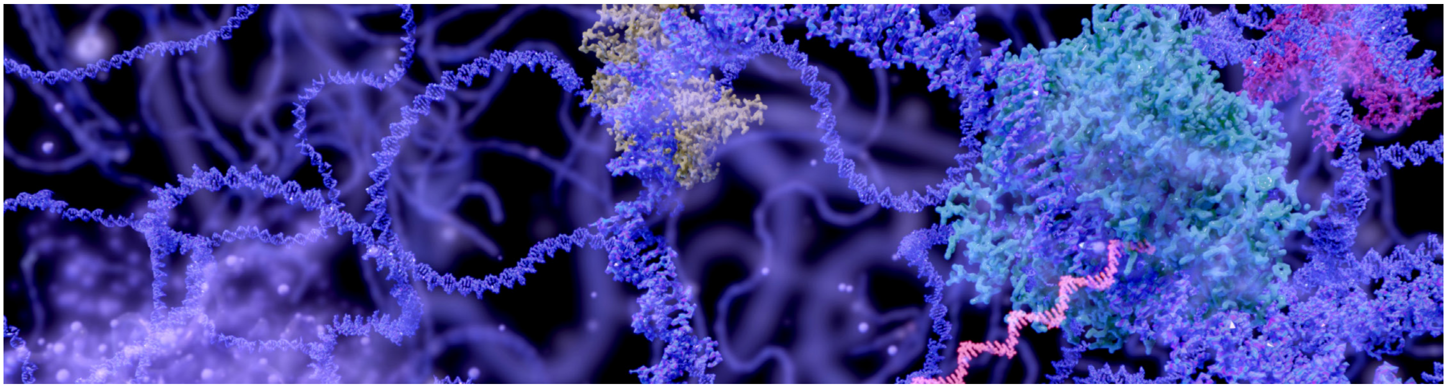
AppliedRadiationOncology™ November 2025

RadOnc Student Scan

Editors: Colin McNamara[1], Danielle Newhouse[2], Olivia Pocha[3], Alexys Gayne[1], Rayan Alzahrani[4], Benjamin Talom[5], Zachary Keepers[6], Anthony Alanis[7], Kory Punch[7], Zachary McSween[8], Laura Maule[9]

Affiliations: [1]Geisel School of Medicine at Dartmouth, [2]Lincoln Memorial University Debusk College of Osteopathic Medicine – Knoxville, [3]Tulane University School of Medicine, [4]Al-Baha University, Faculty of Medicine Saudi Arabia, [5]American University of the Caribbean School of Medicine, [6]University of Maryland School of Medicine, [7]University of Texas Rio Grande Valley School of Medicine, [8]St. George's University School of Medicine, [9]Drexel University School of Medicine



IN THIS ISSUE

Introduction

The Interdisciplinary Field of Radiation Oncology

By Danielle Newhouse

Radiation oncology is a medical subspecialty that utilizes radiation therapy to optimize cancer treatment or provide palliative pain relief. Professionals in this field work collaboratively with multiple specialties, including medical and surgical oncology, to ensure the best treatment modality is selected for each patient and to maximize outcomes. Without this approach, success rates for long-term remission and pain control would not be as high as they are now.[1] The radiation oncology team itself comprises radiation oncologists, medical physicists, dosimetrists, radiation therapists, nurses, and other staff.

Radiation oncologists are physicians trained in the biological impact of radiation on malignant and benign tissue. Some of their responsibilities include determining the necessity of radiation therapy in coordination with other treatment modalities, managing the treatment plan, monitoring the patient's progress, and addressing adverse effects. They determine the most appropriate type of radiation treatment, whether it be external beam radiation therapies (EBRT) such as stereotactic radiosurgery (SRS) or intensity-modulated radiation therapy (IMRT), or internal radiation therapy such as brachytherapy. They also determine optimal dose and number of treatment sessions for each patient. These physicians work with radiation therapists to ensure precise and accurate delivery of treatment, as well as with dosimetrists and medical physicists to design a treatment plan best suited for each case.[2]

Medical physicists apply concepts in physics to radiation therapy. They prioritize patient and staff safety by ensuring that the equipment can deliver the prescribed treatment plan and troubleshoot any problems that arise.[3] Together with dosimetrists

and radiation oncologists, they help plan treatment, calculate radiation dose, and make continuous quality assurance checks throughout treatment.[4]

Dosimetrists generate, design, and measure radiation dose and distribution for EBRT and brachytherapy. They analyze the prescribed treatment technique, beam angles and shapes, surrounding tissue and organs, tumor size and location, and dose to tailor the treatment plan. They also collaborate with the medical physicists on QA checks and assist in modifying treatment as needed during the planning or treatment process.[5]

Radiation therapists are trained in operating a variety of technology used to deliver radiation therapy. These include linear accelerators, brachytherapy equipment, CT scanners, MRI machines, and computer planning systems.[6] They ensure proper patient positioning to limit unnecessary radiation exposure, administer the prescribed therapy, monitor progress, and maintain treatment records. Radiation therapists also provide patients with emotional support during treatment.[7]

Multidisciplinary meetings are held where physicians collaborate to optimize patient management and treatment planning. These conferences include radiologists, pathologists, surgeons, radiation and hematology oncologists, and other professionals. Hematologist-oncologists conduct risk stratification to determine optimal disease control and symptom management with, among other treatments, chemotherapy, immunotherapy, targeted therapy, bone marrow transplantation, radiation therapy, and surgery. A general surgeon or one specializing in surgical oncology or head and neck surgery, can diagnose, stage, and resect or debulk tumors. Procedures include but are not limited to tumor removal, biopsies, reconstructive surgery to restore appearance or function, and palliative surgery to relieve the side effects of advanced cancers.[8] This multidisciplinary gathering ensures that each patient receives the most appropriate and comprehensive care.

Radiotheranostics: Precision Tumor Therapy with Radioligand Magic

By Olivia Pocha

Radiotheranostics combines diagnostic imaging, such as positron emission tomography (PET), with a targeted radionucleotide to permit real-time, image-guided radiation therapy to a specific ligand expressed by tumor cells. This enlists molecules, peptides, or antibodies that are conjugated to radionucleotides that emit alpha or beta radiation.[9] Known as radiopharmaceuticals, they are designed to deliver radiation directly to cancer cells that express a specific targeted ligand. Unlike traditional radiation, which uses an external radiation source that affects targeted and nontargeted tissue, radiopharmaceuticals directly impact cancerous tissue while sparing the healthy tissue.[10] Combining imaging and targeted radiation, radiotheranostics allows physicians to evaluate the patient's treatment regimen early and accurately. This permits more informed decision-making and higher success rates with radionucleotide therapies compared to conventional cancer treatments.[9] Currently, two radiotheranostics have FDA approval, one for prostate cancer and one for gastroenteropancreatic neuroendocrine tumors.

Prostate-specific antigen (PSA) is a transmembrane protein expressed in prostate tissue. Normal prostate tissue expresses low levels of PSA, while abnormal, prostate neoplasia expresses high levels of the antigen.[11] The increased expression of PSA by the malignant tissue makes prostate cancer a highly specific target for radiotheranostics purposes. Specialized imaging such as PSMA PET scans have high sensitivity and positive predictive value for detecting cancer recurrence, even when PSA levels are low.[12] The recent phase III VISION trial sought to evaluate the efficacy of combining a radiopharmaceutical with standard of care versus standard of care alone in patients with metastatic castration-resistant prostate cancer (mCRPC) who previously received at least one chemotherapy regimen. The VISION trial produced favorable results, leading to DA approval of [^{177}Lu]Lu-PSMA-617 for the treatment of patients with mCRPC.[13]

Building on the success seen in mCRPC, clinical trials are underway using theranostics to identify specific ligands expressed on cancer cells for diagnostic imaging, followed by targeting the same ligand with radiopharmaceuticals. Several targets are being investigated; they include the fibroblast activation protein (FAP), carbonic anhydrase IX (CAIX), and gastrin-releasing peptide receptor (GRPR), among others.[14] As stated by Bodei 2022, radiotheranostics is a promising new approach to cancer therapy allowing physicians to "treat what they can see. Bodei 2022"

Interviews

Why Radiation Oncology? A Perspective from a Saudi Radiation Oncologist

By Rayan A. Alzahrani

Majed Alghamdi, MD, MSc, MBA, FRCPC, DABR, specializes in central nervous system (CNS) oncology and stereotactic radiosurgery. Dr. Alghamdi serves as an assistant professor at King Saud bin Abdulaziz University for Health Sciences in Jeddah, Saudi Arabia, as well as chairman of the Saudi Association of Radiation Oncology.

When were you first exposed to radiation oncology, and what were your initial impressions?

My initial exposure was during my first year of neurosurgery residency. I was immediately intrigued by the precision and science behind radiation therapy, its crucial role in multidisciplinary cancer management, and the compassionate care provided to patients.

Witnessing how radiation oncology balances advanced technology with human empathy was genuinely captivating. Before I completed my first year in neurosurgery, I made my decision to switch to radiation oncology.

What do you appreciate most about your career?

What I appreciate most is the opportunity to impact patients positively at critical moments of their cancer journey. The specialty uniquely integrates cutting-edge technology, patient-centered care, and collaborative teamwork with other oncology disciplines. This intersection provides immense professional satisfaction and continuous learning opportunities.

What are the daily expectations and typical clinical practices in radiation oncology?

A typical day involves patient consultations, treatment planning and contouring, reviewing patient cases with multidisciplinary teams, and ongoing patient management. Daily interactions include collaboration with medical physicists, radiation therapists, medical oncologists, and surgeons to ensure comprehensive patient care.

What excites you about the future of radiation oncology?

The future is incredibly promising, with exciting advances like artificial intelligence-assisted treatment planning, adaptive radiation therapy, and novel interaction between radiotherapy and drugs. Continued technological innovation and personalized medicine promise enhanced precision, improved patient outcomes, and reduced side effects, making it an exciting and fulfilling time to be in this specialty.

Patient-focused Care in Private Practice Radiation Oncology

By Alexys Gayne

Hasan Murshed, MD, MS, is a radiation oncologist and medical director of the Hope Regional Cancer Center in Lynn Haven, Florida. Dr. Murshed received his medical degree from Dhaka University and completed his radiation oncology residency at the University of Alabama, Birmingham. He completed his fellowship in IMRT/respiratory gating at the MD Anderson Cancer Center. Dr. Murshed has also earned a Master of Science in clinical medical physics from the Louisiana State University. In addition to treating patients using his expertise in head and neck, lung, and prostate cancer, Dr. Murshed has also written a textbook, Fundamentals of Radiation Oncology: Physical, Biological, and Clinical Aspects, which is a widely used resource.

What drew you to radiation oncology when choosing your specialty?

I was initially drawn to the field because it blends two areas I've always enjoyed: medicine and physics. My background in radiation physics gave me a strong appreciation for the technical precision of radiation therapy, but what truly solidified my choice was the ability to care for cancer patients throughout their journey.

What is your favorite aspect of your career?

The most rewarding aspect is seeing patients' cancers improve and regain their quality of life. I enjoy developing personalized treatment plans, and the variety of cases I see in private practice keeps each day intellectually engaging.

What prompted you to work in private practice versus an academic setting? What do you think are the most significant advantages and disadvantages of working in private practice?

Private practice allows me to treat a wide variety of cancer types rather than specializing in [cancers affecting] one site. It also offers flexibility, autonomy, and a strong connection to the local community. While the tradeoff is fewer research and teaching opportunities, the breadth of clinical experience is a major advantage.

What advice do you have for medical students interested in pursuing a career in radiation oncology?

Explore the field early through electives, shadowing, or mentorship. A strong interest in oncology and patient care is essential, and while a physics and mathematics background helps, it is not critical. Compassion and communication matter most.

How do clinical trials and new breakthroughs translate to the private practice setting?

While clinical trials are not usually done in private practice, we stay closely attuned to emerging evidence by attending conferences and peer reviews and rapidly integrate proven advances into everyday patient care. The emphasis in private practice is to integrate up-to-date research findings into accessible, high-quality treatments within real-world clinical settings. That said, for those interested in research, multispecialty groups like NRG Oncology offer numerous clinical trials that can be opened and conducted in private practice environments as well.

Hot Topics in Radiation Oncology

By Zachary Keepers

Development and Validation of an Artificial Intelligence Digital Pathology Biomarker to Predict Benefit of Long-Term Hormonal Therapy and Radiotherapy in Men with High-Risk Prostate Cancer Across Multiple Phase III Trials[16]

Armstrong AJ, Liu VYT, Selvaraju RR, et al. Development and Validation of an Artificial Intelligence Digital Pathology Biomarker to Predict Benefit of Long-Term Hormonal Therapy and Radiotherapy in Men With High-Risk Prostate Cancer Across Multiple Phase III Trials. *J Clin Oncol.* Published online April 16, 2025. doi:10.1200/JCO.24.00365

Androgen deprivation therapy (ADT) is an important treatment for patients with high or very-high-risk localized prostate cancer receiving radiation therapy. Long-term ADT (18-36 months) compared to short-term ADT (4-6 months) confers a survival benefit for these patients. However, long-term ADT is associated with significant comorbidities and side effects. In this study, researchers sought to develop and validate a multimodal artificial intelligence (MMAI)-derived predictive biomarker to guide ADT duration. The model was trained using pretreatment prostate biopsy images and other clinical data; eg, age, baseline prostate-specific antigen, Gleason score, from patients enrolled in six phase III randomized trials. The model was validated on a seventh randomized trial that compared long-term to short-term ADT, with distant metastasis (DM) as the primary outcome. Ultimately, the authors showed that the 15-year risk of DM was significantly greater for MMAI-positive men, with no difference between the short-term and long-term MMAI-negative patients. They conclude that with the use of this MMAI predictive model, approximately one-third of patients with high-risk prostate cancer would be adequately treated with short-term ADT.

An Ultrasound Visual Servoing Dual-arm Robotics System for Needle Placement in Brachytherapy Treatment[17]

Li Y, Lu Z, Tzemanaki A, Bahl A, Persad R, Melhuish C, Yang C. An ultrasound visual servoing dual-arm robotics system for needle placement in brachytherapy treatment. *Front Robot AI*. 2025;12. doi:10.3389/frobt.2025.1558182

Brachytherapy is an option for several types of cancer, including prostate cancer. For delivery of high-dose rate (HDR) brachytherapy, skilled physicians are required to accurately insert needles into the prostate. To reach the prostate, physicians must advance the needles through several layers of heterogeneous tissue, which requires various levels of force and speed. In this paper, researchers sought to validate a dual-arm robotic system for automated brachytherapy. One arm of the robot was used to position an ultrasound probe, while the other drove the brachytherapy needles into a synthetic “phantom” tissue designed to represent in vivo conditions. A camera-based visual system was also employed to track the needle base and monitor the procedure. Ultimately, the system achieved a mean needle placement accuracy of 2.85 millimeters, demonstrating the potential for accurate and automated prostate brachytherapy.

Virtual Rounds: Unique Cases in Radiation Oncology

By Anthony Alanis

Exploring the Rarity: A Case of Adenosquamous Carcinoma of the Nasal Cavity with Literature Review

Bhatnagar AR Favazza; LA; Momin; SR; Siddiqui; F. Exploring the Rarity: A Case of Adenosquamous Carcinoma of the Nasal Cavity With Literature Review. Appl Rad Oncol. 2024;(3):40 - 47. doi:10.37549/ARO-D-24-00013

Background

Adenosquamous carcinoma (ADSC) is a rare and aggressive head and neck tumor that was first described in 1968. A rare cancer, only 16 cases of primary ADSC of the nasal cavity, excluding paranasal sinuses, have been reported. The cancer is characterized by distinct histomorphology compared to conventional head and neck squamous cell carcinomas (HNSCC) and mucoepidermoid cancers. Despite the aggressive nature and deep tissue infiltration of ADSC, treatment outcomes compared to conventional HNSCC are similar.18 Adjuvant radiotherapy after surgical resection of a nasopharyngeal tumor can cause acute side effects such as mucositis, edema, and impaired wound healing, as well as late effects such as fibrosis, tissue necrosis, and compromised vascularity. Reduced vascularity, chronic inflammation, and fibrosis cause increased rates of wound dehiscence, infection, and poor integration of reconstructive tissue. Careful management of these patients by a multidisciplinary team is vital.[19,20]

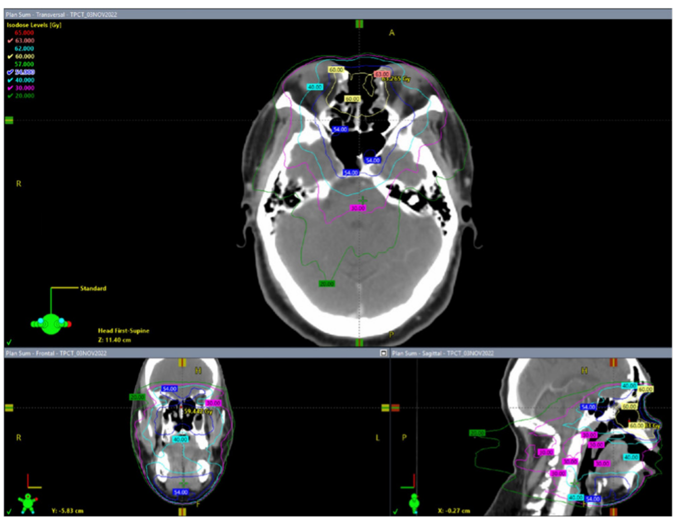


Figure 1. Intensity-modulated radiation therapy plan demonstrating different isodose levels.

Case Description

A 38-year-old patient presented with a history of painful swelling over the nasal bridge, nasal congestion, and intermittent nose bleeding during the previous 8-12 months. Imaging revealed a large mass in the nasal septum. Biopsy results showed ADSC consisting of squamous and glandular components. The patient underwent total rhinectomy, septectomy, and turbinate resection and received 60 Gy in 30 fractions of adjuvant radiation therapy. There was no recurrence at 18-month follow-up and the patient was planning a delayed surgical reconstruction.

Key Insights

This cancer's ability to mimic benign conditions makes early detection and accurate staging of ADSC a challenge. Treatment requires a team of surgeons and radiation oncologists. A literature review conducted by the authors revealed that HPV-positive cases of ADSC had better outcomes. Endoscopic treatment techniques also resulted in reduced morbidity and faster recovery.[18] This case illustrates the multidisciplinary approach to treating rare head and neck cancers.

Industry Insights

The Puzzle of Receiving Approval for Care in Radiation Oncology

By Colin McNamara

Challenges in receiving insurance coverage for recommended therapies are increasingly common, with high rates of denial for many services. Clinicians are forced to follow convoluted pathways of prior authorization and peer reviews to receive approval of their care recommendations.

In radiation oncology specifically, Bingham et al demonstrated that the burden of completing prior authorizations is particularly high owing to the highlight specialized, urgent, and intensive nature of pretreatment planning.[21] The time alone required for academic radiation oncologists to manage prior authorization-related tasks translates to a national cost of $46M, or about 2.7% of the $1.7B annual US expenditure for academic radiation oncology services. A 2024 ASTRO survey of radiation oncologists showed that nearly two-thirds of radiation oncologists had hired additional staff to facilitate prior authorizations.[22] An evaluation by Pasetsky et al. of the Appeals Decision Search on the Centers for Medicare and Medicaid Services (CMS) of claims for radiation therapy submitted 2022-2024 found an inappropriate denial rate of 15.04-18.69%, compared to an inappropriate denial rate of all medical services of just 3.44-5.28%.[23] The rate of inappropriate denial varied widely by service, with breast cancer appeals for IMRT demonstrating an inappropriate denial rate of 82.14%, compared to the appeal rate of prostate cancer proton therapy of 3.45%.[23] Despite high rates of initial denial for radiation therapy, Koffler et al demonstrated a denial overturn rate of 69% for claims filed by their institution without any changes to the initial treatment plan, but with a delay of treatment initiation by a median of 12.1 days.[24]

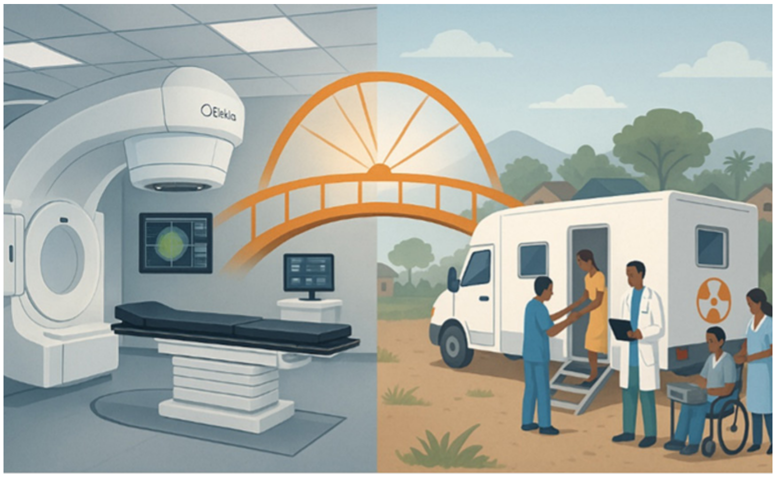
To help reduce the clerical burden and delays to initiation of care, a discussion by Pasetsky et al recently published in the Volume 14, Issue 6, November-December 2024 edition of *Practical Radiation Oncology* offers guidance on how to structure peer-to-peer phone calls and appeals letters.[25] The authors' advice for successful peer-to-peer calls and appeals letters integrates resources from ASTRO and CMS and includes reminders for providers to cite standards of care and their reasons for medical necessity.

Radiation oncology is particularly prone to challenges in receiving approval for recommended therapies owing to prior authorizations and peer-to peer-appeals. These obligations are expensive for radiation oncology practices and lead to delays in care, but endeavors to help standardize appeals can make denials more navigable.

The Global Cancer Crisis: How Radiation Oncology Can Lead the Charge

By Benjamin K. Talom

Global Disparities in Cancer Treatment



Cancer treatment inequity is one of today's most critical healthcare concerns. Although radiation therapy is a keystone therapy in developed countries, low- and middle-income countries (LMICs) face significant gaps in availability. These gaps have been attributed to limitations in physical infrastructure, a shortage of human resources, and high costs of care. The World Health Organization estimates that over 50 percent of cancer patients require radiotherapy, yet an estimated one-third of the countries in Africa have no access to such lifesaving treatments.[26,27]

Innovative Solutions to Expand Global Access

Several models have been developed to address these inequities. In the US, a hub-and-spoke system provides complex services at central facilities and basic services at smaller sites. This approach has been used with patients living in rural areas who cannot travel great distances for care. Urban-based oncologists may also travel to rural areas to provide care. Telehealth visits have also been found to be helpful in monitoring for toxicity and for overseeing systemic therapy distribution. These approaches are promising options to address a global shortage of radiotherapy access.[29]

Artificial intelligence can streamline and standardize complicated treatment plans for medically underserved areas. The Radiation Planning Assistant, created by the University of Texas MD Anderson Cancer Center, Houston, TX, is an AI-powered tool that allows clinicians to input CT scans and receive high-quality, computer-generated treatment plans. The system has been successfully deployed in resource-constrained environments such as South Africa, allowing local teams to concentrate on fine-tuning plans and improving clinical services.[30]

Innovative engineering approaches are also being explored to enhance medical linear accelerators (LINACs) and radiotherapy systems, particularly in LMICs. These include radiofrequency power systems, durable and sustainable power supplies, LINAC beam production and control systems, LINAC safety and operability, and computer applications in radiation therapy. Each unit strives to make radiotherapy more robust, affordable, and accessible to resource-constrained areas.[31]

How Medical Students Can Get Involved

Aspiring radiation oncologists have the opportunity to make a difference in cancer care globally. They can join ASTRO, ACRO, and ASCO global health groups dedicated to providing radiation oncology services to populations with limited resources. These organizations offer mentorship, networking, and educational opportunities. In addition, international organizations such as RAD-AID International have structured programs that include students in cancer care projects with hands-on learning to manage the challenges of delivering radiation therapy in resource-limited settings. While cancer incidence is on the increase worldwide, radiation oncology has a unique role to play in addressing disparities in treatment.

Career Development Opportunities in Radiation Oncology

By Zachary McSween

SUPERS@PENN – Summer Undergraduate Program in Radiation Science

Focus: Summer research program at the University of Pennsylvania that introduces undergraduate students to radiation oncology, cancer biology, and medical physics

Offerings:
- Mentored research in radiation biology, cancer immunology, imaging, or physics
- Weekly seminars on research ethics, communication, and professional development
- $4,000 stipend (housing and meals not included

Website: med.upenn.edu/supers/

ASTRO Medical Student Fellowship Award

Focus: Introducing medical students from underrepresented backgrounds to radiation oncology through mentored clinical and research experiences.

Offerings:
- Eight-week summer research fellowship in clinical or basic science.
- $6,000 stipend for project support and $1,000 for attending the ASTRO Annual Meeting

Website: astro.org/provider-resources/research/funding-opportunities/

Academy for Emerging Leaders in Patient Safety (AELPS

Focus: Four-day immersive workshop designed to build leadership skills and a deeper understanding of patient safety through hands-on learning, real-world case discussions, and mentorship by clinicians, educators, and patient advocates

Offerings:
- Four-day, in-person workshops with interactive, simulations and reflective exercises
- Full scholarships for US participants (covers airfare, lodging, transport, and materials).

Website: aelpsworkshops.com

MD Anderson RADAR Program (Radiation Oncology First-Year Medical Student Program)

Focus: Offers first-year medical students the opportunity to explore careers in radiation oncology through mentored summer research and exposure to clinical practice

Offerings:
- Ten-week paid summer program focused on clinical, translational, or basic science research
- One-on-one mentorship by MD Anderson radiation oncology faculty.
- Exposure to departmental seminars, tumor boards, and multidisciplinary care teams

Website: mdanderson.org/education-training/research-training/early-career-pathway-programs

Upcoming Conferences

RSNA (Radiological Society of North America)

Nov 30 – Dec 5, 2025, Chicago, IL

Website: rsna.org/annual-meeting

References

1. Chandra RA, Keane FK, Voncken FEM, Thomas CR. Contemporary radiotherapy: present and future. Lancet Lond Engl. 2021;398(10295):171-184. doi:10.1016/S0140-6736(21)00233-6

2. Hartford AC, Galvin JM, Beyer DC, et al. American College of Radiology (ACR) and American Society for Radiation Oncology (ASTRO) Practice Guideline for Intensity-modulated Radiation Therapy (IMRT). Am J Clin Oncol. 2012;35(6):612. doi:10.1097/COC.0b013e31826e0515

3. Medical Physicist - Explore Healthcare Careers - Mayo Clinic College of Medicine & Science. Accessed July 9, 2025. https://college.mayo.edu/academics/explore-health-care-careers/careers-a-z/medical-physicist/

4. Seung SK, Larson DA, Galvin JM, et al. American College of Radiology (ACR) and American Society for Radiation Oncology (ASTRO) Practice Guideline for the Performance of Stereotactic Radiosurgery (SRS). Am J Clin Oncol. 2013;36(3):310-315. doi:10.1097/COC.0b013e31826e053d

5. AAMD Foundation | Scholarships & Support for Medical Dosimetrists. AAMD Foundation. Accessed July 9, 2025. https://aamdfoundation.org/

6. Who We Are - ASRT Mission and Vision. Accessed July 9, 2025. https://www.asrt.org/main/about-asrt/who-we-are#mission

7. Frane N, Bitterman A. Radiation Safety and Protection. In: StatPearls. StatPearls Publishing; 2025. Accessed July 9, 2025. http://www.ncbi.nlm.nih.gov/books/NBK557499/

8. Pollock RE, Morton DL. The Contemporary Role of Surgical Oncology. In: Holland-Frei Cancer Medicine. 6th Edition. BC Decker; 2003. Accessed July 9, 2025. https://www.ncbi.nlm.nih.gov/books/NBK13802/

9. Bodei L, Herrmann K, Schöder H, Scott AM, Lewis JS. Radiotheranostics in oncology: current challenges and emerging opportunities. Nat Rev Clin Oncol. 2022;19(8):534-550. doi:10.1038/s41571-022-00652-y

10. Zhang S, Wang X, Gao X, et al. Radiopharmaceuticals and their applications in medicine. Signal Transduct Target Ther. 2025;10(1):1. doi:10.1038/s41392-024-02041-6

11. Wright GL, Haley C, Beckett ML, Schellhammer PF. Expression of prostate-specific membrane antigen in normal, benign, and malignant prostate tissues. Urol Oncol Semin Orig Investig. 1995;1(1):18-28. doi:10.1016/1078-1439(95)00002-Y

12. Jones W, Griffiths K, Barata PC, Paller CJ. PSMA Theranostics: Review of the Current Status of PSMA-Targeted Imaging and Radioligand Therapy. Cancers. 2020;12(6):1367. doi:10.3390/cancers12061367

13. Sartor O, Bono J de, Chi KN, et al. Lutetium-177–PSMA-617 for Metastatic Castration-Resistant Prostate Cancer. N Engl J Med. 2021;385(12):1091-1103. doi:10.1056/NEJMoa2107322

14. Tran HH, Yamaguchi A, Manning HC. Radiotheranostic landscape: A review of clinical and preclinical development. Eur J Nucl Med Mol Imaging. 2025;52(7):2685-2709. doi:10.1007/s00259-025-07103-7

15. Zhang W, Hong X, Zhu YN, et al. A Proton Treatment Planning Method for Combining FLASH and Spatially Fractionated Radiation Therapy to Enhance Normal Tissue Protection. Published online May 9, 2025. doi:10.48550/arXiv.2505.06223

16. Armstrong AJ, Liu VYT, Selvaraju RR, et al. Development and Validation of an Artificial Intelligence Digital Pathology Biomarker to Predict Benefit of Long-Term Hormonal Therapy and Radiotherapy in Men With High-Risk Prostate Cancer Across Multiple Phase III Trials. J Clin Oncol. 2025;0(0):JCO.24.00365. doi:10.1200/JCO.24.00365

17. Li Y, Lu Z, Tzemanaki A, et al. An ultrasound visual serving dual-arm robotics system for needle placement in brachytherapy treatment. Front Robot AI. 2025;12. doi:10.3389/frobt.2025.1558182

18. Bhatnagar AR, Favazza LA, Momin SR, Siddiqui F. Exploring the Rarity: A Case of Adenosquamous Carcinoma of the Nasal Cavity With Literature Review. Appl Radiat Oncol. 2024;13(3):40-47. doi:10.37549/aro-d-24-00013

19. Yang K, Ahn YC, Nam H, Hong SD, Oh D, Noh JM. Clinical features of post-radiation nasopharyngeal necrosis and their outcomes following surgical intervention in nasopharyngeal cancer patients. Oral Oncol. 2021;114:105180. doi:10.1016/j.oraloncology.2021.105180

20. Rocha PHP, Reali RM, Decnop M, et al. Adverse Radiation Therapy Effects in the Treatment of Head and Neck Tumors. Radiogr Rev Publ Radiol Soc N Am Inc. 2022;42(3):806-821. doi:10.1148/rg.210150

21. Bingham B, Chennupati S, Osmundson EC. Estimating the Practice-Level and National Cost Burden of Treatment-Related Prior Authorization for Academic Radiation Oncology Practices. JCO Oncol Pract. 2022;18(6):e974-e987. doi:10.1200/OP.21.00644

22. Prior Authorization and Cancer Patient Care. American Society for Radiation Oncology. April 2019. Accessed July 9, 2025. https://www.astro.org/ASTRO/media/ASTRO/News%20and%20Publications/PDFs/ASTROPriorAuthorizationPhysician-SurveyBrief.pdf

23. Pasetsky J, Bhatt K, Kachnic LA, Yu JB, Horowitz DP. Inappropriate Denials for Radiation Therapy in Medicare Advantage Plans. Int J Radiat Oncol. 2025;121(4):871-874. doi:10.1016/j.ijrobp.2024.11.063

24. Koffler D, Chitti B, Ma DC, Hwang J, Potters L, Chen W. Futility of the Third-Party Peer-to-Peer Review Process and Entailed Delays to Cancer-Directed Therapy. Int J Radiat Oncol Biol Phys. 2022;114(3):S93. doi:10.1016/j.ijrobp.2022.07.509

25. Pasetsky J, Garcia-Young JA, Beatley E, Yu JB. Peer-to-Peer Phone Calls and Letters Appealing Insurance Denials of Service: Practical Tips and Resources. Pract Radiat Oncol. 2024;14(6):e434-e437. doi:10.1016/j.prro.2024.06.015

26. Rays of Hope: Widening Global Access to Cancer Care. September 26, 2023. Accessed July 9, 2025. https://www.iaea.org/newscenter/news/rays-of-hope-widening-global-access-to-cancer-care.

27. New WHO/IAEA publication provides guidance on radiotherapy equipment to fight cancer. Accessed July 9, 2025. https://www.who.int/news/item/05-03-2021-new-who-iaea-publication-provides-guidance-on-radiotherapy-equipment-to-fight-cancer.

28. ChatGPT. Accessed July 9, 2025. https://chatgpt.com.

29. Munhoz R, Sabesan S, Thota R, Merrill J, Hensold JO. Revolutionizing Rural Oncology: Innovative Models and Global Perspectives. Am Soc Clin Oncol Educ Book. 2024;44(3):e432078. doi:10.1200/EDBK_432078

30. Bloom A. Radiation Planning Assistant: Delivering on the promise of AI. MD Anderson Cancer Center. Accessed July 9, 2025. https://www.mdanderson.org/cancerwise/radiation-planning-assistant-delivering-on-the-promise-of-ai.h00-159700701.html

31. Dosanjh M, Aggarwal A, Pistenmaa D, et al. Developing Innovative, Robust and Affordable Medical Linear Accelerators for Challenging Environments. Clin Oncol. 2019;31(6):352-355. doi:10.1016/j.clon.2019.02.002