

Nuclear Pharmacy Training in the Era of Theranostics: Toward Meeting the Needs of Nuclear Medicine Patients for Comprehensive Pharmaceutical Care

TO THE EDITOR: Novel radiopharmaceutical therapies against cancer are revolutionizing cancer care, and many more are in the pipeline. Although such therapies are currently approved for use as monotherapies in later stages of the disease, clinical trials are under way investigating radiopharmaceutical therapies earlier or in combination with other treatments such as classic and targeted chemotherapies, immunotherapy, and hormone therapy, increasing the complexity of regimens and clinical follow-up (1,2). Although calling for an even closer collaboration between the nuclear medicine and oncology teams, this also prompts the need for increased participation by pharmacists with expertise in radiopharmaceuticals in the care of theranostic patients.

Historically, because most nuclear medicine activities have been oriented toward diagnostics, the pharmacist's participation in the clinical management of nuclear medicine patients has been limited. Besides, the nuclear pharmacist (formerly known as the radiopharmacist) has been focused primarily on activities related to radiopharmaceutical services, such as implementing and supervising local radiopharmaceutical production and dispensing (3,4). Over the last 3 decades, however, the Canadian supply of radiopharmaceuticals has shifted toward kit-based radiolabeling, typically performed by nuclear medicine technologists or provided by licensed facilities. In parallel, Canadian undergraduate pharmacy programs (PharmD) evolved toward clinical pharmacy and pharmaceutical care-oriented training, and nuclear pharmacy subspecialty programs are no longer offered. Paradoxically, as theranostics are becoming a new pillar in the anticancer arsenal, most Canadian-trained nuclear pharmacists are retiring without successors, creating a knowledge void at a time when their expertise would be most valuable. Furthermore, the exponential rise of radiopharmaceutical therapy creates a unique opportunity for the nuclear pharmacist to get increasingly involved in clinical care (5). Unfortunately, in the Canadian setting, this opportunity appears to be lost. A new approach to nuclear pharmacy training was thus needed.

In 2022, the Faculty of Pharmacy at Université Laval (Quebec City, Canada) launched a nuclear pharmacy training curriculum leading to a professional graduate diploma in specialized pharmaceutical care (6), offered in partnership with the CHU de Québec—Université Laval Hospital Center—a designated SNMMI Comprehensive Radiopharmaceutical Therapy Center of Excellence—and international collaborators. Université Laval's Faculty of Pharmacy and Department of Physics, Physics Engineering, and Optics, and CHU de Québec—Université Laval's Department of Pharmacy, Division of Nuclear Medicine, as well as Division of Medical Physics and Radiation Protection, teamed to develop a training curriculum for hospital pharmacists that is aligned with the emerging needs driven by theranostics. The completion of an

accredited Canadian pharmacy residency (recognized PGY-1 residency program by the Board of Pharmacy Specialties in the United States), like the master's degree in advanced pharmacotherapy in Quebec (totaling 60 credits [2,700 h]) (7), and additional work experience in oncology are prerequisites for this new professional postgraduate diploma (30 credits [1,350 h]) in the specialty of nuclear pharmacy. It includes academic courses covering basic radiopharmacy sciences and radioprotection and an internship that includes rotations in both nuclear medicine clinics and radiopharmaceutical production, as well as an introduction to regulatory and quality assurance aspects thereof. In particular, building on the strong clinical background of the candidates, the clinical rotations in nuclear medicine aim to enable full participation of the nuclear pharmacy trainee in the interdisciplinary management of theranostic patients by providing comprehensive pharmaceutical care that includes radiopharmaceutical therapy. Combined with internships in facilities producing and dispensing radiopharmaceuticals, trainees will acquire the knowledge enabling them to take part in all stages of the theranostic agent circuit and ensure safe use in health care establishments. An oncology pharmacist (PharmD, MSc) is already engaged in the program.

The proposed training curriculum is in line with our vision in which the field of nuclear pharmacy represents a continuum spanning from the activities surrounding radiopharmaceutical services to the pharmaceutical care and counseling of patients treated with theranostics, that is, predominantly in oncology. The nuclear pharmacist will remain a pillar of the management of the entire process for the safe servicing and use of radiopharmaceuticals in health care establishments (including preparation, dispensing, distribution, administration, disposal, product traceability and quality control, radiation safety, etc.). In addition, the training curriculum will emphasize the clinical dimension of nuclear pharmacy, increasing patient support and hopefully filling an emerging clinical need. The clinical activities of the nuclear pharmacist will be structured around the optimization and safety of radioactive and nonradioactive therapies, in collaboration with the local nuclear medicine team. To the traditional clinical activities of the pharmacist in oncology are added those specific to treatments involving radiopharmaceuticals. The nuclear pharmacist providing pharmaceutical care will ensure that patients receive the right treatment at the right time and with the right activity, dose, and manner; identify and solve pharmacotherapeutic problems; provide pharmaceutical advice to patients and care teams (regarding radiopharmaceuticals, other anticancer and supportive drugs, and other pharmacotherapies); and monitor and manage adverse effects. These roles will both overlap and complement those of the nuclear medicine physician. To become this novel model of the nuclear pharmacist, the candidate needs to have a solid knowledge foundation on pharmaceutical care in oncology and, moreover, to master the basic sciences, radiation safety, and clinical aspects of radiopharmaceuticals. In so doing, the candidate might become eligible for an international nuclear pharmacy specialty certification (as no such certification is currently available in Canada).

The rapid growth of radiopharmaceutical therapy is opening new opportunities—requiring skills and knowledge in both nuclear and clinical pharmacy—for nuclear pharmacists to participate in the clinical management of nuclear medicine patients. To concretize this vision in the current Canadian setting, we developed a

nuclear pharmacy training program for clinical pharmacists that we believe will ultimately lead to improved health care offered in synergy with nuclear medicine and oncology, while broadening the scope of nuclear pharmacy in the era of theranostics.

DISCLOSURE

Isabelle Laverdière and Jean-Mathieu Beauregard are clinical research scholars from the Fonds de recherche du Québec-Santé. Jean-Mathieu Beauregard is consultant/advisor for Novartis and ITM and an investigator for Novartis and POINT Biopharma. No other potential conflict of interest relevant to this article was reported.

REFERENCES

1. Inderjeeth AJ, Iravani A, Subramaniam S, Conduit C, Sandhu S. Novel radionuclide therapy combinations in prostate cancer. *Ther Adv Med Oncol*. 2023;15:17588359231187202.
2. Adant S, Shah GM, Beauregard JM. Combination treatments to enhance peptide receptor radionuclide therapy of neuroendocrine tumours. *Eur J Nucl Med Mol Imaging*. 2020;47:907–921.
3. Ponto JA, Hung JC. Nuclear pharmacy, part II: nuclear pharmacy practice today. *J Nucl Med Technol*. 2000;28:76–81.
4. Nuclear pharmacy specialty certification (BCNP). Board of Pharmacy Specialties website. <https://bpsweb.org/nuclear-pharmacy/>. Accessed June 13, 2024.
5. Augustine SC, Norenberg JP, Colcher DM, et al. An opportunity for pharmaceutical care in a specialty practice. *J Am Pharm Assoc (Wash)*. 2002;42:93–100.
6. Diplôme professionnel de troisième cycle en soins pharmaceutiques spécialisés. Université Laval website. <https://www.pha.ulaval.ca/etudes/programmes/diplome-professionnel-de-troisieme-cycle-en-soins-pharmaceutiques-specialises>. Accessed June 13, 2024.
7. Accredited & accreditation pending programs. Canadian Society of Hospital Pharmacists website. <https://cshp-scph.ca/year-1-programs>. Accessed June 13, 2024.

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