Current Landscape of Radiopharmaceutical Therapies: SNMMI Therapy Task Force Survey

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The field of nuclear medicine is undergoing a renaissance with the growth of new PET agents and applications, as well as several novel radiopharmaceutical therapies. Although radiopharmaceutical therapies are a foundational component of nuclear medicine practice and have been successfully applied for decades in the treatment of benign and malignant disorders, recent and pending approvals for new diagnostic and therapeutic radiopharmaceuticals are the source of clear excitement about the future. Many clinical trials are currently underway for treatment of prostate (*1*)*, neuroendocrine, and other malignant tumors. Recent prospective data show advantages of radiopharmaceutical therapies over conventional chemotherapy, and early unpublished data from industry support the presence of substantial efficacy of new* ^{177}*Lu prostate cancer therapies* (*2*). This bodes well for the greater growth and development of radiopharmaceutical therapies and for the field of nuclear medicine in general.

The SNMMI Therapy Task Force developed a wide-ranging survey on radiopharmaceutical therapies that was opened to all members of the society. The overarching goal of this survey was to gather information to evaluate the current status of radiopharmaceutical therapies and to identify opportunities to enhance and implement training, education, and operational strategies for the future.

METHODOLOGY

The Task Force developed a comprehensive survey questionnaire with 39 questions related to demographics, types of therapies, current volume (number of patients/year, number of treatment administrations/year), types of specialties administering these therapies, referral patterns, dosimetry, and physician concerns related to several specific therapies. Additional questions about future prospects, perceptions of specialty capabilities and the most appropriate specialist engagement, and radiopharmaceutical therapy nomenclature were included. These questions were designed to inform SNMMI on the current status of the field, gaps in our delivery systems, and opportunities for future initiatives.

The survey was distributed using an email-based tool (SurveyMonkey; SVMK, Inc., San Mateo, CA). The target audience included all active SNMMI members (physicians, scientists, technologists, pharmacists, and others), as well as in-training members and international members. Responses were anonymous, although the membership type of each respondent was known. The survey was launched on August 1, 2020, and was open for responses until August 21, 2020. A reminder email was sent to nonrespondents after 14 days.

RESULTS

Demographics

The survey questionnaire was emailed to 13,140 SNMMI members, and 601 completed responses (4.6% response rate) were received from individuals in 31 countries. Of the 601 responses, 37% (n = 220) were from physicians (4.9% response rate). The results described in this article are based only on these physician responses. Nonphysician responses will be reported separately. Physician respondents could select more than 1 specialty if applicable. About 85% (n = 184) of respondents were nuclear medicine physicians, followed by 25% radiologists (n = 25), 14% radiologists with special competency in nuclear radiology (n = 30), 2% radiation oncologists (n = 5), and 2% trainees (n = 5). The "Other" category included medical oncologists (n = 3) and 1 internist.

A large majority of physicians (69%, n = 143) worked in academic institutions/medical centers, followed by nonuniversity-affiliated hospitals (18%, n = 38), private practice/outpatient settings (3%, n = 7), military clinic/hospitals (2%, n = 4), freestanding imaging facilities (2%, n = 4), and 1 respondent each from a government laboratory and industry. The "Other" category (4%, n = 9) included responses such as hospital-based cancer center, other types of hospitals, and student and unemployed statuses.

About 95% (n = 196) of physician respondents considered themselves to be part of multidisciplinary teams performing radiopharmaceutical therapies. The other 5% planned to start performing these therapies in the next 1–2 years and identified ^{131}I, ^{177}Lu, and ^{223}Ra as their top 3 choices with which to begin.

We received responses from physicians in 27 different countries. The majority were from the United States and its territories, including Puerto Rico (n = 150), followed by Canada (n = 14), India (n = 6), Japan (n = 4), Germany (n = 3), Australia (n = 3), South Africa (n = 3), and Italy, the United Kingdom, and Mexico with 2 each to round off the top 10.

Type and Volume of Radiopharmaceutical Therapies

Survey respondents were asked about the different types and volumes of radiopharmaceutical therapies administered at their institutions, including number of patients/year as well as treatment administrations/year (Table 1). A list of common radiopharmaceutical therapies was provided with the option of adding other therapies. The most common types of radiopharmaceutical therapies performed were with oral ^{131}I, followed by ^{223}Ra, ^{90}Y-microspheres, and ^{177}Lu-DOTATATE. Respondents were provided 5 different ranges of yearly therapy volumes from which to choose. We asked separate questions for numbers of patients/year and numbers of treatment administrations/year. The responses for these questions were similar, with oral ^{131}I being the highest volume, followed by ^{223}Ra, ^{177}Lu, and ^{90}Y-microspheres.

A limitation in the way in which this set of questions was framed was observed in the many responses in the 0–10/year range. We could not differentiate responses that were 0 (meaning respondents were performing no therapy) from those that were between 1 and 10/year. Resolution of this question could be part of a second, more focused follow-up. However, it can be inferred that for some of the less common therapies (e.g., Zevalin) no cases were performed in the large majority of centers.

Radiopharmaceutical Therapies by Specialties

To identify all the specialties administering radiopharmaceutical therapies, a list was provided to survey respondents. Responses (n = 150) included nuclear medicine with 88% (n = 132), followed by interventional radiology with 30% (n = 45), nuclear radiology with 27% (n = 41), radiation oncology with 19% (n = 28), radiology with 7% (n = 10), and endocrinology with 4% (n = 6) as the top specialties administering radiopharmaceutical therapies at their institutions. Medical oncology, urology, and pediatric oncology were each selected by 1 respondent. We also asked about the percentage breakdown of different radiopharmaceutical therapies by medical specialties at their institutions (Table 2).

Referral Patterns

According to 93% (n = 137) of survey respondents, patient referrals come from a variety of settings. The majority of patient referrals for radiopharmaceutical therapies were internal (from their own institutions), followed by external referrals from physicians working in nonuniversity hospitals (73%, n = 117), physicians from multispecialty offices (62%, n = 92), physicians from private offices (62%, n = 92), and physicians from other university hospitals (53%, n = 79). Other referrals were from patients themselves (20%, n = 30), treating physicians or self-referrals (7%, n = 11), and referrals from insurance companies (7%, n = 10).

Medical specialties most frequently referring patients for radiopharmaceutical therapies included endocrinology (99%, n = 145; i.e., at a given center, 99% reported referrals from endocrinology), followed by medical oncology (86%, n = 126), radiation oncology (54%, n = 79), urology (52%, n = 77), hepatopancreatobiliary surgery (39%, n = 58), ear/nose/throat (32%, n = 47), and others (12%, n = 18; including surgical oncology, internal medicine, interventional radiology, and cardiology).

Dosimetry

When asked whether they perform any dosimetry for radiopharmaceutical therapies administered at their institutions, 54% (n = 79) of physician respondents replied affirmatively and 46% (n = 67) replied that they did not. However, about 71% (n = 50) of those not performing dosimetry were either considering or planning to do so. Lack of necessary physics support, dosimetry not proven useful, lack of tools to perform dosimetry, lack of access to quantitative SPECT/CT, and lack of training were selected as top reasons by those who did not plan to perform dosimetry. Table 3 shows the percentages of patients in whom dosimetry is performed for specific radiopharmaceutical therapies.

We also asked about the type of dosimetry performed. For those respondents who selected organ dosimetry for safety, the most common organs listed were lung, liver, kidney, bone marrow, and thyroid (Table 4).

Physician Concerns: Administration of Radiopharmaceutical Therapies

Survey respondents were provided with a list of top concerns or issues they might encounter or perceive to be impediments to the growth of radiopharmaceutical therapies. Respondents were prompted to pick up to 3 concerns or issues, even if they were not currently administering these therapies. As expected, the top concerns for some newer therapies (e.g., radiopharmaceutical therapy for joints and prostate radiopharmaceutical therapy) were that respondents did not have sufficient information or were not adequately trained to perform the procedure.

However, for some of the other therapies that were U.S. Food and Drug Administration (FDA)–approved not long ago, like ^{223}Ra (Xofigo) and ^{177}Lu-DOTATATE (Lutathera), the top concern was that the treatment is "too expensive." The same was true for other therapies, including ^{131}I-meta-iodobenzylguanidine (^{131}I-MIBG; Azedra or generic), ^{90}Y- radioimmunotherapy (Zevalin), and ^{90}Y-microspheres (SIRSpheres and TheraSpheres). Also of note, for therapies like oral ^{131}I ($>$33 mCi), oral ^{131}I ($\leqq$33 mCi), and ^{131}I-MIBG, respondents had concerns about radiation safety. The top 3 concerns/issues for each radiopharmaceutical therapy are listed online in Supplemental Table 1.

Future of Radiopharmaceutical Therapies

This survey had questions about SNMMI member perceptions of the future of radiopharmaceutical therapies. Respondents were asked about the future volume of radiopharmaceutical therapies (increase or decrease), and about 93% (n = 129) believed it would definitely or probably increase, whereas about 4% (n = 5) each were either uncertain or thought it would not increase.

Another question asked whether radiopharmaceutical therapy administration should be limited to nuclear medicine physicians, and 73% (n = 102) of respondents believed that it should, whereas 17% (n = 23) reported that it should not be limited to any single specialty. About 10% (n = 14) picked the "Other" option, with varied responses that included restricting radiopharmaceutical therapies to American Board of Nuclear Medicine–certified physicians (nuclear medicine physicians and nuclear radiologists), opening administration up to qualified radiologist and radiation oncologists, and the need to train true "nuclear oncologists."

Respondents were also asked whether radiation oncologists were more qualified than nuclear medicine physicians to administer these therapies. About 93% (n = 129)

TABLE 1

Percentages of Respondents Reporting Numbers of Patients and Types of Radiopharmaceutical Therapies Performed at Their Institutions

	No. patients per year (respondents, total 143)						No. treatment administrations per year (respondents, total 140)					
Procedure	0–10	11–20	21–30	31–40	>40	Total*	0–10	11–20	21–30	31–-40	>40	Total*
Oral ^{131}I (≦33 mCi)	18% (26)	22% (32)	18% (26)	8% (11)	34% (49)	144	17% (23)	20% (27)	20% (27)	9% (12)	36% (49)	138
Oral ^{131}I (>33 mCi)	18% (24)	15% (21)	15% (21)	9% (13)	42% (58)	137	17% (23)	14% (19)	14% (19)	10% (13)	44% (58)	132
^{223}Ra (Xofigo)	48% (50)	25% (26)	10% (10)	5% (5)	13% (14)	105	38% (39)	13% (13)	12% (12)	11% (11)	26% (27)	102
^{177}Lu-DOTATATE (Lutathera)	34% (29)	16% (14)	15% (13)	3% (3)	31% (27)	86	29% (24)	12% (10)	7% (6)	10% (8)	42% (35)	83
^{90}Y-microspheres (SIRSpheres	46% (39)	13% (11)	14% (12)	12% (10)	15% (13)	85	43% (37)	14% (12)	13% (11)	13% (11)	17% (15)	86
^{90}Y-microspheres (TheraSpheres)	33% (24)	18% (13)	15% (11)	12% (9)	23% (16)	73	35% (25)	15% (11)	15% (11)	10% (7)	24% (17)	71
^{153}Sm-EDTMP (Quadramet)	93% (67)	3% (2)	0%	0%	4% (3)	72	95% (69)	1% (1)	1% (1)	0%	3% (2)	73
^{89}Sr (Metastron)	95% (57)	0%	2% (1)	0%	3% (2)	60	93% (56)	2% (1)	2% (1)	0%	3% (2)	60
^{90}Y anti-CD 20 (Zevalin)	98% (58)	0%	0.00%	0%	2% (1)	59	96% (55)	2% (1)	0%	0%	1% (1)	57
Prostate radionuclide therapy	59% (33)	16% (9)	11% (6)	2% (1)	13% (7)	56	56% (35)	14% (9)	6% (4)	8% (5)	16% (10)	63
^{131}I-MIBG (Azedra or generic)	81% (44)	13% (7)	4% (2)	0%	2% (1)	54	80% (48)	13% (8)	2% (1)	3% (2)	2% (1)	60
Radionuclide therapy for joints	93% (41)	0%	2% (1)	0%	5% (2)	44	90% (46)	4% 2)	0%	0%	6% (3)	51
Others**	83% (24)	7% (2)	0%	0%	10% (3)	29	85% (29)	3% (1)	3% (1)	0%	9% (3)	34

*Total survey respondents for each survey item.

**Including ^{177}Lu-EDTMP, ^{131}I-anti CD45 in leukemia, ^{225}Ra-PSMA/DOTATATE, ^{186}Re-labeled nanoliposomes for glioblastoma, and ^{90}Y-radiosynoviorthesis.

TABLE 2
Percentages of Respondents Reporting Types of Therapy Performed by Specialties at Their Institutions (Respondents, total 139)

Specialty/radiopharmaceutical therapy (total no. of respondents re: each therapy)	<25% (*n*)	25%–50% (*n*)	50%–75% (*n*)	75%–100% (*n*)
Nuclear medicine				
Oral ^{131}I (≦33 mCi) (117)	3% (3)	5% (6)	4% (5)	88% (103)
Oral ^{131}I (>33 mCi) (110)	3% (3)	6% (7)	3% (3)	88% (97)
^{223}Ra (Xofigo) (71)	1% (1)	7% (5)	1% (1)	91% (64)
^{177}Lu-DOTATATE (Lutathera) (61)	3% (2)	5% (3)	0%	92% (56)
^{153}Sm-EDTMP (Quadramet) (51)	6% (3)	2% (1)	0%	92% (47)
^{90}Y-microspheres (SIRSpheres) (43)	12% (5)	12% (5)	0%	76% (33)
^{89}Sr (Metastron) (38)	3% (1)	0% (0)	0%	97% (37)
^{90}Y anti-CD 20 (Zevalin) (36)	3% (1)	6% (2)	0%	91% (33)
Prostate radionuclide therapy (35)	6% (2)	3% (1)	0%	91% (32)
^{131}I-MIBG (Azedra or generic) (30)	0% (0)	0%	0%	100% (30)
Radionuclide therapy for joints (18)	6% (1)	0%	0%	94% (17)
Others (11)	0%	0%	0%	100% (11)
Radiology/nuclear radiology				
^{90}Y-microspheres (SIRSpheres) (50)	2% (1)	8% (4)	0%	90% (45)
Oral ^{131}I (≦33 mCi) (28)	11% (3)	18% (5)	0%	71% (20)
Oral ^{131}I (>33 mCi)) (23)	13% (3)	17% (4)	0%	70% (16)
^{223}Ra (Xofigo) (16)	6% (1)	19% (3)	0%	75% (12)
^{177}Lu-DOTATATE (Lutathera) (13)	0% (0)	15% (2)	0%	85% (11)
^{90}Y anti-CD 20 (Zevalin) (12)	8% (1)	17% (2)	0%	75% (9)
^{153}Sm-EDTMP (Quadramet) (10)	10% (1)	10% (1)	0%	80% (8)
Prostate radionuclide therapy (7)	0%	0%	0%	100% (7)
^{89}Sr (Metastron) (6)	17% (1)	0%	0%	83% (5)
^{131}I-MIBG (Azedra or generic) (5)	0%	0%	0%	100% (5)
Radionuclide therapy for joints (1)	0%	0%	0%	100% (1)
Others (2)	0%	0%	0%	100% (2)
Radiation oncology				
^{223}Ra (Xofigo (16))	0%	25% (4)	6% (1)	69% (11)
Oral ^{131}I (>33 mCi) (5)	0%	0%	0%	100% (5)
Oral ^{131}I (≦33 mCi) (2)	50% (1)	0%	0%	50% (1)
^{90}Y anti-CD 20 (Zevalin) (4)	0%	0%	0%	100% (4)
^{90}Y-microspheres (SIRSpheres) (3)	0%	33% (1)	0%	67% (2)
^{177}Lu-DOTATATE (Lutathera) (3)	33% (1)	33% (1)	0%	33% (1)
Prostate radionuclide therapy (2)	0%	0%	0%	100% (2)
^{131}I-MIBG (Azedra or generic) (2)	50% (1)	0%	0%	50% (1)
Others (1)	0%	0%	0%	100% (1)
Endocrinology				
Oral ^{131}I (≦33 mCi) (7)	29% (2)	0%	42% (3)	29% (2)
Oral ^{131}I (>33 mCi) (6)	17% (1)	0%	50% (3)	33% (2)
^{223}Ra (Xofigo) (1)	0%	0%	0%	100% (1)
^{90}Y-microspheres (SIRSpheres) (1)	0%	0%	0%	100% (1)
^{177}Lu-DOTATATE (Lutathera) (1)	0%	0%	0%	100% (1)
^{131}I-MIBG (Azedra or generic) (1)	0%	0%	0%	100% (1)

disagreed, whereas 7% ($n = 10$) responded that this was either true or was dependent on the individual radiation oncologist. Two respondents mentioned that radiation oncologists have regular clinics and may be well suited to patient evaluation and follow up.

Finally, survey respondents were asked about the lack of uniformity in nomenclature for radiopharmaceutical therapies. Although these therapies have long been a part of nuclear medicine, several names may be used to describe them as a group. A list of the most commonly used names was provided, and respondents were asked to pick the top 3. Most respondents (52%, $n = 72$) picked "radionuclide therapy" as their first choice, followed by "targeted radionuclide therapy" (42%, $n = 58$), "theranostics" (34%, $n = 47$), "targeted radiopharmaceutical therapy" (31%, $n = 43$), and "radiopharmaceutical therapy" (29%, $n = 40$).

Limitations

Online or email-based web surveys are an efficient and attractive means of data collection; however, they are not without methodologic challenges. Responses are based on self-selection, and certain groups in the target audience maybe underrepresented. There is also the possibility of nonresponse bias; for example, physicians who are either performing radiopharmaceutical therapies now or are planning to start in the near future may be more likely to respond to this type of survey than those who are not. The overwhelming majority of this survey's physician respondents were nuclear medicine physicians, mainly working in the academic setting, which may have skewed the results but is reflective of the SNMMI physician membership.

Because of the brevity of the survey, more detailed follow-up questions on important topics, such as dosimetry, could not

TABLE 3
Percentages of Respondents Reporting Dosimetry for Specific Radiopharmaceutical Therapies at Their Institutions

Radiopharmaceutical therapy (total no. of respondents re: each therapy)	<25% (*n*)	25%–50% (*n*)	50%–75% (*n*)	75%–100% (*n*)
Oral ^{131}I (>33 mCi) (73)	56% (41)	12% (9)	5% (4)	26% (19)
Oral ^{131}I (≦33 mCi) (64)	63% (40)	3% (2)	3% (2)	31% (20)
^{223}Ra (Xofigo) (44)	84% (37)	0%	2% (1)	14% (6)
^{90}Y-microspheres (SIRSpheres) (43)	28% (12)	7% (3)	2% (1)	63% (27)
^{177}Lu-DOTATATE (Lutathera) (41)	68% (28)	5% (2)	0%	27% (11)
^{90}Y-microspheres (TheraSpheres) (39)	33% (13)	3% (1)	0%	64% (25)
^{131}I-MIBG (Azedra or generic) (29)	45% (13)	3% (1)	0%	52% (15)
^{90}Y anti-CD 20 (Zevalin) (28)	86% (24)	0%	0%	14% (4)
^{153}Sm-EDTMP (Quadramet (27)	81% (22)	0%	0%	19% (5)
Prostate radionuclide therapy (23)	57% (13)	13% (3)	0%	30% (7)
^{89}Sr (Metastron) (20)	80% (16)	0%	0%	20% (4)
Radionuclide therapy for joints (17)	82% (14)	0%	0%	18% (3)
Others (11)	45% (5)	0%	0%	55% (6)

be included. Another limitation was that for some questions, respondents were not provided dropdown lists of options.

DISCUSSION

The SNMMI Therapy Task Force was formed with representatives from various entities within SNMMI, with the mandate of ensuring that SNMMI will serve as the leader in implementation of high-quality radiopharmaceutical therapies to our patients as an important part of personalized patient care. A therapy strategic plan was developed by the Task Force with sections focusing on adequate reimbursement of radiopharmaceutical therapies, developing processes and quality standards for performing dosimetry, and standardizing therapies by providing appropriate training and education.

We were able to collect substantial baseline information about the types and volumes of therapies currently being performed, their referral patterns, and information about specialties performing these therapies. However, additional focused follow-up surveys are needed to collect more specific information related to these topics.

For example, under nuclear medicine in Table 2, ^{223}Ra is mentioned as the third most performed therapy by percentage. More than 91% of respondents stated that at their institutions nuclear medicine performs 75%–100% of these therapies. At the same time, under radiation oncology, ^{223}Ra was mentioned as the number 1 therapy by percentage with more than 69% stating that radiation oncology performs 75%–100% of these therapies at their institutions. However, recent research by Morgan et al. (*3*) on the pharmacoeconomics of ^{223}Ra indicates that radiation oncology is the number 1 specialty being reimbursed for ^{223}Ra by the Centers for Medicare and Medicaid Services (*4*). Because the number of responses varied from question to question on ^{223}Ra and other therapies, it is likely that some of the answers were preferentially provided by those already offering these therapies. It is perhaps not surprising that a great majority of nuclear medicine physicians reported that they were the most qualified to administer radiopharmaceutical therapies. This seems reasonable given the complexity of the imaging and therapy decision-making processes involved. However, there is clearly great interest by other specialties—notably, "teams" of physician providers were identified as the norm for radiopharmaceutical therapy by most surveyed.

TABLE 4
Percentages of Respondents Reporting Dosimetry at Their Institutions

Radiopharmaceutical therapy (total no. of responses re: each therapy)	Organ dosimetry for safety (*n*)	Tumor dosimetry for efficacy (*n*)	Other (*n*)	No dosimetry (*n*)
Oral ^{131}I (>33 mCi) (67)	57% (38)	27% (18)	4% (3)	25% (17)
Oral ^{131}I (≦33 mCi) (63)	22% (14)	27% (17)	2% (1)	57% (36)
^{223}Ra (Xofigo) (49)	6% (3)	10% (5)	2% (1)	84% (41)
^{90}Y-microspheres (SIRSpheres) (47)	70% (33)	51% (24)	2% (1)	23% (11)
^{177}Lu-DOTATATE (Lutathera) (42)	36% (15)	29% (12)	7% (3)	55% (23)
^{90}Y-microspheres (TheraSpheres) (41)	66% (27)	46% (19)	2% (1)	24% (10)
^{153}Sm-EDTMP (Quadramet) (34)	9% (3)	9% (3)	0%	88% (15)
Prostate radionuclide therapy (33)	27% (9)	18% (6)	3% (1)	67% (22)
^{90}Y anti-CD 20 (Zevalin) (32)	9% (3)	6% (2)	0%	87% (28)
^{131}I-MIBG (Azedra) (28)	46% (13)	14% (4)	0%	54% (15)
^{131}I-MIBG (generic) (28)	18% (5)	18% (5)	0%	75% (21)
^{89}Sr (Metastron) (28)	14% (4)	4% (1)	0%	86% (24)
Radionuclide therapy for joints (24)	12% (3)	8% (2)	0%	83% (20)
Others (20)	20% (4)	10% (2)	5% (1)	75% (15)

The appropriate nomenclature for the field was a survey element of interest. “Radiopharmaceutical therapy” was the most popular of the names assessed, but others were also popular, including “theranostics,” “targeted radiopharmaceutical therapy,” and “radiopharmaceutical therapy.” Agreement on a consistent nomenclature is important for the field. Names such as “molecular radiotherapy” and “molecular-targeted radiopharmaceutical therapy” were viewed with less enthusiasm than the simpler and more traditional “radionuclide therapy” and “radiopharmaceutical therapy.” We suggest the use of “radiopharmaceutical therapy,” abbreviated as RPT, as a useful term, because it clearly indicates that our therapeutic radioactive agents are pharmaceuticals and because it distinguishes the systemic internal administration of radioactivity from external-beam radiation therapy. Some respondents emphasized that RPT is not simply another form of radiation therapy. This confusion could occur by using terms like targeted radionuclide therapy or molecular-targeted radionuclide therapy, for example. Others noted that “theranostics,” while an attractive term linking our diagnostic and therapeutic efforts, is not sufficiently focused on radiopharmaceutical therapies to be a clear terminology for this evolving field.

This survey also highlighted certain areas that require additional education and training to dispel any potential negative perceptions about the utilization of radiopharmaceutical therapies. For example, many physician respondents reported that recently approved novel therapies, such as ^{223}Ra and ^{177}Lu-DOTATATE, are “too expensive.” Many types of newer cancer therapies, notably cellular therapies, can cost hundreds of thousands of dollars, so that “too expensive” may be a relative term for RPTs. That said, if many nuclear medicine physicians believe our treatments to be too expensive and that professional reimbursement is poor, it may be difficult to drive the use of these treatments forward, at least by nuclear medicine physicians. The SNMMI Therapy Task Force should consider funding pharmacoeconomic analyses of utilization of these therapies, specifically with head-to-head comparisons with other recent FDA-approved therapies. Similar efforts should be made to develop refresher educational primers on radiation safety, raised as another concern for radiopharmaceutical therapies. Additional concerns highlighted the need for more training in RPT.

This survey complements and builds upon data from a 2017 European Association of Nuclear Medicine survey that focused on dosimetry (*5*). As in that survey, we found dosimetry was most commonly used in ^{90}Y-microsphere procedures. Consistent with the European data, our responses indicated that most radiopharmaceutical therapies are performed using a fixed dose of radioactivity; thus, although dosimetry is emerging in importance, it is not yet routine in deployment.

We acquired substantial baseline information in this survey, but, given the rapidity of change in the field, additional focused follow-up surveys are needed to guide SNMMI Therapy Task Force activities. Future topics may include questions related to training of residents, fellows, and the current workforce, as well as interest in participating in the Radiopharmaceutical Therapy Registry currently under development and in proposed Therapy Center of Excellence programs. Additional questions about coding and reimbursement as well as dosimetry would be helpful. It is expected that surveys regarding RPT will be conducted regularly in the coming years to help inform and guide growth in this important area of nuclear medicine.

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SNMMI Leadership Update: A Year of Progress Amid a Pandemic

Alan B. Packard, PhD, SNMMI President

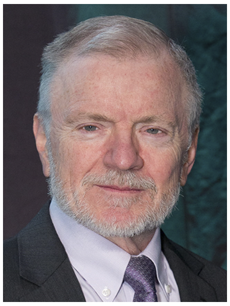
Despite the unprecedented challenges of the past year, SNMMI has successfully continued its mission to improve human health by advancing nuclear medicine, molecular imaging, and radionuclide therapy. SNMMI members and staff showed remarkable commitment to achieving the goals of the Society and accomplished a great deal despite the many challenges they faced and continue to face, effecting positive change for our field.

One of the first steps that SNMMI took to address the impact of the pandemic on nuclear medicine and molecular imaging was to convene a COVID-19 Task Force in the spring of 2020. The activities of the task force include issuing multiple statements regarding ventilation/perfusion lung studies and partnering with the Physics, Instrumentation, and Data Sciences Council to develop workstation guidelines for nuclear medicine physicians who are working from home. In addition, sessions related to COVID-19 were presented at SNMMI's Annual and Mid-Winter Meetings, and a number of COVID-19-related articles were published in both *The Journal of Nuclear Medicine* (*JNM*) and the *Journal of Nuclear Medicine Technology*.

Perhaps the biggest challenge was transitioning the SNMMI Annual Meeting from an in-person to a virtual event within only a couple of months. The virtual Annual Meeting was offered free to all members and was an enormous success, with 9,000 registrants, many more attendees than usual. This increased attendance was due partly to the virtual participation of many people who usually are not able to travel to the meeting. Meeting attendees participated in live continuing education and plenary sessions and visited virtual poster and exhibit halls as well as several virtual networking events.

The same model was utilized for the 2021 SNMMI Mid-Winter Meeting, which saw a 48% increase in registration from 2020, with 800 participants. The meeting offered live and on-demand education sessions, had high involvement from exhibitors and sponsors, and surpassed all of SNMMI's financial goals.

Several new SNMMI initiatives were launched over the past year to address challenges presented by COVID-19 and advance the field of nuclear medicine and molecular imaging. To address the absence of in-person meetings, the Radiochemistry Task Force established a forum where individuals interested in radiopharmaceutical sciences can meet virtually and discuss topics of mutual interest. These "Drink and Think" sessions focused on a variety of topics, including the impact of COVID-19 on radiopharmaceutical research and practical issues related to implementation of USP <825>. Several more sessions are planned. A Diversity, Equity, and Inclusion Task Force was created to enact change in the field. The task force's activities included launching a new series of virtual "Inclusive Gatherings" to bring together underrepresented minority members and individuals who support a commitment to diversity, creating an SNMMI statement on Diversity, Equity, and Inclusion that was adopted by the SNMMI Board of Directors, and organizing sessions at the Mid-Winter Meeting and upcoming Annual Meeting.



Alan B. Packard, PhD

As part of SNMMI's Radiopharmaceutical Therapy Strategic Initiative, the Society launched several new programs and partnerships. A Therapy Task Force was created, as were task forces focusing on education and training, dosimetry, coding and reimbursement, and artificial intelligence. Information about the Society's activities in this area can be accessed through the new therapy-focused web portal, "SNMMI Radiopharmaceutical Therapy Central." In addition, a therapeutics conference is being planned for November 2021, and a new Radiopharmaceutical Therapy Registry is being created.

SNMMI received a 3-year, $750,000 grant from the U.S. Department of Energy (DoE) to provide capacity building for nuclear medicine and molecular imaging institutions in least-developed countries in sub-Saharan Africa. The SNMMI DoE Grant Task Force will focus its initial efforts in Ghana and has begun working with Korle Bu Teaching Hospital to provide education and technical assistance.

On the advocacy front, in December the Society was successful in getting the Centers for Medicare and Medicaid Services (CMS) to remove the national noncoverage decision for infection/inflammation imaging. In 2021, SNMMI will continue to work with CMS to further expand nononcologic PET coverage. SNMMI, along with its coalition partners, continues in its efforts to ensure adequate reimbursement for high-value radiopharmaceuticals. The coalition introduced a bill for separate payment of high-value radiopharmaceuticals (HR 3772) with broad bipartisan support in the last congress and is planning to introduce similar legislation to the new congress.

(*Continued on page 22N*)

^{18}F-FDG PET National Coverage Determination for Infection/Inflammation Retired

On January 1, 2021, the Centers for Medicare and Medicaid Services (CMS) National Coverage Determination (NCD) for noncoverage of ^{18}F-FDG PET for infection and inflammation was retired. The removal of this NCD, in effect since 2008, opens a path to reimbursement through coverage determinations made at the discretion of local Medicare Administrative Contractors (MACs). In the absence of a MAC Local Coverage Determination, NCD, or CMS Manual Instruction, "reasonable and necessary guidelines" apply.

Section 1862(a)(1)(A) of the Social Security Act directs that: "No payment may be made under Part A or Part B for any expenses incurred for items or services not reasonable and necessary for the diagnosis or treatment of illness or injury or to improve the functioning of a malformed body member." Each MAC will determine if an item or service is "reasonable and necessary" under §1862(a)(1)(A) of the act, if the service is: "Safe and effective; not experimental or investigational; and appropriate, including the duration and frequency in terms of whether the service or item is: Furnished in accordance with accepted standards of medical practice for the diagnosis or treatment of the beneficiary's condition or to improve the function of a malformed body member; furnished in a setting appropriate to the beneficiary's medical needs and condition; ordered and furnished by qualified personnel; and one that meets, but does not exceed, the beneficiary's medical need."

For any service reported to Medicare, it is expected that medical documentation can clearly demonstrate that the service meets each of these criteria. Documentation must be maintained in the patient's medical record and be available to the contractor upon request.

On March 11, SNMMI reported that leadership and staff had met with Palmetto GBA (Columbia, SC), WPS Government Health Administrators (WPS GHA; Madison, WI), and CGS Administrators (Nashville, TN) and had communicated with Novitas Solutions (Mechanicsburg, PA) and Noridian Healthcare Solutions (Fargo, ND). At that time, no MACs were in the process of developing a Local Coverage Determination, although CGS expressed an interest. SNMMI will keep working with all the MACs as well as its own members on claims processing issues.

Although all MACs are required to process claims according to reasonable and necessary guidelines in the absence of a Local Coverage Determination, WPS GBA reported that they are not looking to develop a Local Coverage Determination at this time; instead, they prefer to monitor claims, because the volume is expected to be low. They assured SNMMI representatives that there should be no reimbursement issues with ^{18}F-FDG PET for inflammation and infection.

SNMMI, the American Society of Nuclear Cardiology, the American College of Nuclear Medicine, and the American College of Radiology will continue meeting with local MACs to provide education and information about the new policy and ensure coverage at the local level. SNMMI will soon approve appropriate use criteria for use of PET for infection and inflammation. In addition, a new workgroup has been formed to create appropriate use criteria for use of PET to diagnose fever of unknown origin.

For more information, contact hpra@snmmi.org.

SNMMI

IAEA Webinar Series for Women in Nuclear Science

On February 24, the International Atomic Energy Agency (IAEA) launched a series of webinars intended to increase female representation in nuclear sciences and associated applications. The first webinar, with more than 300 participants, encouraged careers in accelerator science and technology. "The low representation of women working with particle accelerators weakens diversity and competitiveness in our field," said Aliz Simon, PhD, Accelerator Specialist at IAEA and a speaker at the event. "More outreach and additional efforts are needed to inspire young women to engage in nuclear physics and to support, inform, and empower them throughout their careers."

Speakers emphasized the technical, scientific, and societal benefits of working with accelerator technology. "Working with accelerators means you get to operate insanely powerful machines that are beautiful pieces of engineering, but you also get to work on inspirational projects with people who are passionate about what they do," said Ceri Brenner, PhD, Leader of the Centre for Accelerator Science at the Australian Nuclear Science and Technology Organisation.

The international nature of the work was also emphasized, with multiple career opportunities in government, academic, and industry settings around the world. "Accelerator science has by default an international character," said Melissa Denecke, PhD, Director of the IAEA Division of Physical and Chemical Sciences. "It is a fantastic place for women in science to gather momentum and drive the progress on gender equality."

The webinar on careers in accelerator science is available at: https://www.youtube.com/watch?v=NcJcPGuubFg. The next webinar in the series will highlight careers for women in fusion, followed by events on radiopharmaceuticals, radiation technologies, isotope hydrology, nuclear data, research reactors, and nuclear instrumentation. More information is available at www.iaea.org.

International Atomic Energy Agency

Increased Imaging Resources Could Save Lives

In an article published online on March 3 ahead of print in *Lancet Oncology*, the journal's Commission on Medical Imaging and Nuclear Medicine detailed the results of a report issued during the European Congress of Radiology, reviewing data collected from 211 countries, territories, and principalities on availability and gaps in imaging resources. Substantial shortages in equipment and workforce were identified, especially in low- and middle-income countries. The *Lancet Oncology* Commission on Medical Imaging and Nuclear Medicine was established with International Atomic Energy Agency support in 2018. "The aim was to provide data and guidance to catalyze sustainable improvement of medical imaging and nuclear medicine services for cancer management, particularly in low- and middle-income countries," said co-lead author Hedvig Hricak, MD, PhD, from Memorial Sloan Kettering Cancer Center (New York, NY).

Microsimulation models of 11 cancers showed that greater availability of imaging would avert 3.2% (2.46 million) of all deaths caused by these cancers between 2020 and 2030, saving 54.92 million life-years worldwide. A more comprehensive and integrated scale-up of imaging, treatment, and care quality would avert 12.5% (9.5 million) of all cancer deaths caused by the modeled cancers, saving 232.30 million life-years. Cost estimates put the scale-up of imaging at US$6.84 billion for the 10-y time frame but projected a yield in lifetime productivity gains of $1.23 trillion worldwide, a net return of $179.19 per $1 invested. Similarly, the combined scale-up of imaging, treatment, and quality of care was projected to provide a net benefit of $2.66 trillion and a net return of $12.43 per $1 invested. In what the report called a conservative approach to estimates of human capital, the scale-up of imaging alone would provide a net benefit of $209.46 billion and net return of $31.61 per $1 invested and the comprehensive scale-up would provide a net benefit of $340.42 billion and return per dollar invested of $2.46.

Although the report showed significant disparities in access to imaging technology and skilled workforces, these potential benefits held true across geographic regions. The commission proposed several actions and investments to enhance access to imaging equipment, workforce capacity, digital technology, radiopharmaceuticals, and research and training programs in low- and middle-income countries "to produce massive health and economic benefits and reduce the burden of cancer globally."

Lancet Oncology

NIH Advances Public/Private Partnership in Alzheimer Disease

The National Institutes of Health (NIH) announced on March 2 the launch of the next version of the Accelerating Medicines Partnership (AMP) Alzheimer disease (AD) program (AMP AD 2.0) to expand its open-science, big-data approach to identifying biologic targets for therapeutic interventions. AMP AD 2.0 is supporting new technologies, including cutting-edge, single-cell profiling and computational modeling, to enable a precision medicine approach to therapy development. Managed through the Foundation for the NIH (FNIH), AMP AD 2.0 brings together NIH, industry, nonprofit, and other organizations with a shared goal of using open-science practices to accelerate discovery of new drug targets, biomarkers, and disease subtypes.

"Unraveling the complex biological mechanisms that cause AD is critical for therapeutic development," said NIH Director Francis S. Collins, MD, PhD. "AMP AD 2.0 aims to add greater precision to the molecular maps developed in the first iteration of this program. This will identify biological targets and biomarkers to inform new therapeutic interventions for specific disease subtypes."

Because the prevalence of AD is greater among Black and Latino Americans than among white Americans, AMP AD 2.0 will expand the molecular characterization of AD in brain, blood, and spinal fluid samples collected in these diverse populations. These datasets will allow research teams to refine characterization of new targets, discover new fluid biomarkers, define disease subtypes, and increase understanding of causative factors and steps in disease progression. The knowledge gained will inform the development of therapies that can be tailored to different stages of the disease and diverse disease risk profiles.

"AMP AD has helped transform the way we learn about the disease process and identify new targets for treatment," said Richard J. Hodes, MD, director of the National Institute on Aging (NIA). "By expanding the molecular characterization of AD to be more inclusive of diverse populations and by renewing the commitment to open-science practices for sharing data, methods, and results, we will enable researchers across the globe to better understand the complex nature of the disease and take a precision medicine approach to the development of effective treatments."

During the first AMP AD program, research teams generated high-quality data from human biologic samples and animal and cell-based models and discovered more than 500 unique candidate targets through computational methods. These novel data resources were made available through a centralized data infrastructure and data-sharing platform, the AD Knowledge Portal (https://adknowledgeportal.synapse.org/), and the portal-linked, open-source platform Agora (https://agora.ampadportal.org/genes). The wide availability of these data has led to new insights into the role of the genome, proteome, metabolome, and microbiome in AD processes. To date, more than 3,000 researchers representing academic, biotechnology, and pharmaceutical industry sectors have used these data resources for research on AD and related dementias. NIA will lead research efforts and contribute an estimated total of $61.4 million over 5 years, pending availability of funds. This includes funding for a data coordinating center at Sage Bionetworks (Seattle, WA) and 6 multi-institutional, cross-disciplinary academic research teams. Private contributions from industry will total more than $13.45 million.

"This partnership offers real hope to the tens of millions of people affected by Alzheimer's disease," said Maria C. Freire, PhD, president and executive director of the FNIH. "Collaboration through the first round of AMP AD has already enabled breakthrough advances in researchers' understanding of how AD progresses, uncovering numerous potential targets for drug therapy in a field where treatment options are severely limited."

National Institute on Aging

SNMMI and Coalition Partners Address Nuclear Medicine Access

SNMMI, along with the Medical Imaging & Technology Alliance (MITA) and the Council on Radionuclides and Radiopharmaceuticals, Inc. (CORAR), hosted on March 3 a virtual briefing with physicians, patients, and industry representatives on the need to improve patient access to innovative nuclear diagnostics and the growing role of PET, SPECT, and nuclear medicine in detecting prostate cancer, Parkinson and Alzheimer diseases, and other life-threatening conditions. Attended by a broad coalition of patient and provider stakeholders, the briefing included presentations from SNMMI member Thomas Hope, MD, Director of Molecular Therapy in the Department of Radiology and Biomedical Imaging at the University of California, San Francisco, and Joel Nowak, MA, MSW, cofounder and CEO of Cancer ABCs and a cancer advocate and patient.

"At a time when millions of Americans have delayed or avoided regular screening care amid the COVID-19 public health emergency, allowing access to advanced diagnostic imaging procedures that can better detect deadly diseases earlier—when they are most treatable—is essential," said Michael J. Guastella, MS, MBA, Executive Director of CORAR, who delivered the briefing's opening remarks. "Unfortunately, due to arcane Medicare reimbursement policies, patients and their doctors are unable to fully leverage the benefits of these innovative diagnostic imaging tools. This ongoing problem undermines public health and incentivizes the use of less effective screening modalities."

Dr. Hope provided an overview of the latest advances in PET imaging in identifying prostate cancer. Mr. Nowak discussed his personal experience battling metastatic prostate cancer and the central role of diagnostic radiopharmaceuticals in supporting recovery. Ann Marie Dawidczyk, Vice President of Patient Access at Blue Earth Diagnostics and chair of the MITA Coverage, Coding, and Payment Committee, discussed Medicare's current reimbursement policy and suggested ways to advocate for a solution, including supporting legislation to provide access to innovative radiopharmaceutical diagnostics. "Despite having demonstrated health benefits for Medicare beneficiaries, outdated Centers for Medicare and Medicaid Services payment methodologies create significant, often insurmountable access barriers to a newer, more precise generation of PET and SPECT diagnostic imaging modalities," she said. "To provide patient access, improve treatment outcomes, and incentivize the research and development of future diagnostic breakthroughs, these structural reimbursement barriers must be addressed. Therefore, we urge all attendees to join us in supporting the proposed Facilitating Innovative Nuclear Diagnostics (FIND) Act of 2021, which, if passed, would update Medicare reimbursement policy to grant greater access to innovative diagnostic radiopharmaceuticals for patients." More information on the FIND Act is available at http://s3.amazonaws.com/rdcms-snmmi/files/production/public/SNMMI_FIND_ONEPAGER_3-3-21.pdf.

SNMMI

Genetic Study on Lewy Body Dementia, Alzheimer Disease, and Parkinson Disease

Chia, from the National Institute on Aging (NIA), and a team of National Institutes of Health (NIH) researchers and international collaborators reported in the March issue of *Nature Genetics* (2021;53[3]:294–303) on the results of a study identifying 5 genes that may play a critical role in determining whether an individual will develop Lewy body dementia. These results supported not only the disease's ties to Parkinson disease (PD) but suggested that individuals with Lewy body dementia may share similar genetic profiles with those who have Alzheimer disease (AD).

"Lewy body dementia is a devastating brain disorder for which we have no effective treatments. Patients often appear to suffer the worst of both AD and PD. Our results support the idea that this may be because Lewy body dementia is caused by a spectrum of problems that can be seen in both disorders," said Sonja Scholz, MD, PhD, investigator at the NIH National Institute of Neurological Disorders and Stroke and the senior author of the study, in an NIH press release. "We hope that these results will act as a blueprint for understanding the disease and developing new treatments." The study was led by Scholz's team and researchers in the lab of Bryan J. Traynor, MD, PhD, senior investigator at NIA. "Compared to other neurodegenerative disorders, very little is known about the genetic forces behind Lewy body dementia," said Traynor. "To get a better understanding we wanted to study the genetic architecture of Lewy body dementia."

The researchers compared the chromosomal DNA sequences of 2,981 Lewy body dementia patients with those of 4,931 healthy, age-matched controls. Samples were collected from participants of European ancestry at 44 sites: 17 in Europe and 27 across North America. The DNA sequencing was led by Clifton Dalgard, PhD, and researchers at the American Genome Center, a series of state-of-the-art laboratories located at the Uniformed Services University of the Health Sciences (Bethesda, MD) and supported by the Henry M. Jackson Foundation for the Advancement of Military Medicine.

The sequences of 5 genes from Lewy body dementia patients were identified as different from those of the controls: SNCA, APOE, GBA, BIN1, and TMEM175. Differences in the same 5 genes were documented when comparing DNA sequences from 970 additional Lewy body dementia patients and those from a new set of 8,928 controls. Additional analyses suggested that changes in the activity of these genes may lead to dementia and that the GBA gene may have a particularly strong influence on this process. This gene encodes instructions for β-glucosylceramidase, a protein that helps cellular breakdown of sugary fats. The researchers found that both common and rare variants in the GBA gene are tied to Lewy body dementia.

To examine apparent links between Lewy body dementia and other neurodegenerative diseases, the researchers further analyzed data from previous studies on AD and PD. "Although AD and PD are molecularly and clinically very different disorders, our results support the idea that the problems that cause those diseases may also happen in Lewy body dementia," said Scholz. "The challenge we face in treating these patients is determining which specific problems are causing the dementia. We hope studies like this one will help doctors find precise treatments for each patient's condition."

The team has published the genome sequence data from the study on the database of Genotypes and Phenotypes (https://www.ncbi.nlm.nih.gov/gap/), a National Library of Medicine website that researchers can freely search for new insights into the causes of Lewy body dementia and other disorders.

National Institutes of Health
Nature Genetics

Repurposing Drugs in Alzheimer Disease with Artificial Intelligence

In an article published on February 15 ahead of print in *Nature Communications*, Rodriguez et al. from Harvard Medical School and Massachusetts General Hospital (both in Boston, MA) presented a machine-learning framework to quantify potential relationships between types of pathology associated with Alzheimer disease (AD) stage (early, mid, or late, as defined by Braak staging) and molecular mechanisms that can be characterized by a list of gene names. Called Drug Repurposing in AD (DRIAD), the framework is offered as an alternative to the current proliferation of clinical trials of novel AD-targeted therapeutics and the very low yield in terms of promising candidates. The project applies artificial intelligence tools with the aim of identifying U.S. Food and Drug Administration (FDA)–approved agents for other indications that might have beneficial effects if developed for AD. The authors make a distinction between current efforts to repurpose existing drugs for new indications and using repurposing to test a therapeutic concept that can then be advanced (with additional testing and/or alterations) to become a New Molecular Entity as defined by the FDA. This study of DRIAD's utility identified associations of gene perturbations in AD brain regions by a subset of 80 FDA-approved and clinically tested drugs and investigational compounds (mainly kinase inhibitors), with a resulting ranked list of possible repurposing candidates. The authors concluded that the DRIAD method "can be used to nominate drugs that, after additional validation and identification of relevant pharmacodynamic biomarker(s), could be readily evaluated in a clinical trial."

Nature Communications

New Los Alamos Generator for α-Emitters

In a press release issued on March 10, the U.S. Department of Energy (DOE) Los Alamos National Laboratory (NM) highlighted its new system for producing α-emitting medical radioisotopes. "The new system is based on a $^{230}U/^{226}Th$ pairing, where the ^{226}Th is supplied in a form suitable for medical applications," said Michael Fassbender, PhD, the lead researcher at Los Alamos. "The ^{226}Th emits multiple α particles as it decays, delivering a powerful blow to diseased cells. This is similar to ^{225}Ac, another promising α therapy isotope. The DOE Isotope Program is committed to making multiple options, or a variety of radioisotopes, available to accelerate the development of therapeutics that could be used to treat different cancers."

Through a chemical process, the new Los Alamos generator allows repeated separation of ^{226}Th from ^{230}U. The generator will be available to researchers through the National Isotope Development Center, providing a consistent supply of ^{226}Th for use in investigating the next steps in creating new radiopharmaceuticals. (For additional information on the generator, see Mastren et al. A reverse $^{230}U/^{226}Th$ radionuclide generator for targeted alpha therapy applications. *Nucl Med Biol.* 2020;69:90–91; and Friend et al. Production of ^{230}Pa by proton irradiation of ^{232}Th at the LANL isotope production facility: Precursor of ^{230}U for targeted alpha therapy. *Appl Radiat Isot.* 2020;156:108973.

Los Alamos National Laboratory

In Memoriam: Dan G. Pavel, MD

Dan G. Pavel, MD, a pioneer in nuclear medicine, passed away on February 20. He is remembered by friends and colleagues as a warm and generous man who guided many to be better physicians and scientists. He was always focused on the task at hand, with little patience for small talk. His style might seem somewhat abrasive at first, but behind that was a genuinely caring person of great integrity.

Originally from Bucharest, Romania, Dr. Pavel completed his residency in nuclear medicine at Northwestern University (Evanston, IL) in 1974. He immediately joined the faculty at the University of Illinois Medical Center (Chicago). In 1977 he was promoted to Director of Nuclear Medicine and in 1982 became a professor of radiology/nuclear medicine. He remained in the department until 2005, when he retired from academia. He continued in private practice as director of Pathfinder Brain SPECT Imaging (Deerfield, IL) until his death.

Dr. Pavel developed a strong interest in image processing algorithms and display techniques. He insisted on rigorous quality control and reproducibility; in particular, he promoted the use of color in report displays and created an intuitive color palette allowing semiquantitative readings. Open to new ideas, he pioneered the use of factor analysis to discover patterns in dynamic studies, both in renal studies and planar-gated ventriculography. He became one of the top specialists in the latter technique.

In the late 1990s, he became more involved with brain SPECT, working to establish rigorous criteria for the diagnosis of various pathologies, as well as developing better techniques for image processing and display of SPECT brain scans. His goal was to make these scans understandale by general practitioners and patients alike. He was a founding member of the International Society of Applied Neuroimaging (ISAN) and worked to improve the utility and appreciation of SPECT neuroimaging.

In addition to ISAN, Dr. Pavel was an active member of SNMMI. He served on the Instrumentation Council from 1980 to 1982, the Brain Imaging Outreach Working Group from 2016 to 2017, and as a reviewer throughout the 1980s and 1990s. His contributions to the scientific community include more than 100 research articles in multiple languages, 4 book chapters, more than 90 presentations, and more than 100 invited lectures.

We lost a friend and mentor, but his contributions to nuclear medicine will live on.

Theodore A. Henderson, MD, PhD
Simon DeBruin, MSEE
Philippe Briandet, PhD

(Continued from page 17N)

JNM had a banner year; it was ranked third highest among all medical imaging journals for impact factor and highest among all nuclear medicine journals. *JNM* celebrated its 60th anniversary in 2020, commemorating the occasion with a special supplement highlighting 6 decades of leadership in the field. The journal also launched a new website, as well as Facebook and Twitter sites.

Looking to the future, a vision document, titled "Mars-Shot for Molecular Imaging and Molecular Targeted Radiopharmaceutical Therapy," was published in *JNM* in January 2021. The document was a culmination of input from all the SNMMI councils and centers on the possibilities for the future of nuclear medicine, molecular imaging, and radiopharmaceutical therapy.

Finally, even in the face of the COVID-19 pandemic, SNMMI finances are in excellent shape, and the Value Initiative continues to be successful thanks to the ongoing support of our many industry partners. SNMMI's relationships with other nuclear medicine societies and peer organizations are also strong, as the Society continues to engage with them virtually to maintain these crucial connections.

SNMMI's members and staff have proven that we can do great things even in the face of a pandemic, and they will continue to do great things in the coming year. I encourage you to join us in these efforts and for the SNMMI Virtual Annual Meeting, June 11–15, 2021, to learn about the latest advances in the field of nuclear medicine and molecular imaging.