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Beyond Imaging

Nuclear Medicine's Next Decade

"The pace of innovation is so rapid that impactful developments may still be unforeseen today"
- Professor Nadia Withofs, MD, PhD, 2024-2025 President of the Belgian Association of Nuclear Medicine (BELNUC)

"The number of PET scans performed in France - now exceeding one million annually"
- Professor Frédéric Courbon, President of the French Society of Nuclear Medicine (SFMN)

"The use of theranostic radiopharmaceuticals will replace chemotherapy for some indications"
- Professor Dr. Andor Glaudemans, President of Dutch Society of Nuclear Medicine (NVNG)

"Our field could emerge as both a therapeutic and diagnostic powerhouse"
- Professor Sabina Dizdarevic MD MSc PhD FRCP, President of the British Nuclear Medicine Society (BNMS)

At the end of the nineteenth century, Henri Becquerel's discovery of an invisible, penetrating energy transformed a curiosity of physics into a new way of reading the living body. A generation later, George de Hevesy turned that insight into method, redefining radioactive atoms as tracers and making the body visible through function rather than form. In 1941, that journey entered clinical practice with the first therapeutic use of radioactive iodine in thyroid disease, led by Saul Hertz, shifting radioactivity from observation to intervention and **establishing the foundations of nuclear medicine**.

From the emergence of radioligand therapies (RLT / TRT[1] - a targeted treatment that delivers radioactive isotopes directly to cancer cells via specific ligands, enabling precise tumor destruction while sparing surrounding healthy tissue) to the continuous evolution of drugs and devices, we asked renowned experts from the field: **What will nuclear medicine look like ten years from now?**

A series of interview-based contributions gave insights on both recent progress and future outlook. Building on experiences from the past five years, **these interviews aim to project the role of nuclear medicine in 2035**, taking into account European market dynamics, emerging technologies, and clinical demand.

The perspectives of the Presidents of leading European nuclear medicine societies provide a strategic and experience-driven view of these developments, offering a consolidated reflection on key breakthroughs, areas of highest potential, and influential publications shaping the field today.

Key points

- Nuclear medicine has entered **a phase of rapid maturation**, driven by the convergence of advanced imaging, radioligand therapies, and growing clinical evidence.
- **Theranostics has moved from a niche application toward broader clinical adoption**, with therapies progressively entering earlier stages of disease pathways, particularly in oncology.
- **Major advances in imaging technologies**, including PET and SPECT scanners, and AI-enabled software, are reshaping diagnostic capability and clinical workflows.
- Oncology remains the primary engine of growth, but **nuclear medicine is also expanding its role in non-cancer indications**, notably in neurodegenerative, infectious and cardiovascular diseases.
- **Artificial intelligence is becoming an integral component** of nuclear medicine, supporting image analysis, workflow efficiency, and clinical decision-making.
- The future of nuclear medicine hinges on **balancing the high cost of advanced technologies** with the **urgent need to expand and train a specialized workforce** to deliver them at scale.
- Looking to 2035, the central challenge is not innovation alone, but the **consolidation, scaling, and integration of nuclear medicine** within sustainable healthcare systems.

A Discipline in Fast Forward

Asked to reflect on the most important developments of the past five years, **all four society presidents point first to a decisive shift toward therapy**, enabled by parallel advances in imaging technology.

For **Professor Frédéric Courbon**, **President of the French Society of Nuclear Medicine**, the transformation has been driven above all by technology. As an example, he is pointing to "*the arrival of PET cameras with extended fields of view and scintillation cameras equipped with CZT detectors.*" On the therapeutic side, one trend stands out clearly: "*the most striking advancement is the development of radioligand therapy.*"

That assessment is echoed across Europe. **Professor Sabina Dizdarevic**, **President of the British Nuclear Medicine Society**, describes how theranostics has **reshaped clinical practice**: "*Radionuclide theranostics has now moved from the niche to the mainstream.*" She highlights the

"The most significant developments in nuclear medicine, from my perspective, are technological"

- Professor Frédéric Courbon, President of the French Society of Nuclear Medicine (SFMN)

approval and adoption of Lutetium-177–labelled therapies for metastatic castration-resistant prostate cancer (mCRPC) as "*a landmark moment, transforming patient pathways in many countries.*" Importantly, she notes that the field is already moving further, with trials exploring earlier intervention and combination strategies that could "*transform long-term outcomes by introducing targeted molecular radionuclide treatments much earlier in the disease course.*"

Several respondents underline how quickly **these therapies have moved from research into routine care**. **Professor Nadia Withofs, President of the Belgian Association of Nuclear Medicine and chair of the EANM HTA Project Group**, admits to being struck by the pace of change: "*What surprised many in the field, me included, was the speed with which PSMA-based TRT moved from research to routine clinical practice.*" She adds a personal perspective, recalling that when she began her residency in 2005, "*I could not have foreseen the rapid evolution and impact of RLT.*" Today, she notes, "*numerous new RLT candidates are under development,*"[2] with expanding indications and a growing number of clinical trials reflecting "*strong confidence in RLT's therapeutic potential.*"

This therapeutic acceleration has unfolded alongside major advances in imaging hardware. **Professor Andor Glaudemans, President of the Dutch Society of Nuclear Medicine**, highlights the introduction of long axial field-of-view (LAFOV) PET/CT systems as a turning point. While the concept itself was not unexpected, he emphasises that "*the benefits of LAFOV scanners did surprise me.*" In practice, he explains, "*new patient groups became available, such as intensive care patients or children,*" with scan times reduced to "*2–3 minutes,*" **often eliminating the need for sedation**.

Beyond PET, Professor Withofs draws attention to developments in SPECT imaging. "*The growing clinical adoption of high-resolution 360° CZT cameras has significantly increased the use of SPECT/CT,*" she notes, citing applications ranging from low-dose ventilation-perfusion scans to cardiac imaging and post-therapy dosimetry. She adds that this has contributed to "*the resurgence of quantitative SPECT/CT,*" further strengthened by "*AI-enhanced software tools that improve diagnostic accuracy and workflow efficiency.*"

"The pace of progress has been striking and a surprise to me. While I anticipated continued and growing industry involvement, the sheer scale of investment has exceeded expectations."

- Professor Sabina Dizdarevic MD MSc PhD FRCP, President of the British Nuclear Medicine Society (BNMS)

Artificial intelligence is also reshaping the field more broadly. As Professor Dizdarevic observes, "*augmented intelligence has long been part of nuclear medicine,*" but AI is now "*increasingly integrated into workflows, from image reconstruction to prognostic modelling,*" already changing how clinicians "*interpret and quantify molecular imaging data.*"

Finally, several respondents point to **the scale of growth as a surprise in itself**. In France, Professor Courbon highlights that "*the number of PET scans performed now exceeds one million annually,*"[3] alongside the recognition of

therapeutic nuclear medicine through high-level reimbursement decisions. Professor Dizdarevic places this in a global context, noting that investment in radiopharmaceuticals has surged well beyond expectations[4], with a **rapidly expanding pipeline of both diagnostic and therapeutic agents**.

Taken together, these voices describe a field that has moved swiftly **from promise to practice**. Imaging systems are faster and more sensitive; therapies are entering earlier stages of disease, and **nuclear medicine is increasingly embedded in multidisciplinary care**. A common thread emerges from these reflections: it is not the direction of travel that is surprising, but the speed at which nuclear medicine has reached this new phase of maturity.

Projecting the Next Decade

Looking ahead to 2035. When asked to project the future role of nuclear medicine in the next decade, the Presidents converge on a clear vision: **a field that is no longer peripheral, but deeply embedded in personalised medicine**, oncology pathways, and data-driven clinical decision-making. While they acknowledge uncertainties, their forecasts consistently point to expansion in scale, scope, and clinical responsibility.

Professor Frédéric Courbon anticipates **steady growth grounded in access and evidence**. "*Looking ahead to 2035, I foresee nuclear medicine playing an increasingly important role in clinical care,*" he says, attributing this evolution to "*improved access to PET technologies and radioligand therapy.*" He is careful to underline the conditions attached to this growth, noting that it will depend on "*economic sustainability and the confirmation of clinical benefits in real-world settings.*" Based on national data, he adds, "*one can reasonably hypothesize a strong potential not only for PET imaging but also for radioligand therapy.*"

> ***"The use of theranostic radiopharmaceuticals will be one of the standard care treatment options"***
>
> - Professor Dr. Andor Glaudemans,
> President of Dutch Society of Nuclear Medicine (NVNG)

At European level, this emphasis on real-world evidence is **increasingly reflected in policy**. The EU Health Technology Assessment Regulation[5] is establishing a coordinated framework for the clinical evaluation of new health technologies across Member States, with the potential to shape how innovative nuclear medicine diagnostics and therapies are assessed, compared, and ultimately adopted within national health systems.

For Professor Andor Glaudemans, **the shift is both technological and conceptual**. By 2035, he expects nuclear medicine to respond directly to "*increasing demand for personalized healthcare,*" with theranostic radiopharmaceuticals becoming "*with theranostic radiopharmaceuticals becoming one of the standard care treatment options*" and, for some indications, "*replacing chemotherapy.*" He sees nuclear medicine imaging increasingly combined "*with molecular and genetic profiling,*" while emphasizing the importance of equitable access: "*hopefully the access to nuclear medicine*

services will be improved, with availability to our techniques and treatment options available for each patient."

Artificial intelligence is a recurring pillar in these projections. Professor Glaudemans foresees artificial intelligence and machine learning playing "*a crucial role in imaging analysis, tumour measurements, automatic segmentation of involved organs,*" as well as in "*predicting treatment options.*" This view is shared by Professor Nadia Withofs, who expects **AI to become firmly embedded in daily practice**. "*Artificial intelligence will continue advancing image processing and assist with workflow automation,*" she explains, adding that while "*full autonomy may not be reached,*" AI will "*improve diagnostic consistency and efficiency, especially in high-throughput settings.*"

under development in Europe that could "*change this landscape*" and enable broader clinical adoption.

Professor Sabina Dizdarevic frames the outlook in more systemic terms. "*By 2035, our field could emerge as both a therapeutic and diagnostic powerhouse, delivering personalised benefits at scale,*" she says, stressing that this **outcome is contingent on investment**. She highlights the need to act now on "*radiopharmaceutical production, supply chains, training and expanding the workforce, regulatory clarity, and integrated care pathways.*" With those foundations in place, she believes nuclear medicine will not only respond to demand but "*lead the way in personalised healthcare.*"

"By 2035, nuclear medicine will likely be even more integrated into personalized oncology care. However, the pace of innovation is so rapid that impactful developments may still be unforeseen today."

- Professor Nadia Withofs, MD, PhD, 2024-2025 President of the Belgian Association of Nuclear Medicine (BELNUC)

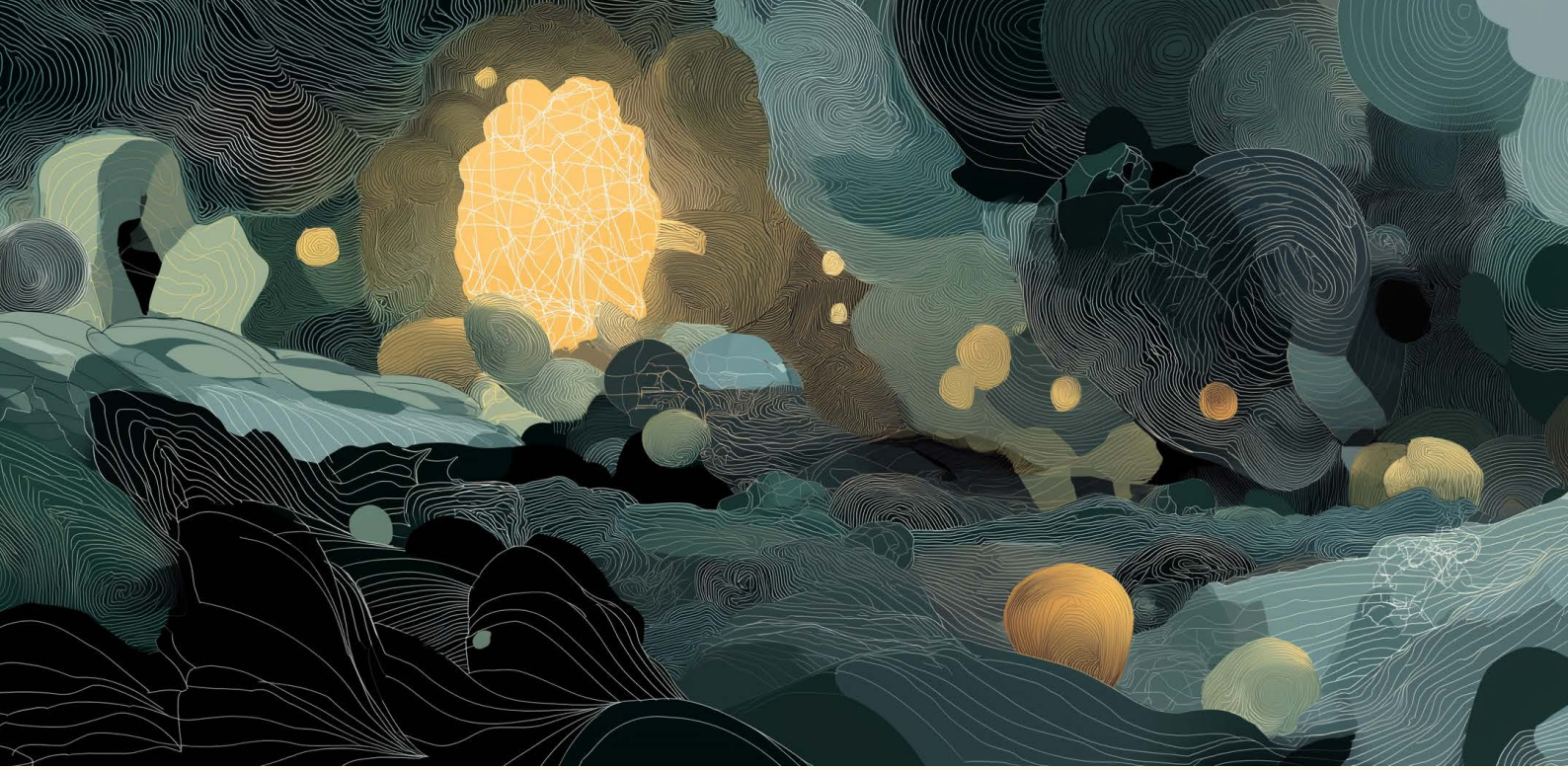
Professor Withofs also places **radioligand therapy at the heart of nuclear medicine's future**. "*Beyond neuroendocrine tumours and prostate cancer, TRT may become standard for a wider range of tumours,*" she says, pointing to the growing role of Auger and alpha emitters, such as Terbium-161 and Actinium-225, alongside beta emitters. She envisions a structural evolution of care delivery, with "*integrated TRT centres embedded in oncology care, where nuclear medicine, medical oncology and radiation oncologists collaborate closely.*"

On the imaging side, she anticipates **broader adoption of long axial field-of-view PET/CT systems**, while remaining realistic about economic constraints. "*Their cost will likely restrict widespread use to large research institutions and academic hospitals,*" she notes, before highlighting emerging alternatives, including lower-cost total-body PET concepts

Across these perspectives, a shared message emerges. By 2035, **nuclear medicine is widely expected to be more therapeutic, more data-driven, and more tightly integrated into multidisciplinary care**. While uncertainties remain, particularly around cost, access, and infrastructure, the convergence of theranostics, advanced imaging, and artificial intelligence points toward a future in which nuclear medicine becomes a central pillar of precision medicine in Europe and beyond.

A Clinical Momentum

When asked where nuclear medicine's greatest future impact lies, the responses converge quickly and emphatically on **oncology**, while also opening toward a broader clinical horizon that includes neurodegenerative disease and earlier, more decisive drug development.

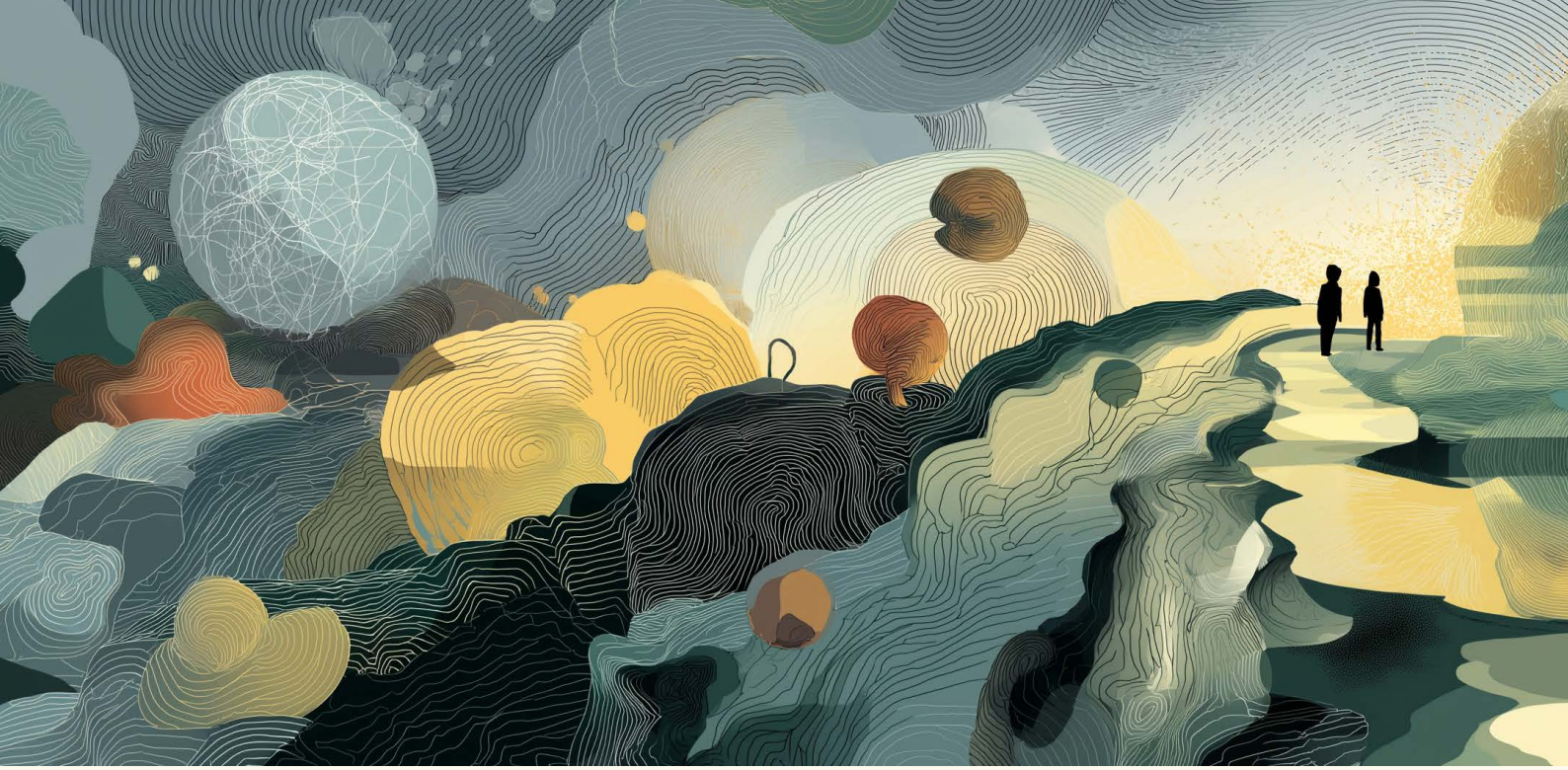


For Professor Andor Glaudemans, the answer is unambiguous. "*Theranostics, theranostics, theranostics,*" he says, pointing to its expanding role across "*many oncological indications.*" Beyond patient care, he also highlights **the strategic value of nuclear medicine for industry**, noting its growing role in "*industry-driven research for an early go/no go of new expensive drugs.*" Looking beyond oncology, he adds that there will be major developments not only in neurodegenerative diseases such as Alzheimer's and Parkinson's, but also in infectious and cardiovascular conditions, as molecular imaging becomes increasingly central to early and differential diagnosis.

That oncology will remain as the primary growth engine is strongly supported by clinical data. Professor Nadia Withofs describes **radioligand therapy as the clearest area of momentum**[6]. "*The greatest potential for nuclear medicine clearly lies in oncology,*" she states, "*particularly with the rapid expansion of TRT.*" She points out that "*the number of active clinical trials in TRT has more than doubled over the past five years,*" with **targets now extending well beyond neuroendocrine tumours and prostate cancer** to include "*breast, colorectal, pancreatic cancers, and glioblastoma.*" This expansion, she adds, is mirrored by market signals, with the global RLT sector projected to grow substantially toward 2030, driven by "*expanding indications, positive trial outcomes, and increased investment in radiotheranostics.*"

Professor Sabina Dizdarevic places this growth within a broader conceptual shift. In oncology, she explains, nuclear medicine offers "*a unique lens into tumour heterogeneity,*" enabling **more precise patient selection and treatment sequencing**. She sees the future in "*multitracer multimodality radionuclide theranostics,*" where treatment decisions are guided by imaging and genetic profiling, and therapies are "*combined and sequenced,*" whether beta emitters, alpha emitters, or mixed approaches, alongside hormone therapy, chemotherapy, immunotherapy, radiotherapy, and radiosensitisers. "*This is not just a technical or scientific evolution,*" she emphasises. "*It is a paradigm shift*", which from her perspective is already supported by robust clinical evidence, e.g. from the PEACE-3 or PSMAddition trial.

While oncology dominates, several respondents stress that **nuclear medicine's potential extends well beyond cancer**. Professor Dizdarevic highlights neurodegenerative disease as a key area of growth, noting that molecular imaging enables "*more specific differential diagnoses,*" supports patient selection for emerging therapies, and allows "*dynamic monitoring of treatment response and disease progression.*" She points in particular



to dopaminergic and metabolic imaging in neurodegenerative parkinsonism, where nuclear medicine already supports differential diagnosis and surgical planning.

Technology again acts as a cross-cutting enabler. Total-body PET/CT, Professor Dizdarevic argues, has the potential to "*transform clinical protocols*" across adult and paediatric medicine alike, **redefining how patients are screened, staged, monitored, and followed** across oncology, neurology, cardiology, immunology, infection, and inflammation.

Are we entering the golden age for nuclear medicine?

Taken together, these perspectives suggest that nuclear medicine is no longer defined by a single breakthrough or technology, but by its ***growing capacity to link diagnosis, therapy, and evidence into increasingly coherent clinical pathways***. Over the past five years, the field has demonstrated how rapidly concepts can progress from research into structured clinical use; the coming decade will test how effectively this progress can be consolidated, expanded, and embedded more broadly across healthcare systems. Whether in oncology, neurology, or emerging indications, **the challenge ahead is less about proving relevance than about ensuring access, integration, and durability**. In that sense, **the future of nuclear medicine will be shaped as much by organisation, investment, and collaboration as by innovation itself**.

Recent advances have pushed the field from promise to practice, placing it at the heart of modern clinical care. **Mart-Jan Blauwhoff, President of Nuclear Medicine Europe** says : "*Nuclear medicine is entering a transformative era, with targeted radiopharmaceutical therapies and theranostics opening unprecedented possibilities for patients through more precise and personalised care.*" The challenge now is to sustain that momentum, by matching scientific innovation with long-term investment in the workforce and the infrastructure needed to deliver it at scale. As Professor Dizdarevic puts it, "*There has never been a more exciting time to work in nuclear medicine.*"

Communications
Nuclear Medicine Europe working group

Footnotes

[1] Ref.: Consensus Nomenclature for Radionuclide Therapy:
Initial Recommendations from Nuclear Medicine Global Initiative. J Nucl Med. 2025 May 1;66(5):757-763. doi: 10.2967/jnumed.124.269215.

[2] https://www.nature.com/articles/d41573-025-00096-w

[3] https://www.cnp-mn.fr/wp-content/uploads/2025/03/20250323_ENQUETE_3.0_SITE_SFMN-.pdf

[4] https://assets.kpmg.com/content/dam/kpmgsites/uk/pdf/2024/12/leveraging-opportunities-in-radiopharm.pdf

[5] https://health.ec.europa.eu/health-technology-assessment/implementation-regulation-health-technology-assessment_en?

[6] https://www.mdpi.com/2072-6694/17/21/3412

This publication is an initiative of the Nuclear Medicine Europe Communications Working Group.

A selection of the Working Group's projects and publications is presented below :

The Interactive Hygieia
https://hygieia.nuclearmedicineeurope.eu/

Communicating nuclear medicine to a wider audience
https://nuclearmedicineeurope.eu/communicating-nuclear-medicine-to-a-wider-audience/

Why do medical students decide not to get trained in the most appealing speciality, nuclear medicine?
https://nuclearmedicineeurope.eu/why-do-medical-students-decide-not-to-get-trained-in-the-most-appealing-specialty-nuclear-medicine/

Additional resources

- Belgian Association of Nuclear Medicine - BELNUC - https://www.belnuc.be
- British Nuclear Medicine Society BNMS - http://www.bnms.org.uk
- Dutch Society of Nuclear Medicine - NVNG - http://www.nvng.nl
- French Society of Nuclear Medicine - SFMN - https://www.cnp-mn.fr/sfmn-accueil

SFMN – « Étude Capacité Théranostique 2023-2024 »
https://www.cnp-mn.fr/wp-content/uploads/2024/06/Etude-Capacite-Theranostique-2023-DEF-finale-v2-240426.pdf

SFMN – « 16 Propositions concrètes pour décisions
- Pour un accès équitable des patients à la médecine nucléaire théranostique »
https://sofra-radiopharmacie.org/IMG/pdf/collectif_mn_-_manifeste_politique_-_vdef.pdf

NIH - Radiopharmaceuticals: Radiation Therapy Enters the Molecular Age
https://www.cancer.gov/news-events/cancer-currents-blog/2020/radiopharmaceuticals-cancer-radiation-therapy

"An EANM position paper on the application of artificial intelligence in nuclear medicine"
https://link.springer.com/article/10.1007/s00259-022-05947-x?