 410 before RLT down to 14.3
- Residual bulky pelvic nodal disease after RLT
- Proton to pelvic nodal region with boost to gross nodal disease

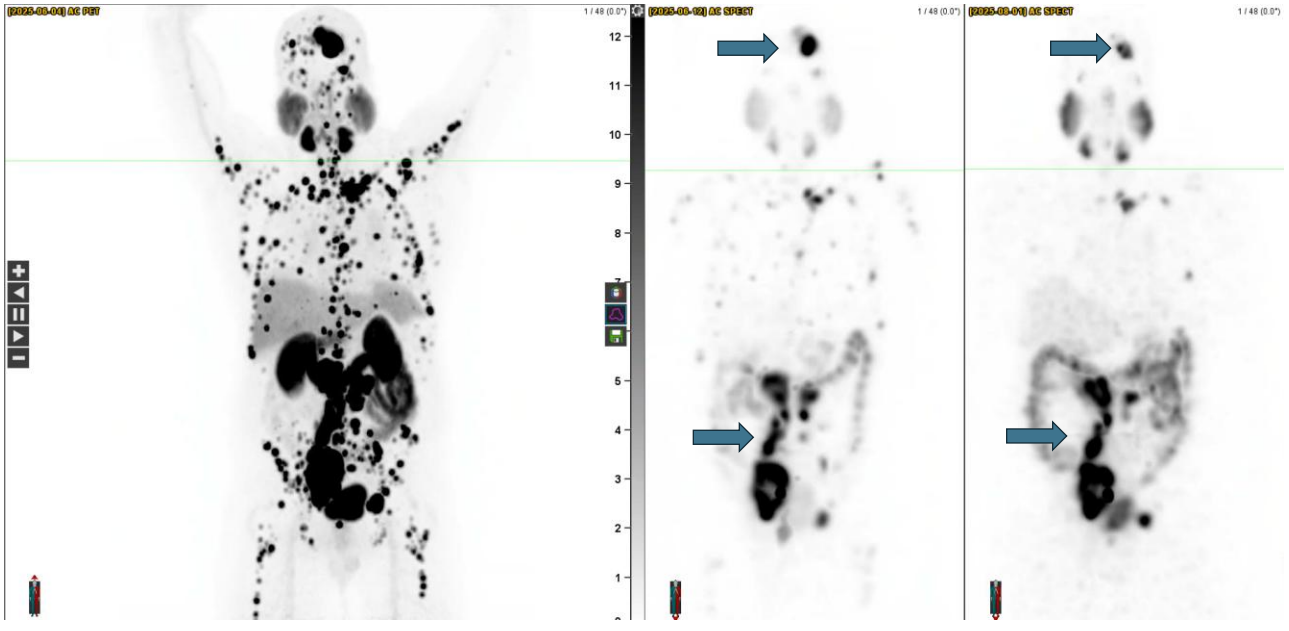
24

PET PSMA Previous to RLT Mid Tx Post Tx



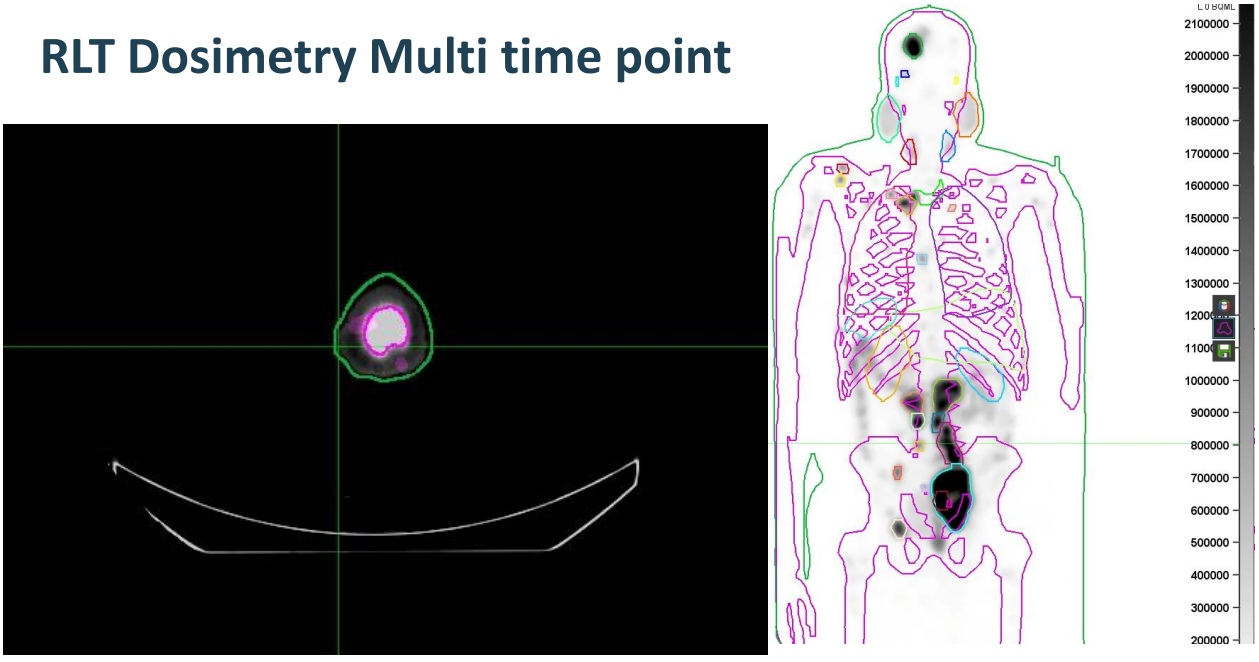
25

PET PSMA Previous to RLT SPECT 1 SPECT 2



26

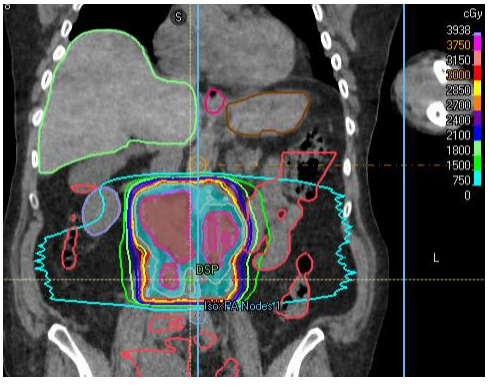
RLT Dosimetry Multi time point



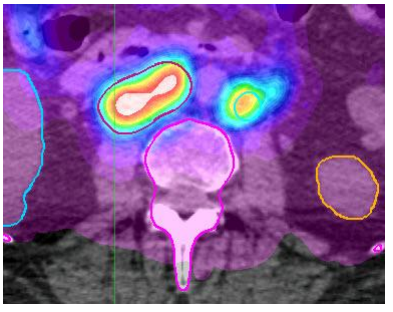
27

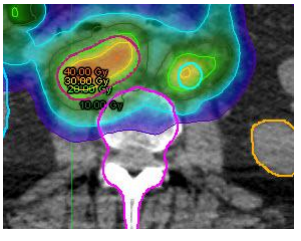
TOMO SBRT

30Gy in 5 fx SIB to 37.5Gy

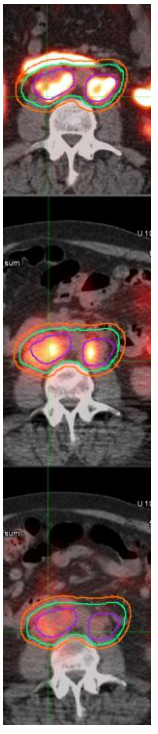


RLT Dosimetry





PET

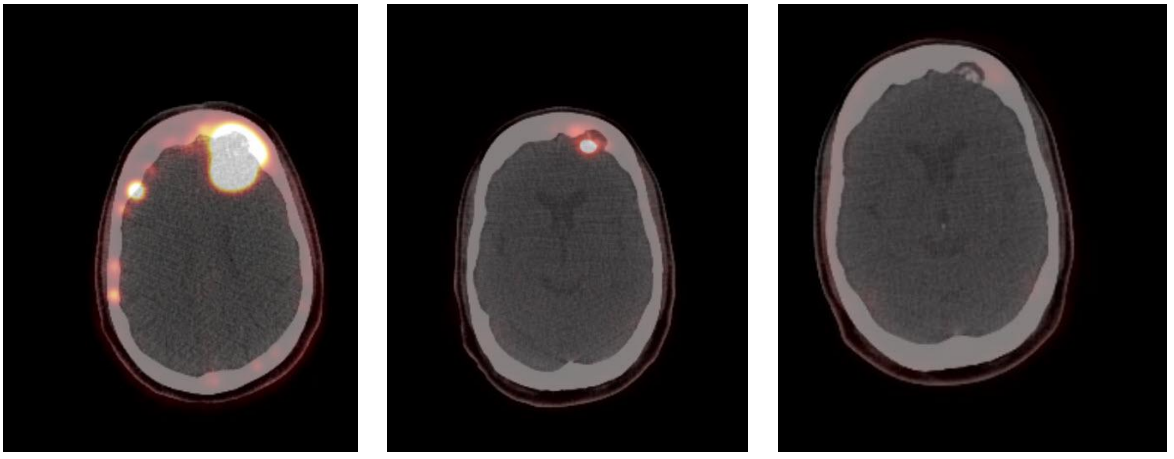


28

PET Previous to RLT

Mid Tx

Post Tx

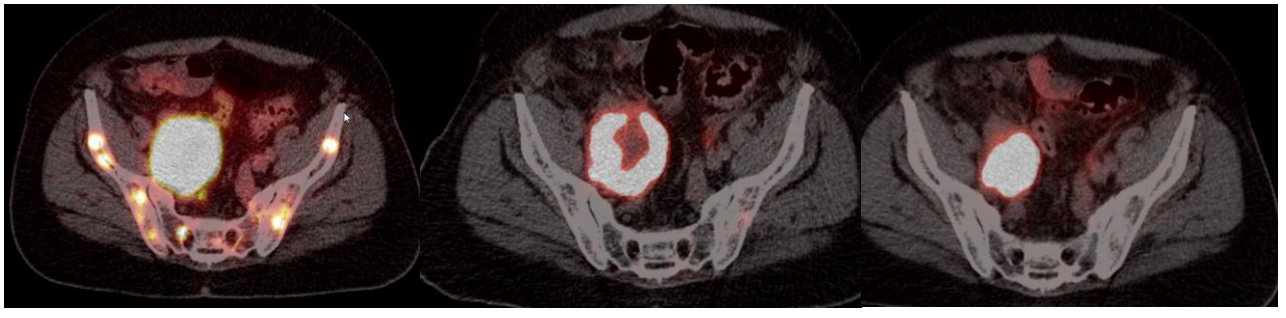


29

PET Previous to RLT

Mid Tx

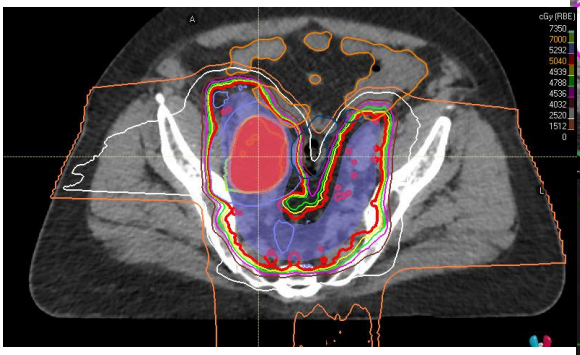
Post Tx



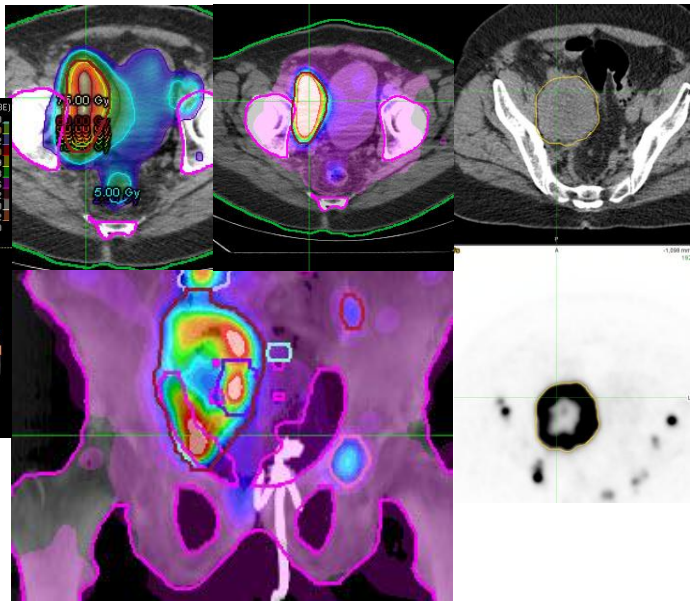
30

Proton Tx

50.4Gy in 28 fx SIB to 70Gy



RLT Dosimetry



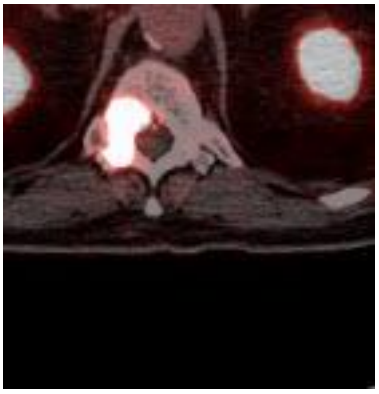
31

Case 2

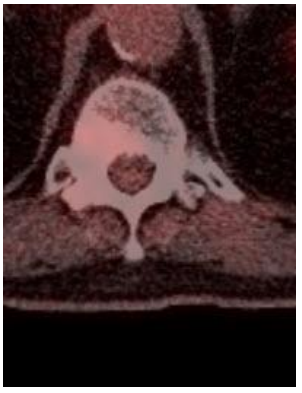
- 86 year old male
- Metastatic castration resistant prostate cancer
- Previous Radiation to prostate fossa in 2003
- Different lines of treatment with raising PSA
- Received PSMA targeted radiopharmaceutical therapy
- SBRT to T12 spine and anterior second rib
- PSA 4.4 before RLT down to 1.5

32

PET PSMA Previous to Tx

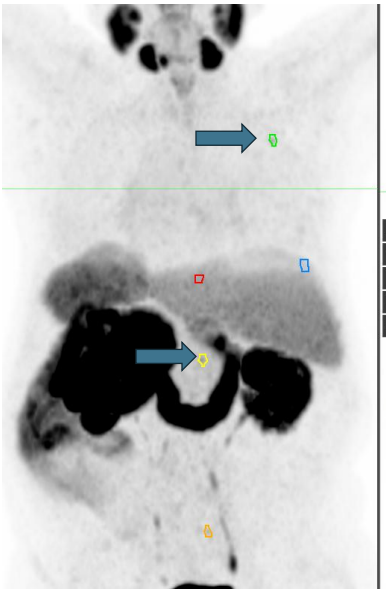


Post Tx

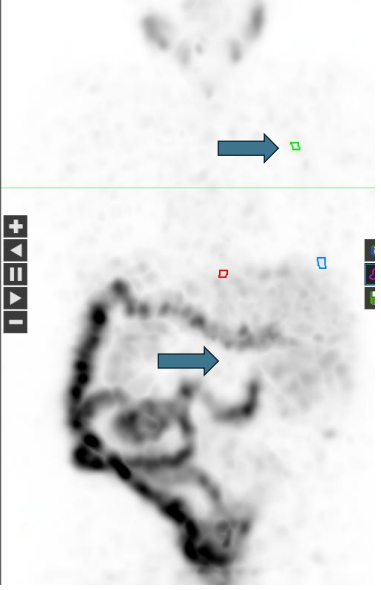


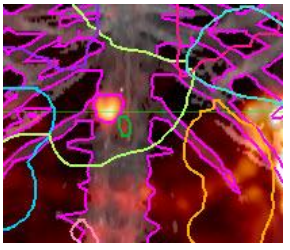
33

PET PSMA Mid Tx



SPECT After SBRT





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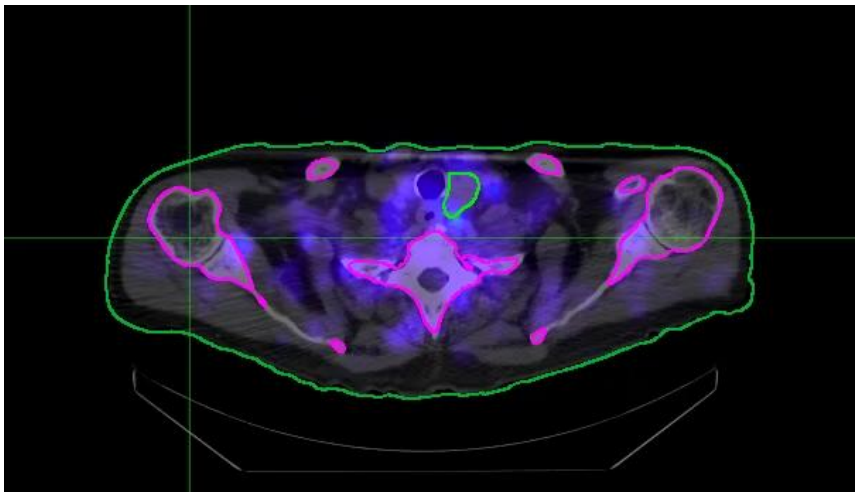
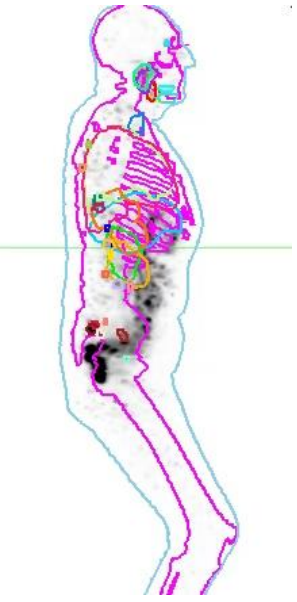
RLT Dosimetry Multi time point





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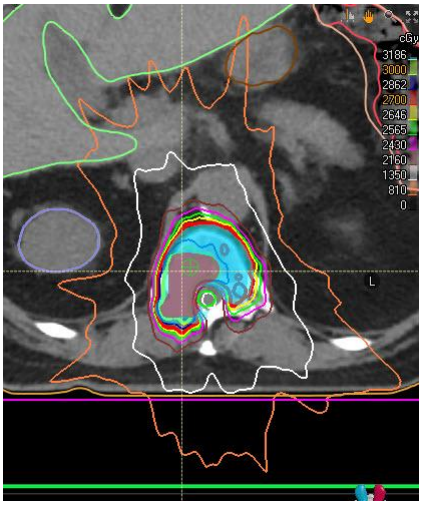
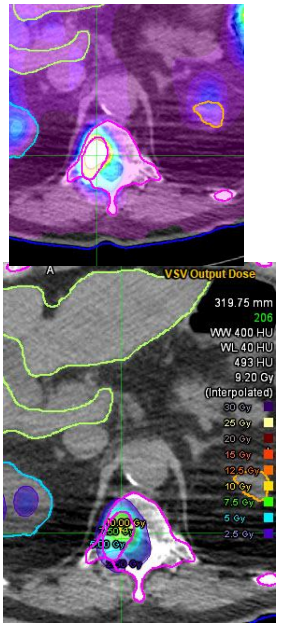
SBRT

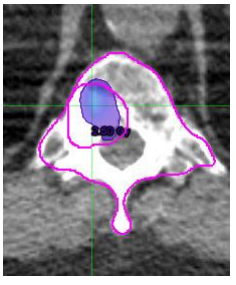
27Gy in 3 fx SIB to 30Gy



RLT Dosimetry



RLT Dosimetry post Tx



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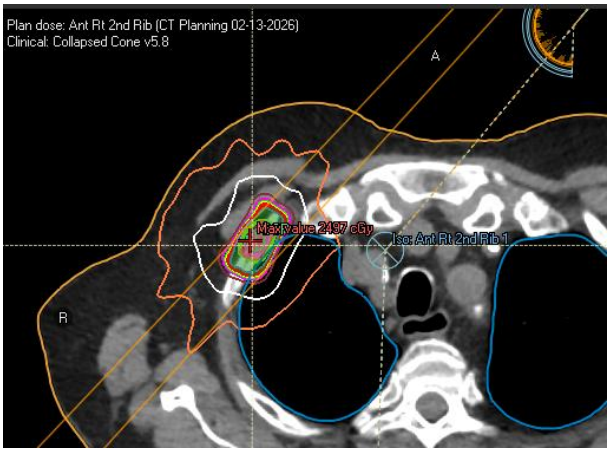
SRS

18Gy in 1 fx SIB to 21/24Gy



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Conclusion

- Recent developments in theranostics have opened new opportunities for growth and collaboration within radiation oncology
- Dosimetrists Cross-training in theranostic dosimetry applications is both feasible and valuable
- Dosimetrists should advocate to be part of the theranostic conversation to contribute their specialized knowledge
- Integrating external beam radiation therapy (EBRT) with radioligand therapy (RLT) has the potential to improve patient outcomes through a more comprehensive treatment approach

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