ST 4: DPG meets DGMP: Dosimetry in Nuclear Medicine

Time: Wednesday 16:15–17:45 Location: KH 01.013

Invited Talk ST 4.1 Wed 16:15 KH 01.013

Introduction to modern nuclear medicine: almost one century of interdisciplinary innovations — •Stephan Nekolla — TUM Klinikum, München, Germany

Nuclear medicine began in the 1940s with the clinical use of radioisotopes for diagnosis and therapy, evolving through gamma cameras and SPECT to PET. Early progress depended on advances in radiochemistry, detector physics, and instrumentation, which translated laboratory approaches into clinical applications. Nuclear medicine is inherently interdisciplinary: physicists are involved in tasks ranging from design detectors to reconstruction algorithms; radiochemists synthesize tracers; biologists identify molecular targets; and clinicians apply findings to patients. Current advances include digital PET and SPECT with improved detector materials, and integrated theranostic approaches that combine imaging with targeted therapy. Especially the latter resulted in an unprecedented interest and investments of the pharmaceutical industry. Where is this going to ? The emphasis is most likely a precision nuclear medicine with personalized radiopharmaceuticals, AI-enhanced image reconstruction and interpretation, and harmonized hybrid modalities that integrate molecular imaging with other data. Nuclear medicine's trajectory is defined by the open dialogue between interdisciplinary partners: in this particular context, physics supplies tools, models, and quantification; medicine supplies biological context and clinical questions. Sustained progress will require an open mindset, collaborative research infrastructures , cross-disciplinary training, and predictable regulatory pathways.

Invited Talk ST 4.2 Wed 16:45 KH 01.013

Personendosimetrie in der Nuklearmedizin — •Felix Bärenfänger — Universität Witten/Herdecke, Alfred-Herrhausen-Str. 50, 58453 Witten

Im Vergleich zu anderen *strahlenden* Disziplinen ist das Personal in der Nuklearmedizin häufiger messbaren Strahlenexpositionen ausgesetzt. Ursache hierfür sind der routinemäßige Umgang mit offenen radioaktiven Stoffen, nicht ortsfeste Strahlenquellen in Form der Patienten sowie komplexe, zeitlich und räumlich variable Strahlenfelder unterschiedlicher Nuklide. Diese Besonderheiten stellen sowohl die amtliche Personendosimetrie als auch den praktischen Strahlenschutz vor Herausforderungen. Neben der externen Exposition müssen häufig auch Kontaminationen und mögliche Inkorporationen als relevante Expositionspfade berücksichtigt werden. Die Auswertung des SSR-Registers für das Jahr 2024 zeigt, dass Grenzwertüberschreitungen in der Nuklearmedizin im Rahmen der amtlichen Personendosimetrie selten auftreten. Dennoch liefert die systematische Analyse der Personendosis bei der Anwendung von Dosisrichtwerten wertvolle Hinweise auf strukturelle, organisatorische oder arbeitsplatzbezogene Optimierungspotenziale. Personendosimetrie wird damit nicht nur zum Instrument der Grenzwertüberwachung, sondern zu einem aktiven Werkzeug der Qualitätssicherung im Strahlenschutz. Der Vortrag gibt einen Überblick über Möglichkeiten, Herausforderungen und Limitationen der Personendosimetrie in der Nuklearmedizin. Darauf aufbauend werden sinnvolle ergänzende Dosimetriekonzepte sowie praxisnahe Maßnahmen zur Reduktion der Personendosis diskutiert.

Invited Talk ST 4.3 Wed 17:15 KH 01.013

Dosimetry in Targeted Radionuclide Therapy: Challenges, Concepts, and Perspectives — •Johannes Tran-Gia — Universitätsklinikum Würzburg

Targeted radionuclide therapy (TRT) has emerged as a rapidly expanding modality in nuclear medicine, driven by highly effective β- and α-emitting radiopharmaceuticals. Unlike external beam radiation therapy (EBRT), where radiation dose delivery can be planned and verified with high spatial and temporal precision, TRT involves internally distributed, time-dependent radiation exposure from radiopharmaceuticals whose biodistribution and kinetics vary substantially between patients. Consequently, dosimetry in TRT poses distinct physical and methodological challenges, including limited imaging sensitivity and spatial resolution, complex decay schemes, and the need for quantitative SPECT or PET imaging over multiple time points.

This talk introduces the principles of dosimetry in TRT and highlights key differences compared to EBRT from a physics perspective. Current clinical practice, which largely relies on fixed administered activities, is discussed in the context of historical and technical constraints. At the same time, growing evidence for absorbed dose*effect relationships for tumor response and normal-tissue toxicity motivates a shift toward dosimetry-guided treatment planning and verification. Recent advances in quantitative imaging, standardization, and computational methods offer promising pathways toward routine patient-specific dosimetry. The talk concludes with an outlook on how these developments may enable individualized and optimized TRT.