Consensus Nomenclature for Radionuclide Therapy: Initial Recommendations from Nuclear Medicine Global Initiative

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Since its inception in 2012, the Nuclear Medicine Global Initiative (NMGI) of the Society of Nuclear Medicine and Molecular Imaging has played an important role in addressing significant challenges in the field of nuclear medicine and molecular imaging. The first 3 projects were dedicated to standardizing pediatric nuclear medicine practices, addressing the global challenges of radionuclide access and availability, and assessing the educational and training initiatives on theranostics across the globe. These efforts aimed to advance human health, foster worldwide educational collaboration, and standardize procedural guidelines to enhance quality and safety in nuclear medicine practice. In its latest project, NMGI aimed to develop a unified nomenclature for systemic radionuclide therapy in nuclear medicine, addressing the diverse terminology currently used. An online survey was distributed to NMGI member organizations, drawing participation from various geographical locations and disciplines. The survey anonymously collected responses from physicians, physicists, scientists, radiopharmacists, radiopharmaceutical scientists, dosimetrists, technologists, and nurse managers, totaling 240 responses from 30 countries. Findings revealed a prevailing use of the term targeted radionuclide therapy for radionuclide therapy,

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with 52% of respondents expressing a preference for this term. In contrast, approximately 37% favored "radiopharmaceutical therapy," whereas 11% favored "molecular radionuclide therapy." Other key terms under the umbrella of targeted radionuclide therapy were also discussed to achieve a consensus on terminology. NMGI efforts to standardize terminology in this dynamic and fluid field should improve communication within the field, better reflect the technology used, enable comparison of results, and ultimately lead to improved patient outcomes.

Key Words: NMGI; radionuclide therapy; TRT; consensus nomenclature; terminology consensus

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Standardizing the therapeutic radionuclide nomenclature is desirable for increasing awareness of radionuclide use, driving policy changes, and promoting awareness of health care societies to new practices and innovations (*1*). For many decades, radioactive iodine therapy using ^{131}I has been the cornerstone of targeted therapy for differentiated thyroid cancer and thyrotoxicosis (*2*). This conceptual framework has anchored our current understanding of radionuclide therapy. It has driven the development and adoption of numerous additional approaches to provide similar targeted therapies for other diseases and conditions, addressing the challenges posed by cancer and the rise of noncommunicable diseases (*3*).

Despite its legacy as the preferred targeted agent for treating thyrotoxicosis and differentiated thyroid cancer, there is no current consensus on a uniform, definitive nomenclature that can be adopted to ensure consistency in communication about the use of therapeutic radiopharmaceuticals. Such nomenclature would be most effective if it could define the underlying general perspective on the mechanism of action, distinguishing this innovative therapeutic approach from traditional methods. The same principle applies to other radionuclide therapies, whether labeled with iodine, such as metaiodobenzylguanidine (MIBG), or with other radionuclides, such as ^{177}Lu-based therapies or ^{90}Y radioembolization. As our understanding of radionuclide therapies grows with the increased availability and development of many promising novel agents in both clinical and preclinical settings, we now encounter many agents with overlapping primary targeted approaches (*4*,*5*). These agents can fit into the same conceptual framework by targeting specific receptors or ligands or by undergoing transporter uptake, thus falling under a major category for their mutual targeted approach.

Developing a consensus on nomenclature for radionuclide-based therapies for these agents is crucial to mitigate issues and concerns of heterogeneity and strengthen the general understanding of their concept. These concerns have led to a multistakeholder effort under the auspices of the Society of Nuclear Medicine and Molecular Imaging and Nuclear Medicine Global Initiative (NMGI), which has engaged academics, specialists, and professionals from around the world, including nuclear medicine physicians, radiation oncologists, nuclear medicine technologists, radiologists, physicists, dosimetrists, radiochemists, radiopharmacists, scientists, and colleagues from industry, regulatory agencies, and patient advocacy organizations. This collaborative effort aims to resolve these concerns and provides an initial attempt to develop a consensus on nomenclature for radionuclide-based therapies. The current NMGI project will focus on highly relevant and clinical targeted radionuclide therapy (TRT) agents to achieve its goals and establish a basis for a comprehensive consensus terminology for all TRT agents in the coming years.

MATERIALS AND METHODS

Exploration of Previous Efforts

Before initiating this project, the authors systematically reviewed the literature to assess the necessity and novelty of such an undertaking. Keywords related to the topic of interest were listed on PubMed, Scopus, and Google Scholar. A search was conducted using the keywords "Consensus nomenclature" AND (radiopharmaceutical OR radionuclide) AND (therapy OR therapeutic OR agents) following a Boolean strategy (*6*). Only 1 relevant previous study was identified. Unlike the current initiative, this study aimed to provide a consensus on nomenclature for radionuclide-based therapies from a radiochemical perspective rather than from a therapeutic one (*1*).

Review of Literature

PubMed and Scopus databases were systematically screened to identify relevant review articles discussing the current landscape of radionuclide therapies. The systematic literature screening was initiated using relevant keywords. Filters for date and language were applied to include only English literature reviews from the past 5 y. After duplicate entries were eliminated, only research articles containing essential terminology, definitions, or acronyms pertinent to the subject matter were included. The primary objective of reviewing the most recent publications was only to extract as many pertinent keywords, definitions, and radionuclide names as possible related to the primary topics of interest. Figure 1 illustrates a summary flowchart detailing the methodology used in the screening process. [**Fig. 1**]

Questionnaire Formulation

A set of keywords was extracted from the reviewed articles. These keywords were recorded and organized using Microsoft Excel version 2021 by 2 authors. Terms that were consistently referenced with a frequency of over 90% using the same terminology were presented in a closed-ended question format to assess the level of agreement or disagreement. Conversely, terminologies that were not uniformly stated but referred to the same radionuclide therapy or agent were included as multiple-choice questions to facilitate consensus on relevant terms. In cases for which no specific key term was identified for certain agents, coauthors were asked to generate at least 2 relevant terms through group discussion. All coauthors involved in the study contributed to the formulation and organization of the questionnaires. The questionnaires were then distributed via online surveys using Google Forms, without collecting any personal information.

Online Survey Participation

Coauthors asked 415 individuals from various disciplines and geographical locations to complete the online survey questionnaire. The selection of potential participants was directed and managed by the Society of Nuclear Medicine and Molecular Imaging office. This process was conducted anonymously and remained unknown to the NMGI experts and authors of this project. Only those who responded and marked their consent were considered eligible for participation. To ensure global representation and minimize the risk of bias, the invited participants represented a diverse range of disciplines, demographics, and specialties (Fig. 1B).

Statistical Analysis

Data extracted from the online survey were organized using Microsoft Excel version 2021. These data were then imported into SPSS software version 27 (IBM) to calculate response rate percentages and summarize the results. Adapted from Delphi consensus techniques (*7*), a 51% response rate threshold was used to differentiate between

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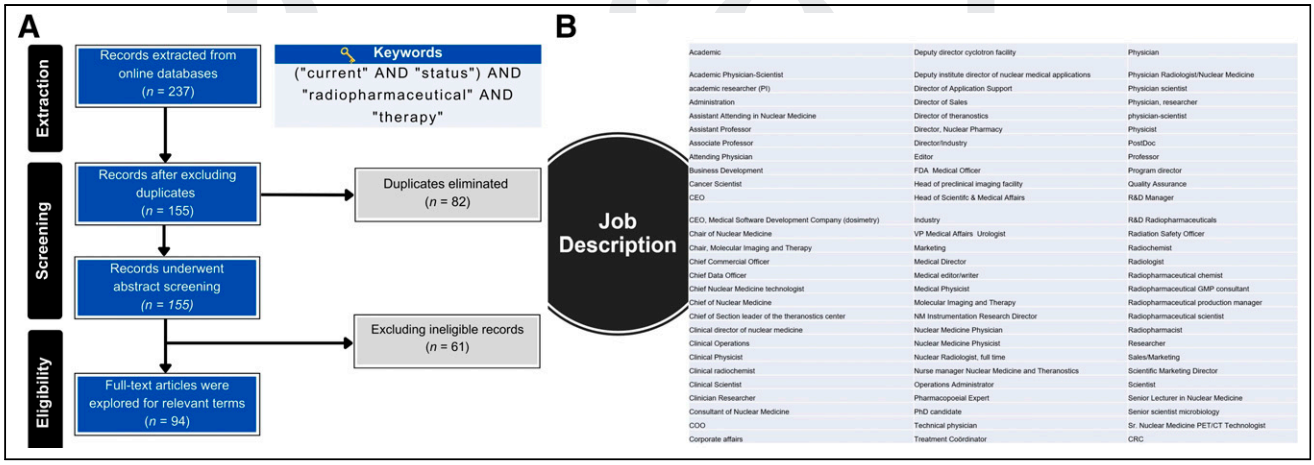

[AQ4] **FIGURE 1.** (A) Flowchart showing adopted methodology for studies' selection. (B) Graphical representation summarizing invited personnel on online survey platform.

consensus (more than 51%) and no consensus (less than 51%) evaluation. Terms that reached consensus were selected as the primary key terms in their respective fields. Terms with no consensus underwent an additional round of internal survey, with the exclusive participation of all coauthors, to reach a final consensus.

RESULTS

A total of 15 key terms were identified by analyzing 94 research papers, each detailing radionuclide therapy's specific modes of action. Consistent terminology was found for therapeutic agents referring to peptide receptor radionuclide therapy (PRRT), peptide-based radioligand therapy (RLT), and [^{131}I]MIBG. However, other therapy modes showed varied nomenclature, necessitating the use of multiple-choice questionnaires to address this heterogeneity (Table 1). Of the 415 invited individuals, 266 responded to the initial invitation and received the online form after providing consent. Of these, 244 participants from 30 countries completed the online survey. Most participants were from the United States, with a predominance of experts specialized in nuclear medicine (Fig. 2). [Table 1] [Fig. 2]

TABLE 1
Table Summary for Retrieved Key Terms

Retrieved key term	Abbreviation	Definition of key term
Targeted radionuclide therapy	TRT	A therapy that uses radionuclides to target and treat cancer cells at the cellular or molecular level
Systemic radiopharmaceutical therapy	SRPT	
Molecular radionuclide therapy	MRT	
Endoradiotherapy	ERT	
Radioactive iodine therapy	RAIT	A treatment using radioactive iodine to destroy thyroid cells, commonly used for hyperthyroidism and thyroid cancer
Radioiodine therapy	RIT	
Targeted α-therapy	TAT	A therapy that uses α-emitting radionuclides to target and destroy cancer cells
Targeted α-particle therapy	TAPT	
Peptide receptor radionuclide therapy	PRRT	A treatment that combines a peptide with a radionuclide to target and treat neuroendocrine tumors
Peptide-based radioligand therapy	PRLT	A therapy using peptides conjugated with radionuclides to target specific receptors on cancer cells
[^{131}I]metaiodobenzylguanidine	[^{131}I]MIBG	A radionuclide used for imaging and treating neuroblastoma and other neuroendocrine tumors
Targeted palliative radionuclide therapy	TPRT	A therapy aimed at relieving symptoms and improving quality of life in patients with metastatic cancer
Targeted radionuclide therapy of osteoblastic metastases	TRT-OM	
Targeted therapy of metastatic bone pain	TTMBP	
Bone-targeted radionuclide therapy	BTRT	

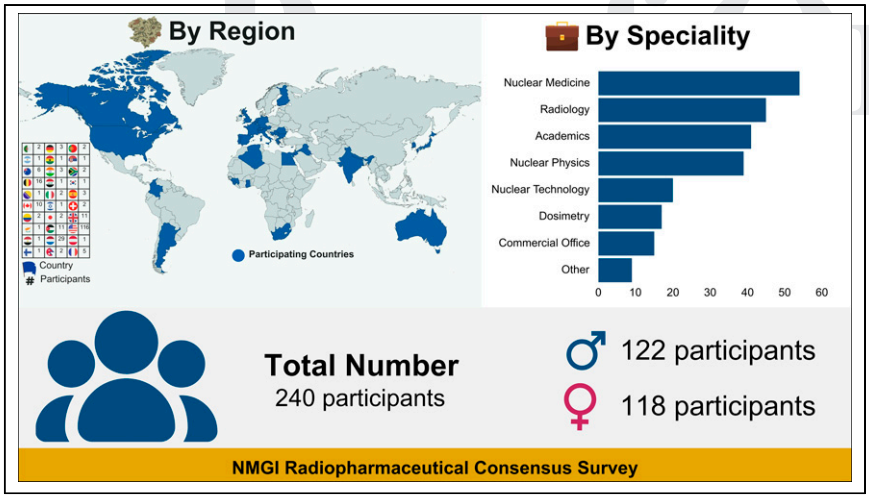

FIGURE 2. Graphical presentation that illustrates numbers, geographic areas, and specialties of participating individuals.

Radionuclide Therapy: Root Key Term

Radionuclide therapy is a specialized medical approach that uses radioactive substances, or radionuclides, to specifically target and eliminate cancerous, inflammatory, or abnormal cells within the body (*8*). This highly selective treatment method delivers radiation to the affected areas while minimizing exposure to healthy tissues (*9*). Radionuclides typically comprise a radioactive atom or isotope. These can be paired with molecules designed to target specific cells or biologic processes, enabling precise and selective action.

So far, a specific key term that defines this innovative therapeutic approach has not been uniformly established. The authors identified the top 3 most frequently used key terms in the literature. During the first roundtable discussion, the coauthors formulated a multiple-choice questionnaire within the online survey for participants and experts to select the single most appropriate terminology that best represents these key terms. Participants were asked to choose among 3 terms: TRT, radiopharmaceutical therapy, and molecular radionuclide therapy. Among the participants, 52% of participants favored using TRT. In contrast, 37% favored radiopharmaceutical therapy, whereas 11% favored molecular radionuclide therapy. Consequently, a consensus was reached to use TRT as the term of choice from the first round (Fig. 3A; Supplemental Table 1; supplemental materials are available at http://jnm.snmjournals.org). [Fig. 3]

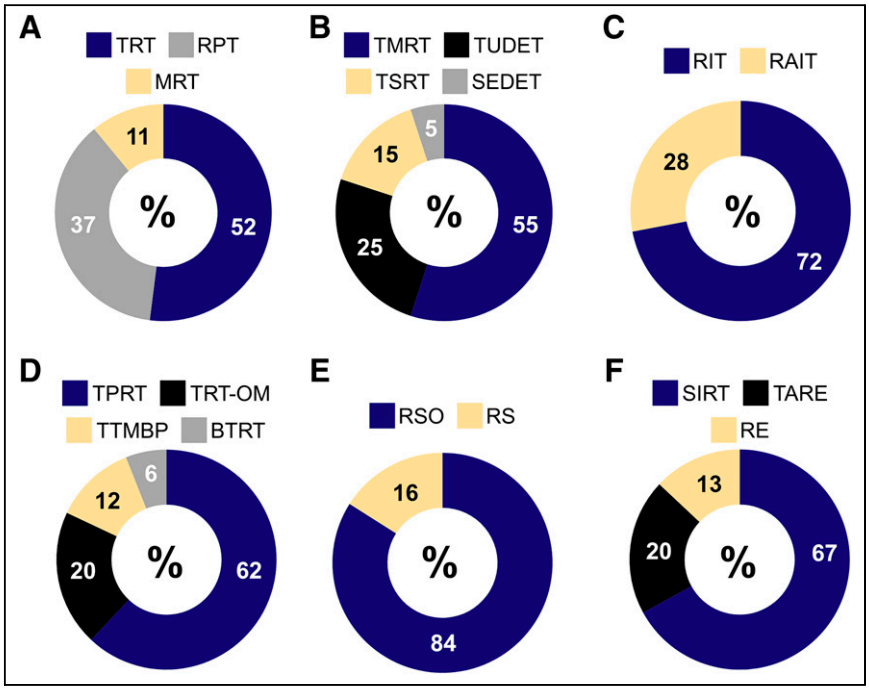

FIGURE 3. Graphical presentation that illustrates results from circulated questionnaire for terminology consensus in radionuclide therapy for root term (A), iodine-based (B), ^{131}I (C), bone pain (D), arthritis (E), and intratumoral agents and domains (F). BTRT = bone-targeted radionuclide therapy; MRT = molecular radionuclide therapy; RAIT = radioactive iodine therapy; RE = radioembolization; RIT = radioiodine therapy; RPT = radiopharmaceutical therapy; RS = radiation synovectomy; RSO = radiosynoviorthesis; SIRT = selective internal radiation therapy; SUDET = selective uptake-driven endoradiotherapy; TARE = transarterial radioembolization; TMRT = transporter-mediated radionuclide therapy; TPRT = targeted palliative radionuclide therapy; TRT-OM = targeted radionuclide therapy of osteoblastic metastases; TSRT = transporter-specific radionuclide therapy; TTMBP = targeted therapy of metastatic bone pain; TUDET = targeted uptake-directed endoradiotherapy.

Iodine-Based Radionuclide Therapy

The origins of radionuclide therapy can be traced back to the early 1940s, with Dr. Saul Hertz pioneering the use of radioactive iodine for treating hyperthyroidism, specifically Graves disease. The successful treatment of a patient at Massachusetts General Hospital in March 1941 marked a significant milestone in the development of nuclear medicine and the therapeutic application of radionuclides (*10*). Several decades later, in 1984, a new form of iodine-based TRT was introduced. That year saw the initial application of [^{131}I]MIBG for therapeutic purposes in patients with pheochromocytoma (*11*). Subsequently, in 1986, [^{131}I]MIBG therapy was used for the treatment of neuroblastoma (*11*). Interestingly, both ^{131}I and [^{131}I]MIBG therapies operate through a shared mechanism involving transporter-mediated uptake (*12*,*13*). The uptake of radioiodine in thyroid cancer cells is facilitated by the sodium-iodide symporter, which actively transports iodide ions into thyroid follicular and cancer cells, enabling the accumulation of radioactive iodine for targeted radiation therapy (*12*,*13*). Conversely, the uptake of [^{131}I]MIBG in neuroendocrine tumor cells is mediated by the norepinephrine transporter (*12*,*13*). Currently, there is no universally accepted term to describe the general mechanism of transporter-mediated uptake for both radioiodine and [^{131}I]MIBG therapies.

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The authors were requested to generate at least 3 specific key terms to denote the shared underlying mechanism and to present these as a multiple-choice questionnaire within the online survey for participants and experts to select the single most appropriate terminology that best represents these root key terms. Participants were asked to choose among 4 terminologies: transporter-mediated radionuclide therapy, targeted uptake-directed endoradiotherapy, selective uptake-driven endoradiotherapy, and transporter-specific radionuclide therapy. Most of the participants favored the use of transporter-mediated radionuclide therapy for this purpose, with about 55% of respondents expressing a preference for this term. In contrast, approximately 25% favored targeted uptake-directed endoradiotherapy, about 15% preferred transporter-specific radionuclide therapy, and only 5% favored selective uptake-driven endoradiotherapy. Therefore, it was decided that a consensus for using TMRT as the term of choice was reached in the first round (Figs. 3B and 3C). A more detailed nomenclature selection from the supplied questionnaire is presented in Supplemental Table 2.

Palliative Radionuclide Therapy for Bone Metastases

Within the same time frame as the discovery of radioiodine therapy, the first incorporation of TRT into palliative practice occurred in the 1940s with ^{32}P (*14*). These agents were specifically directed at metastatic bone lesions to suppress bone pain. Multiple radiopharmaceuticals, some still in use today, have then been developed for the same purpose. Currently, 4 specific key terms have been identified for this line of therapeutics: targeted palliative radionuclide therapy, targeted radionuclide therapy of osteoblastic metastases, targeted therapy of metastatic bone pain, and bone-targeted radionuclide therapy. Most authors preferred the term targeted palliative radionuclide therapy, with about 62% of participants favoring this choice over the others (Fig. 3D).

Radionuclide Therapy for Joint Inflammation

Arthritis is a prevalent chronic disease treated with both systemic and local drug therapies (*15*). Disease-modifying antirheumatic drugs for rheumatoid arthritis and nonsteroidal antiinflammatory drugs for polyarthritis are common therapeutic options, including biologics and systemic steroid administration (*16*). In cases of persistent synovitis, local steroid injections or surgical, chemical, or radiation synovectomy may be considered (*17*). The first treatment of arthritis using radioactive gold ^{198}Au was published in 1963 for persistent knee effusions. In the literature, the most common terms for this type of radionuclide therapy are radiation synovectomy and radiosynoviorthesis. These terms are often used interchangeably to emphasize the therapeutic restoration (orthesis) of the synovium using radiation. During the first round of the online survey, 84% of participants preferred the term radiosynoviorthesis over radiation synovectomy (Fig. 3E).

Intratumoral Radionuclide Therapy

Intratumoral radionuclide therapy represents the first collaborative effort to incorporate radionuclide therapy through an interventional radiology approach, aiming to direct the effects of internal radiation to the primary disease site. Radioembolization using ^{90}Y microspheres is a prime example of this approach, introduced back in the 1960s as an effective intraarterial therapy for unresectable primary and metastatic liver cancers (*18*). Currently, there is heterogeneity in referring to this specific therapeutic modality, with 3 major identified key terms: radioembolization, selective internal radiation therapy, and transarterial radioembolization. The first round of the survey failed to achieve consensus, with selective internal radiation therapy receiving the highest preference (44% of participants' choices). Therefore, a second round of the survey was initiated through a roundtable discussion among all authors, who decided to use the term selective internal radiation therapy to specifically denote this therapy line, providing a rationale to explain this preference (Fig. 3F).

PRRT

The last few years of the past century witnessed another significant advancement in the field of radionuclide therapy. This was marked by the first clinical trial of therapeutic [^{90}Y]DOTATOC in the late 1990s, providing the cornerstone and primary example for this therapy line (*19*). Less than a few decades later, the approval of [^{177}Lu]Lu-DOTATATE was granted by the U.S. Food and Drug Administration (*20*). To date, there is regular and uniform use of the term PRRT to refer to this general therapy line. Therefore, participants were asked to approve or disapprove this term as the primary term of choice, and the majority offered their acceptance to adopt the term PRRT as a term of reference. When referring to a specific peptide receptor, most of the participants preferred to use the abbreviated term for the receptor followed by PRRT, separated by a single space (Supplemental Table 3).

Radioligand Therapy

The early 2010s saw the introduction and increasing use of prostate-specific membrane antigen (PSMA)–targeted RLT for metastatic castration-resistant prostate cancer (*21*). This included the use of [^{177}Lu]-PSMA, which showed promising results in targeting prostate cancer cells with high specificity and minimal damage to surrounding healthy tissues. This rapid transition into clinical practice was especially notable after its approval by the U.S. Food and Drug Administration and European Medicines Agency in 2022, providing a prime example of this therapy concept (*22*). Currently, most of the literature addresses RLT as a specific and unique term to denote this therapy line. Therefore, participants were asked to approve or disapprove of this nomenclature, and the majority agreed to use the term RLT. When referring to a specific radioligand, most participants preferred to use the abbreviated term for the ligand followed by RLT, separated by a single space (Supplemental Table 4).

Key Considerations in Specific TRT Agent Nomenclature

On exploration of previously identified terminology consensus, the authors identified a previous consensus study marking the first effort to address heterogeneity in radionuclide nomenclature from a radiochemical perspective (*1*). This was circulated in the online survey, with most of the participants approving adherence to this nomenclature regarding radionuclide names. Another important consideration raised during the roundtable discussion of coauthors revealed an inclination toward addressing the chelator name intervening between the radionuclide name and the target of interest. The rationale behind including the chelator name is important, as it has a significant impact on the biodistribution of the entire radionuclide, and its inclusion is also crucial to provide homogeneity, as the current trend in radionuclide naming addresses the chelator when referring to [^{177}Lu]Lu-DOTA-TATE but not in [^{177}Lu]Lu-PSMA, which also has an intervening DOTA chelator (Supplemental Table 5).

DISCUSSION

Standardization of radionuclide nomenclature is crucial for its recognition and acceptance, research purposes, clinical use, and

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compliance with international guidelines. It ensures that all stakeholders, including researchers, clinicians, and regulatory bodies, understand and interpret the terms uniformly, reducing the risk of miscommunication and errors in the application and reporting of radionuclide therapies (*23*). Clear and standardized nomenclature is essential for accurately describing the chemical and biologic properties of radionuclides, which is essential for their effective use in clinical practice and research. It also enhances patient safety by preventing confusion and incorrect administration of therapies, especially in radiation therapy and targeted therapy. Accurate terminology ensures that therapeutic agents are correctly identified and used, achieving desired therapeutic outcomes. Consistent nomenclature is also necessary for regulatory submissions and approvals, facilitating accurate documentation and reporting in clinical trials and other regulatory processes. It also enables effective collaboration among researchers and institutions globally, ensuring accurate communication and understanding of research findings. Lastly, consistent terminology supports ongoing professional development and helps practitioners stay updated with the latest advancements and guidelines in the field (*24*).

NMGI members have worked on several projects to improve nuclear medicine practice and standardization (*25*–*27*). By establishing a standardized nomenclature, the current project of NMGI aims to enhance communication, reduce errors, and improve the overall quality of nuclear medicine practices globally. Consequently, the present project strives to fulfill its objectives while ensuring that it does not inadvertently disrupt the established nomenclature practices observed in various regions globally. To this end, our NMGI experts have prepared a comprehensive balancing act statement to elucidate their intentions further (Supplemental Table 6).

Despite significant observed heterogeneity in the retrieved terms and the sophisticated nature of radionuclide therapy formulation, the NMGI has developed systematic steps to address the current heterogeneity and ensure uniformity when present. In nonconsensus cases, 2 surveillance rounds were adapted to reach a solid background. Providing a systematic literature review was a major initial milestone for NMGI members to discuss and adopt, as it helped unravel previously identified terminologies and formulate new ideas and terms when applicable. Consequently, a critical responsibility of health care stakeholders and policymakers is to adhere to and disseminate evidence-based consensus guidelines, promoting awareness of these recommendations both domestically and globally to enhance the safe and efficacious implementation of TRT.

In addition to the previously mentioned and achieved goals, this NMGI initiative can pave the way for future efforts to follow the same tracks. The field of radionuclide therapy is expected to see new advancements in the near future with the approval of many other agents derived from combination therapies and immunotheranostics (*28*,*29*). To ensure adherence to specific guidelines on terminology standardization, it will be imperative to implement further analogous approaches and initiatives. This is particularly crucial as the field of TRT is poised for significant growth, with numerous preclinical agents expected to transition into clinical practice in the coming years (*29*).

Moving forward, it is essential to recognize that the development of a comprehensive and universally accepted nomenclature for radionuclide therapy requires broader collaboration. The NMGI acknowledges the need for further discussions with other major international organizations in the field, such as the European Association of Nuclear Medicine, the International Atomic Energy Agency, and similar bodies. These collaborative efforts will ensure that the proposed nomenclature reflects a global consensus, facilitating clearer communication and standardization across the international nuclear medicine community.

It is noteworthy that this study has limitations. First, the absence of direct interaction and dialogue between experts and participants may have influenced response rates. If face-to-face communication had been feasible, greater agreement on additional statements could have been reached. Second, adopting a narrative rather than a systematic approach for surveillance and adherence to only 2 rounds can significantly impact the results by introducing sampling bias. Regional bias is another source of limitation caused by the overwhelming majority of participants hailing from developed nations. Finally, NMGI's decision to adopt a 51% threshold for consensus may have resulted in false consensus bias. However, the pooled analysis revealing over 60% consensus in the majority of examined domains suggests that this limitation had a minor effect on the overall surveillance. Despite these limitations, to the best of our knowledge, this project remains the first and only initiative to address this complex issue for the time being.

CONCLUSION

This fourth project of NMGI represents the first systematic collaboration toward nomenclature consensus for radionuclide therapy. Joint expertise efforts from multinational and interdisciplinary backgrounds provided these efforts through surveillance and roundtable discussions to present this project. Optimistically, such an initiative should reshape our terminology to adopt more systematic and uniform terms when referring to radionuclide therapy. Future attempts should be directed and focused on providing nomenclature consensus in other uncovered vital topics, such as diagnostic radionuclides, to establish a solid uniform background from all perspectives, taking all points of view into consideration.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Coenen HH, Gee AD, Adam M, et al. Consensus nomenclature rules for radiopharmaceutical chemistry: setting the record straight. *Nucl Med Biol.* 2017;55:v–xi. [AQ3]
2. Becker DV, Sawin CT. Radioiodine and thyroid disease: the beginning. *Semin Nucl Med.* 1996;26:155–164.
3. Al-Ibraheem A, Zimmermann R, Abdlkadir AS, Herrmann K. Radiotheranostics global market and future developments. *Semin Nucl Med.* 2024;54:622–633.
4. Gomes Marin JF, Nunes RF, Coutinho AM, et al. Theranostics in nuclear medicine: emerging and re-emerging integrated imaging and therapies in the era of precision oncology. *Radiographics.* 2020;40:1715–1740.
5. Al-Ibraheem A. Theranostics in developing countries: addressing challenges and potentials from training to practice. *World J Nucl Med.* 2023;22:171–173.
6. Montori VM, Wilczynski NL, Morgan D, Haynes RB, Hedges Team. Optimal search strategies for retrieving systematic reviews from Medline: analytical survey. *BMJ.* 2005;330:68.
7. McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clin Pharm.* 2016;38:655–662.
8. Salerno KE, Roy S, Ribaudo C, et al. A primer on radiopharmaceutical therapy. *Int J Radiat Oncol Biol Phys.* 2023;115:48–59.
9. O'Brien SR, Pryma DA. Introduction to radiopharmaceutical therapy. *Pract Radiat Oncol.* 2022;12:285–288.
10. Fahey FH, Grant FD, Hicks RJ. History of radionuclide therapy and theranostics. In: *Radiotheranostics: A Primer for Medical Physicists I.* 2nd ed. CRC Press; 2024:14–26.
11. Kayano D, Kinuya S. Current consensus on I-131 MIBG therapy. *Nucl Med Mol Imaging.* 2018;52:254–265.

JNM-269215 ■ 3/12/25

12. López Quiñones AJ, Wagner DJ, Wang J. Characterization of meta-iodobenzylguanidine (mIBG) transport by polyspecific organic cation transporters: implication for mIBG therapy. *Mol Pharmacol.* 2020;98:109–119.
13. Liu Y, Wang J, Hu X, et al. Radioiodine therapy in advanced differentiated thyroid cancer: resistance and overcoming strategy. *Drug Resistance Updates.* 2023;68:100939.
14. Guerra Liberal FDC, Tavares AAS, Tavares JMRS. Palliative treatment of metastatic bone pain with radiopharmaceuticals: a perspective beyond strontium-89 and samarium-153. *Appl Radiat Isot.* 2016;110:87–99.
15. Kilimozhi D, Parthasarathy V, Manavalan R. A review on arthritis. *Res J Pharm Technol.* 2011;4:29–36.
16. Cutolo M. The roles of steroid hormones in arthritis. *Br J Rheumatol.* 1998;37:597–599.
17. Knut L. Radiosynovectomy in the therapeutic management of arthritis. *World J Nucl Med.* 2015;14:10–15.
18. Lee EJ, Chung HW, Jo JH, So Y. Radioembolization for the treatment of primary and metastatic liver cancers. *Nucl Med Mol Imaging.* 2019;53:367–373.
19. Hofland J, Brabander T, Verburg FA, Feelders RA, de Herder WW. Peptide receptor radionuclide therapy. *J Clin Endocrinol Metab.* 2022;107:3199–3208.
20. Strosberg JR, Caplin ME, Kunz PL, et al.; NETTER-1 investigators. ^{177}Lu-Dotatate plus long-acting octreotide versus high-dose long-acting octreotide in patients with midgut neuroendocrine tumours (NETTER-1): final overall survival and long-term safety results from an open-label, randomised, controlled, phase 3 trial. *Lancet Oncol.* 2021;22:1752–1763.
21. Al-Rashdan R, Al-Abdallat H, Sathekge MM, et al. Global research output of lutetium-177 PSMA in prostate cancer: bibliometric and altmetric analyses. *Nuklearmedizin.* 2024;63:188–198.
22. Sartor O, de Bono J, Chi KN, et al.; VISION Investigators. Lutetium-177-PSMA-617 for metastatic castration-resistant prostate cancer. *N Engl J Med.* 2021;385:1091–1103.
23. Coenen HH, Gee AD, Adam M, et al. Open letter to journal editors on: International Consensus Radiochemistry Nomenclature Guidelines. *EJNMMI Radiopharm Chem.* 2019;4:7.
24. Denton TR, Shields LB, Hahl M, Maudlin C, Bassett M, Spalding AC. Guidelines for treatment naming in radiation oncology. *J Appl Clin Med Phys.* 2015;17:123–138.
25. Fahey FH, Bom HH-S, Chiti A, et al. Standardization of administered activities in pediatric nuclear medicine: a report of the first nuclear medicine global initiative project, part 2—current standards and the path toward global standardization. *J Nucl Med.* 2016;57:1148–1157.
26. Fahey FH, Bom HH-S, Chiti A, et al. Standardization of administered activities in pediatric nuclear medicine: a report of the first nuclear medicine global initiative project, part 1—statement of the issue and a review of available resources. *J Nucl Med.* 2015;56:646–651.
27. Cutler CS, Bailey E, Kumar V, et al. Global issues of radiopharmaceutical access and availability: a nuclear medicine global initiative project. *J Nucl Med.* 2021;62:422–430.
28. Bellavia MC, Patel RB, Anderson CJ. Combined targeted radiopharmaceutical therapy and immune checkpoint blockade: From preclinical advances to the clinic. *J Nucl Med.* 2022;63:1636–1641.
29. Sgouros G, Bodei L, McDevitt MR, Nedrow JR. Radiopharmaceutical therapy in cancer: clinical advances and challenges. *Nat Rev Drug Discovery.* 2020;19:589–608.

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[AQ1] Should affiliation 6 be "German Medical Institute" rather than the street address "Nikis Avenue" as edited?

[AQ2] Please confirm Dr. Nadel's affiliation with the San Francisco address.

[AQ3] References 1 and 7 were duplicated, so 7 was removed and all references were renumbered. Check carefully that all are correctly changed in the text.

[AQ4] Please indicate which image best represents your article, bearing in mind that if your article is selected to be the featured article of the month, this image will appear on the JNM cover and might also be used in promotional media and in the JNM online carousel. We encourage PET or SPECT images (with AQARA scale bars) and simple, minimal labels and arrows. We discourage cluttered, overloaded graphics; schema; tables; and blocks of text.