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EDITORIAL

Nuclear imaging and therapy in oncology in Poland in 2021–2022

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After a long period of COVID-19 pandemic, in May 2022, the community of Polish nuclear medicine finally held its national meeting in Białystok. We were happy to meet again in person and to summarize our scientific and professional achievements. After the long and distressing pause, the relatively small Polish Society of Nuclear Medicine made an impression of a vivid and energetic community. Despite COVID-19 pandemic, economical, and geopolitical instability in the region, Polish nuclear medicine seems to experience a continued growth of the equipment status, number of procedures, and availability of new modalities. It was clear that the optimistic impression should have been confirmed by hard data. In order to provide reliable numeric data, we decided to prepare a report on the status of nuclear medicine in 2021 and 2022. The aim of the report was to evaluate the number of major nuclear medicine procedures in Poland in 2021–2022 with a special focus on oncology and radionuclide therapy.

Data on the equipment and staff of nuclear medicine departments were obtained from regional nuclear medicine consultants in all 16 districts (voivodeships). The consultants were requested to provide the number of nuclear medicine departments; number of professionals: physicians, physicists, radiochemists, technicians, and nurses employed in the departments; and the information on the available equipment. Numbers of PET/CT procedures were provided by the heads of nuclear medicine departments. Data concerning therapeutic procedures were obtained from all of the radiopharmaceutical manufacturers active on the national market.

In 2022, there were 64 active departments of nuclear medicine in Poland. They employed 195 physicians, 249 technicians, 152 nurses, 50 physicists, and 39 radiochemists. Departments were equipped with 161 diagnostic devices, including 30 planar gamma cameras, 34 SPECT scanners, and 87 hybrid devices, including 50 SPECT/CT, 34 PET/CT, and 3 PET/MR scanners.

The very low number of nuclear medicine facilities in Poland is surprising. With its almost 38 million inhabitants, Poland ranks 6th among European countries. Sixty-four nuclear medicine departments is therefore an extremely low number. Statistically, one facility serves a population of as many as ca. 600 thousand inhabitants. For comparison, data from the United Kingdom report 303 departments that cover the needs of ca. 220 thousand inhabitants per facility, on average [1]. Great majority of nuclear medicine departments are located in large multi-specialty hospitals that play a role of tertiary centers. Nuclear medicine departments in smaller institutions, like county hospitals, are almost absent. Small private clinics that are so common in clinical specialties in Poland, are extremely rare in nuclear medicine. As a result, there are areas in Poland (a relatively less densely populated country in comparison to the Western part of Europe) with a distance to the nearest SPECT or PET facility of more than 100 km. In many situations, clinicians from remote medical centres refrain from recommending nuclear medicine modalities to their patients in favour of regular radiological imaging tools that are available on site. Therefore, it should be our priority to promote the foundation of new departments in all newly built hospitals. Moreover, our specialists should be encouraged to initiate their own outpatient clinics that would offer a wide range of diagnostic and treatment options, especially outside larger cities.

One of the major factors limiting the development of nuclear medicine is the shortage of medical professionals. As it may be calculated from the presented data, an average department employs 3 nuclear medicine physicians, 4 technicians, 3 nurses, and 1 physicist. This number has been quite stable over recent years, and the number of new board-certified nuclear medicine physicians (ca. 10 persons per

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year) is highly insufficient. It is a general drawback of the Polish health care system. There are only 238 physicians per 100,000 inhabitants in Poland—the lowest number in the European Union [2]. This index is more than two times higher in the leading countries, like Greece (620 physicians), Austria, and Portugal. The situation is similar among nurses. One of the causes is the emigration of medical staff to other countries that have been offering better wages. It also affects the nuclear medicine community—specialists of Polish origin are present in several European countries. As a result of the shortage in professional staff, some nuclear medicine physicians divide their activity between two or more institutions. All efforts of our community should be aimed at encouraging young doctors to specialize in our field. Although we do not have any hard data of income of the medical staff, the general impression is that wages have been increasing in recent years—the process that was indeed driven by the staff shortage. Therefore, we hope that young doctors will choose nuclear medicine as their field of interest also in their homeland.

The number of imaging devices present in nuclear medicine departments is also insufficient, especially if we compare our data with that from other countries. For example, the British Nuclear Medicine Society reported 129 SPECT/CT and 32 PET/CT scanners present in 59% of all departments registered in the United Kingdom in 2020 [1]. In a very comprehensive survey performed on an annual basis by the Société Française de Médecine Nucléaire et Imagerie Moléculaire, there were as many as 280 SPECT/CT scanners and 177 PET scanners in France in 2022 [3]. At the same time, just 50 SPECT/CT and 34 PET/CT scanners were present in Poland. If adjusted to the population of these 3 states (37.7 mln for Poland, 67.3 mln for UK, and 65.8 mln for France), it is easy to calculate that the number of SPECT/CT scanners per million inhabitants in Poland is ca. 3 times lower than in France and 2.5 times lower than in Britain. The number of PET/CT scanners per million, however, is similar in Poland and in the UK (0.8–0.9 scanners per million) but still approximately 3 times lower than in France. It may be assumed, therefore, that the equipment gap is huge and Poland's situation seems worse in the case of SPECT/CT than PET/CT. We can also see some tendency to mitigate the equipment deficiency throughout the years; there were 42 SPECT/CT and 25 PET/CT scanners in Poland, in 2015.

In 2022, the number of diagnostic procedures with the use of positron-emitting radiopharmaceuticals reached 70,210 and it was 24.1% higher than in 2021. The most commonly used radiotracer, [^{18}F]FDG, accounted for 82.7% of all PET procedures in 2021 and for 83.9% in 2022. Participation of different radiotracers in both reported years are presented in Table 1.

Table 1 Number of PET/CT or PET/MR procedures performed with different tracers in Poland in 2021 and 2022

Radiopharmaceutical	2021	2022	Annual increase (%)
[^{18}F]FDG	55,714	70,210	26.0%
[^{18}F]F/[^{11}C]C-choline	4401	4743	7.8%
[^{68} Ga]Ga-PSMA	3148	4175	32.6%
[^{18}F]PSMA	1508	1546	2.5%
[^{68} Ga]Ga-DOTATATE	2003	2303	15.0%
Other*	606	628	3.6%
Total	**67,380**	**83,605**	**24.1%**

*Other tracers include mainly Na[^{18}F], [^{18}F]florbetaben, [^{18}F]florbetapir, and [^{18}F]fluoroestradiol

The growth in Poland's PET/CT sector is clearly visible also in the number of procedures performed in all of the departments. The number of examinations reached 83,605 in 2022—the historical record high for the country. In the same year, French centers performed almost 10 times as many scans (805,668), i.e., 5.5 times more if the numbers are population-adjusted [3]. Both compared countries experienced an increase in PET examinations between 2021 and 2022 by 24.1% and 16.8%, respectively. What can be read out of these reports is that a statistical PET/CT scanner in France performs almost a double number of examinations per year in comparison to a similar device in Poland. One could have expected that in a country with a suboptimal amount of facilities and equipment, the existing scanners would be exposed to a greater workload. It may be concluded then that it is not the number of PET scanners that limits the availability of radionuclide imaging in this country. There is still a workload reserve in the existing equipment. In our opinion, the main limiting factor is the reimbursement policy. The workload of nuclear medicine centers in Poland is limited by the number of procedures contracted annually by the National Health Fund—the main payer in the health care system. Financial restrictions are still the main limiting factors that prevent the required access to modern nuclear imaging. Indeed, many departments have to cope with an overload of incoming referrals, mostly from oncological clinics and resulting in surplus services. Another limiting factor is the reimbursement indications that have not been updated since 2011. Some radiopharmaceuticals, like [^{68}Ga]Ga-PSMA or [^{68}Ga]Ga-DOTATATE, are not included in the reimbursement policy. That is why, the use of these modalities is based on other funding sources than the National Health Fund or on some specific local agreements. Despite the deficient regulations, the number of these procedures experienced a decent growth of 32.6% and 15.0%, similar to that of the reimbursed [^{18}F]FDG (26.0%). For years now, efforts have been made by representatives of our community to officially acknowledge the use of these radiopharmaceuticals with a special emphasis on fair financial conditions. Achievement of this goal would definitely improve the Polish patient's access to modern imaging in prostate cancer and neuroendocrine tumours.

Data on the status of radionuclide therapy is presented in Table 2.

The results obtained in 2021 and 2022 were compared to the earlier, unpublished data of 2019, i.e., before COVID-19 pandemic. In 2019, the number of all therapy procedures was higher than in 2022, both in the aggregate and for each analyzed modality, except for thyroid cancer radioiodine therapy and bone metastases treated with [^{223}Ra]RaCl$_2$ (see Table 2).

Number of all therapy procedures in 2022 was 19,691, and it was higher by 4.8% than in 2021 (18,792 procedures). The great majority of all radionuclide therapies included radioiodine treatment of thyroid diseases. Therapy of benign thyroid diseases (15,034 procedures) accounted for 76.3% and of thyroid cancer (3,485 procedures) for 17.7% of all reported procedures. It must be pointed out, however, that the data on radioiodine can be biased as the numbers presented here were not obtained from the departments but from the only radioiodine supplier in the country (presented numbers refer to the capsules sold to the hospitals, not to the number of patients treated). In practice, some patients with thyroid cancer are given more than one [^{131}I]NaI capsule at a time if a higher activity is prescribed. Therefore, we are not going to compare the data with other countries. Nevertheless, radioiodine use for both clinical indications experienced an increase between 2021 and 2022 by 4.3% and 9.7%, respectively. The relative growth of radioiodine application in thyroid cancer patients in 2022 is one of the most surprising findings in this analysis. The tendency to limit indications to radioiodine ablation, expressed in international guidelines, has been observed also in Poland. In May 2022, an interdisciplinary meeting of experts endorsed an update of national guidelines regarding thyroid cancer therapy [4]. According to them, radioiodine therapy is not recommended to patients with low-risk thyroid cancer. The observed increased use of radioiodine could be attributed to the delayed reaction of the entire health care system to new recommendations that were published actually in the middle of 2022. Another cause could be a 'catching-up' effect as some thyroid cancer patients used to refuse hospitalization during COVID-19 pandemic and they reentered their management protocol in 2021–2022.

Table 2 Therapeutic procedures performed with different radiopharmaceuticals in Poland in 2019, 2021, and 2022

Therapy procedures	2019	2021	2022	Annual change 2022 *vs*. 2021 (%)
[^{131}I]NaI, benign diseases	19,445	14,415	15,034	+4.3%
[^{131}I]NaI, thyroid cancer	2651	3176	3485	+9.7%
[^{223}Ra]RaCl$_2$	714	812	833	+2.6
[^{153}Sm]Sm-EDTMP	112	95	73	−23.2%
[^{89}Sr]SrCl$_2$	60	39	43	+10.3%
[^{177}Lu]Lu-DOTATATE	250	188	162	−13.8%
[^{90}Y]Y/[^{177}Lu]Lu-DOTATATE	101	36	13	−43.9%
[^{131}I]mIBG	45	28	25	−10.7%
Radioembolization	53	23	23	0%
Total	**23,431**	**18,792**	**19,691**	**+4.8%**

Treatment of bone metastases in castrate-resistant prostate cancer was performed with three available radionuclides: [^{223}Ra]RaCl$_2$, [^{153}Sm]Sm-EDTMP, and [^{89}Sr]SrCl$_2$. Radium chloride accounted for 85.8% and 87.8% of all bone metastases treatment procedures in 2021 and 2022, respectively. Radium chloride was approved for reimbursement in 2019 and it quickly replaced the earlier radiopharmaceuticals: [^{153}Sm]Sm-EDTMP and [^{89}Sr]SrCl$_2$. The absolute numbers of radionuclide therapy procedures in bone metastases are still relatively low. We have to keep in mind, however, that prostate cancer patients are qualified to other systemic treatment modalities and to clinical trials that exclude parallel radionuclide therapy. Now, with great impatience, we are looking forward to the reimbursement of [^{177}Lu]Lu-PSMA therapy (in France, 613 patients were treated with the innovative therapy in 2022 [3]).

Radionuclide therapy of neuroendocrine tumours showed a decline by 21.9%, i.e., from 224 procedures in 2021 to 175 in 2022. The decrease was noted for both, [^{177}Lu]Lu-DOTATATE and [^{90}Y]Y/[^{177}Lu]Lu-DOTATATE "tandem" therapy. Following the approval of [^{177}Lu]Lu-DOTATATE that in Poland was not accompanied by reimbursement, the previously used, cheaper preparations manufactured by Polatom had to be withdrawn from the market. Subsequently, due to the cost of the approved drug, the PRRT has been performed only with a special individual permit as a 'life-saving therapy.' Hence, the accessibility to this previously well-established treatment decreased dramatically. It was as late as at the end of 2022, when the reimbursement of the procedure was announced, and we can expect a significant increase in the number of therapies in 2023. The remaining therapies, [^{131}I]mIBG and radioembolization, were performed only in single centers and their numbers were stable.

The presented analysis shows tendencies of radionuclide imaging and therapy in oncology in Poland only in a limited post-pandemic period. Unfortunately, we have not developed any clear system that would allow for monitoring complete data on radionuclide therapy and imaging year by year as it is, for example, in France [3]. Nevertheless, the obtained data allow for some conclusions regarding the clinical tendencies, as well as a comparison with some other countries. We may conclude that there is still a significant gap in the availability of nuclear medicine facilities and equipment between this country and some other EU member states. Despite a noticeable progress in recent years, the main factor that hinders the access of Polish patients to modern imaging techniques and treatment options is the issue of approval and reimbursement. These administrative and financial obstacles lead to delays in the introduction of new modalities and to restricted availability, especially to patients from remote regions. As the nuclear medicine community, we should be motivated to impose even stronger pressure on decision-makers. Cooperation with other scientific societies, as well as with patient organizations, should be tightened in order to increase the role of nuclear medicine in the management of oncological diseases. It is also our role to attract medical students and young physicians, technicians, physicists, and other medical professionals to the field of nuclear medicine in order to fill the generation gap. Introduction of well-educated and motivated professionals into our departments is crucial for further development of the field.

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Data Availability Data sets generated during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval This editorial falls outside of the scope of ethical concerns regarding experimentation with humans or animals.

Informed consent This manuscript does not contain proprietary human data, accordingly an informed consent is not applicable.

Consent for publication All authors gave their written consent for publication.

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