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Implementing [177Lu]Lu-PSMA-617 radioligand therapy in clinical practice: a multistakeholder evaluation of real-world experience and implementation challenges

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Abstract

Purpose Radioligand therapy with [177Lu]Lu-PSMA-617 is increasingly integrated into the management of metastatic castration-resistant prostate cancer. Although clinical efficacy is well established, data on real-world implementation, including patient understanding and structural barriers, remain limited. This study evaluated patient-reported experiences at a single Swiss tertiary center together with national expert perspectives on the implementation of PSMA radioligand therapy (PSMA-RLT) in Switzerland.

Methods This multistakeholder observational survey study combined a monocentric patient survey with a national survey of oncologists and nuclear medicine physicians. Eligible patients treated with at least two cycles of [177Lu]Lu-PSMA-617 between 2020 and 2026 were contacted ($n = 152$). A structured 10-item patient questionnaire — comprising seven Likert-scale items (scored 1–5, where 1 = lowest and 5 = highest), two dichotomous yes/no questions, and one open-ended item — assessed communication quality, understanding of radioprotection measures, perceived side-effect burden, and overall satisfaction. In parallel, a clinician survey was distributed to 8 oncologists and 10 nuclear medicine physicians (18 in total) from 8 Swiss university and tertiary cancer centers, addressing referral practices, structural constraints, and implementation challenges. Quantitative data were analyzed descriptively using Stata 18, and free-text responses were subjected to thematic analysis.

Results Thirty-seven patients responded (24.3%). On the 1–5 scale, communication quality (mean 4.53 ± 0.97) and clarity of radioprotection instructions (mean 4.64 ± 0.83) were rated highly, with 91.7% of respondents assigning scores ≥ 4. Overall satisfaction was high (mean 4.47 ± 1.13), and 97.3% of patients reported receiving sufficient explanations for post-discharge management. Perceived side-effect burden was low (mean 2.24 ± 1.52). Sixteen patients (43.2%) provided qualitative comments, predominantly expressing satisfaction. Thirteen of the 18 invited clinicians responded (72.2%; seven oncologists and six nuclear medicine physicians). All oncologists

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reported regular referrals. Limited capacity was cited by 42.9% of oncologists and treatment-room constraints by 66.7% of nuclear medicine physicians. All nuclear medicine physicians (6/6, 100%) reported a significant increase in demand for PSMA-RLT.

Conclusion In this exploratory evaluation, [177Lu]Lu-PSMA-617 radioligand therapy was associated with high patient satisfaction at a single center and strong clinician acceptance across participating Swiss centers. Structural capacity and organizational constraints emerged as the principal implementation challenges. These preliminary findings suggest a demand–capacity mismatch as a key implementation challenge in theranostics and highlight the need for coordinated infrastructure and workforce adaptation to ensure equitable and scalable access. Given the monocentric patient cohort and small clinician sample, these observations require confirmation in larger, multicenter studies.

Keywords Radioligand therapy, Prostate-specific membrane antigen, [177Lu] Lu-PSMA-617, Theranostics, Patient-reported outcomes, Health services implementation, Radiation protection

Introduction

Radioligand therapy (RLT) targeting prostate-specific membrane antigen (PSMA) has substantially changed the therapeutic landscape of metastatic castration-resistant prostate cancer (mCRPC) and has contributed to the rapid integration of theranostics within routine oncologic practice. In the phase III VISION trial, the addition of [177Lu]Lu-PSMA-617 to standard of care significantly improved overall survival and radiographic progression-free survival in heavily pretreated patients (Sartor et al. 2021). Complementary evidence from the randomized phase II TheraP trial further demonstrated superior biochemical response rates and a favorable toxicity profile compared with cabazitaxel (Hofman et al. 2021). Beyond traditional oncologic endpoints, patient-reported outcomes confirmed delayed deterioration in quality of life and pain control, underscoring the multidimensional benefit of PSMA-RLT (Fizazi et al. 2023). More recently, the phase III PSMAfore trial demonstrated a significant improvement in radiographic progression-free survival with [177Lu]Lu-PSMA-617 compared with androgen receptor pathway inhibitor switch in taxane-naïve patients, with a favorable safety profile (Fizazi et al. 2025). In parallel, the ongoing phase III PSMAddition trial is evaluating the addition of [177Lu]Lu-PSMA-617 to standard of care in metastatic hormone-sensitive prostate cancer, with radiographic progression-free survival as the primary endpoint (Novartis Pharmaceuticals).

As PSMA-RLT transitions from clinical trials to widespread adoption, attention is increasingly directed toward the substantial operational, logistical, and organizational challenges inherent to its real-world implementation. Unlike conventional systemic therapies, PSMA-RLT requires dedicated nuclear medicine infrastructure, radiation-protected facilities, multidisciplinary coordination, and strict adherence to radiation safety standards. These complexities are reflected in international procedural guidelines issued by EANM and SNMMI, which define best practices for patient selection, treatment administration, monitoring, and radioprotection (Kratochwil et al. 2023, Kratochwil et al. 2019). Importantly, although such guidelines harmonize clinical best practice, radiation protection regulations and institutional requirements differ substantially between countries. Hospitalization requirements, discharge thresholds, and eligibility

for outpatient administration are largely determined at the national or regional level; consequently, international guidelines cannot fully capture every regulatory detail, and each region must adapt its implementation model to its own regulatory and healthcare environment. The successful integration of PSMA-RLT therefore depends not only on radiopharmaceutical efficacy but also on organizational capacity, interprofessional alignment, regulatory context, and patient adherence to safety measures.

Radiation protection instructions provided after each treatment cycle are essential to minimize exposure to relatives and caregivers. Communication of radiation risk in nuclear medicine is inherently complex, and patients often experience uncertainty or limited understanding about radiation exposure (Pandit and Vinjamuri 2014, Ribeiro et al. 2020). In addition, post-therapy safety management may extend beyond nuclear medicine departments, requiring coordination with oncology teams and primary care providers (Mench et al. 2025). Evidence from radiation education research suggests that technical language and insufficient clarification can lead to misunderstanding, anxiety, or suboptimal adherence (Schnitzler et al. 2017, Dong et al. 2014). In the context of PSMA-RLT, structured communication and coordinated workflows are therefore important to ensure both safety and patient-centered care.

While the clinical efficacy and safety profile of PSMA-RLT are well characterized, less is known about how the therapy is experienced by patients and operationalized by referring oncologists and nuclear medicine physicians in routine practice. Multistakeholder evaluation may provide important insight into the facilitators and barriers influencing sustainable implementation of PSMA-RLT programs.

The objective of this study was to conduct an exploratory, hypothesis-generating multistakeholder assessment combining patient-reported experience from a single Swiss tertiary center with clinician perspectives from oncologists and nuclear medicine physicians across Switzerland, in order to characterize real-world communication quality, perceived barriers, and organizational determinants of PSMA-RLT implementation.

Methods

Study design

This multistakeholder observational survey study evaluated the real-world implementation of [177Lu]Lu-PSMA-617 radioligand therapy (PSMA-RLT) in Switzerland through both patient-reported experience and clinician perspectives. The study combined a monocentric patient survey conducted at a tertiary referral center with a national Swiss survey of oncologists and nuclear medicine physicians involved in PSMA-RLT delivery. Patients treated between January 2020 and January 2026 were eligible for inclusion in the patient survey. Survey distribution took place during the study period using retrospective and prospective collection procedures as described below.

This asymmetric design was intentional. Detailed patient-level experience, collected within a standardized communication pathway and uniform in-hospital procedures, was most reliably captured within a single high-volume center where the care pathway could be precisely characterized. The clinician survey, by contrast, was deliberately national in scope in order to characterize implementation barriers and structural constraints across Swiss PSMA-RLT programs. The combination of a monocentric patient survey with a national clinician survey is acknowledged as a limitation and should be taken into account when interpreting comparisons between the two components; patient-reported

findings reflect a single tertiary center and are not intended to represent the national patient experience.

Patient survey

Adult patients who received at least two cycles of [177Lu]Lu-PSMA-617 at the Centre Hospitalier Universitaire Vaudois (CHUV) during the study period were eligible for inclusion. Patients were identified through institutional treatment records. Individuals deceased at the time of survey distribution were excluded. A total of 152 eligible patients were contacted.

A structured 10-item questionnaire was developed in French and English to assess patient-reported experience across three predefined domains: (1) pre-treatment communication and understanding, (2) in-hospital experience and perceived side effects, and (3) post-discharge radioprotection adherence and overall satisfaction. The instrument comprised seven Likert-scale items rated on a 5-point scale (1 = lowest, 5 = highest), two dichotomous yes/no questions, and one open-ended item allowing free-text comments. The questionnaire was developed collaboratively by nuclear medicine physicians and oncology specialists with clinical expertise in PSMA-RLT, in order to enhance content relevance and clarity. The instrument was exploratory and was not formally validated psychometrically or pilot-tested; this limitation is addressed in the Discussion.

Data were collected in two phases. In a retrospective phase, previously treated patients received the questionnaire by postal mail, including a prepaid return envelope and secure QR-code access to an online version via the institutional Sphinx platform. In a prospective phase, the same questionnaire was distributed during hospitalization from the second treatment cycle onward. All responses were fully anonymized: paper questionnaires contained no fields for patient name, date of birth, treatment dates, or any other identifying information, and questionnaire identifiers were not linked to treatment records. Online responses were collected through the institutional Sphinx platform, configured to suppress IP-address logging and metadata collection, in accordance with Swiss data protection regulations.

PSMA-RLT at CHUV is delivered within a standardized communication pathway including written information materials, a dedicated pre-treatment consultation, individualized radiation safety counseling, verbal reinforcement during hospitalization, and structured discharge instructions. This communication framework is summarized in Supplementary Table S1, and the patient information leaflet used at our institution is provided, in an English-language version, as Supplementary Appendix S4. Post-treatment imaging was systematically performed after each [177Lu]Lu-PSMA-617 administration as part of the institutional treatment pathway.

Clinician survey

In parallel, a national Swiss survey was distributed to oncologists and nuclear medicine physicians practicing in major Swiss cancer centers and actively involved in PSMA-RLT referral or administration. The survey was distributed to 8 oncologists and 10 nuclear medicine physicians (18 clinicians in total). Clinicians were recruited from 8 university and tertiary cancer centers across the French-, German-, and Italian-speaking regions of Switzerland, representing both referring oncologists and nuclear medicine physicians involved in PSMA-RLT programs; participation therefore covered all three major

linguistic regions of the country. Participation was voluntary and anonymous. The questionnaire included multiple-choice and open-ended items addressing practice setting, referral patterns, timing of PSMA-RLT integration, perceived barriers to implementation, workflow coordination, radioprotection considerations, and expectations for future development.

The questionnaires were tailored to the primary scope of each specialty. Because reimbursement and coverage decisions in Switzerland are predominantly navigated at the oncology referral stage, where oncologists engage with payers and coverage criteria before initiating the PSMA-RLT pathway, reimbursement-related items were included in the oncologist survey but not in the nuclear medicine survey, whose focus was treatment administration and radiation safety. The questionnaires were available in three languages (French, German, and Italian). The full questionnaires are provided in Supplementary Appendices S1–S3.

Outcomes

At the patient level, primary outcomes included perceived quality of communication, clarity and understanding of radioprotection measures, difficulty applying safety instructions at home, perceived side-effect burden during hospitalization, and overall treatment satisfaction. At the clinician level, outcomes included referral variability, structural and logistical barriers, treatment capacity constraints, and organizational factors influencing implementation.

Statistical analysis

Quantitative data were analyzed using Stata Statistical Software, Release 18 (StataCorp LLC, College Station, TX, USA). The analytical plan — including primary outcomes, summary statistics, and the thematic analysis approach — was defined prior to data collection and analysis. Likert-scale variables were treated as ordinal and summarized as both mean ± standard deviation and median with interquartile range (IQR); means are reported to facilitate descriptive comparison while explicitly acknowledging the ordinal nature of these data. Categorical variables are presented as counts and percentages. The response rate was calculated relative to the number of eligible patients contacted.

Analyses were performed on available cases for each questionnaire item; denominators therefore vary slightly across questions. Given the sample size, no subgroup analyses, formal nonresponse-bias assessment, or association analyses were performed.

Qualitative responses were analyzed using thematic content analysis. Two investigators independently reviewed free-text data to identify recurring themes and categories. Discrepancies were resolved by consensus.

Ethical considerations

The study was conducted in accordance with the Swiss Human Research Act and the Ordinance on Human Research with the Exception of Clinical Trials. Given the observational design, fully anonymized data collection, and absence of interventional procedures, the Cantonal Research Ethics Committee of Vaud (CER-VD) determined that the requirement for formal ethical approval was waived. As the study qualified for this waiver, no formal approval number was assigned; the CER-VD determination is

documented in institutional records. Participation was voluntary, and completion of the questionnaire was considered informed consent for the use of anonymized data.

Results

Patient-reported outcomes

Response rate and study population

Of the 152 eligible patients contacted, 37 completed the questionnaire, corresponding to a response rate of 24.3%. All respondents had received at least two cycles of [177Lu]Lu-PSMA-617 therapy. Detailed quantitative results are summarized in Table 1.

Pre-treatment communication and understanding

Perceived quality of pre-treatment communication was high (mean 4.53 ± 0.97; $n = 36$), with 33 of 36 respondents (91.7%) assigning scores ≥ 4 and 3 of 36 (8.3%) reporting scores ≤ 2. Clarity of radiation protection instructions was similarly rated (mean 4.64 ± 0.83; $n = 36$), with 91.7% assigning scores ≥ 4. Understanding of the treatment prior to initiation showed a mean score of 4.39 ± 0.80 ($n = 36$), with 31 of 36 respondents (86.1%) reporting scores ≥ 4. All respondents (37/37, 100%) considered the information provided before therapy to be adequate.

In-hospital experience

Perceived side-effect burden during hospitalization was low (mean 2.24 ± 1.52; $n = 37$). Twenty-five of 37 patients (67.6%) reported minimal impact with scores ≤ 2, while 7 of 37 (18.9%) reported scores ≥ 4. This item reflects patient-perceived treatment experience and was not correlated with objective clinical toxicity assessment; it should therefore not be interpreted as a measure of clinically graded adverse events, and may in part capture general hospitalization-related discomfort rather than treatment-specific toxicity (see Discussion).

Table 1 Patient-reported experience and satisfaction with [177Lu]Lu-PSMA-617 radioligand therapy ($n = 37$) Likert-scale items

Likert-scale items				
Domain	**Questionnaire item**	**Mean ± SD**	**Median (IQR)**	**Score ≥ 4, *n* (%)**
Pre-treatment	Quality of communication ($n = 36$)	4.53 ± 0.97	5 (4–5)	33 (91.7%)
Pre-treatment	Clarity of radioprotection instructions ($n = 36$)	4.64 ± 0.83	5 (5–5)	33 (91.7%)
Pre-treatment	Understanding prior to therapy ($n = 36$)	4.39 ± 0.80	5 (4–5)	31 (86.1%)
Hospitalization	Perceived side-effect burden ($n = 37$)	2.24 ± 1.52	2 (1–3)	7 (18.9%)
Post-discharge	Difficulty applying safety instructions ($n = 37$)	2.05 ± 1.51	1 (1–3)	6 (16.2%)
Overall	Global satisfaction ($n = 36$)	4.47 ± 1.13	5 (4–5)	33 (91.7%)
Overall	Quality of life since initiation ($n = 37$)	4.14 ± 1.03	4 (4–5)	31 (83.8%)
Dichotomous items				
Domain	**Questionnaire item**		**Yes, *n* (%)**	**No, *n* (%)**
Pre-treatment	Information considered adequate ($n = 37$)		37/37 (100%)	0/37 (0%)
Post-discharge	Explanations sufficient for home management ($n = 37$)		36/37 (97.3%)	1/37 (2.7%)

Abbreviations: SD, standard deviation; IQR, interquartile range. Likert items were scored 1–5 (1 = lowest, 5 = highest). Median (IQR) is reported alongside mean ± SD given the ordinal nature of the data. For side-effect burden and difficulty applying safety instructions, higher scores indicate greater burden or difficulty. Values are reported for available responses; denominators vary slightly across items

Post-discharge radioprotection adherence

After discharge, 36 of 37 patients (97.3%) reported that explanations regarding management of daily life at home were sufficient. Difficulty applying radiation safety instructions was generally low (mean 2.05 ± 1.51; $n = 37$), with 25 of 37 respondents (67.6%) reporting minimal difficulty (scores ≤ 2) and 6 of 37 (16.2%) reporting greater difficulty (scores ≥ 4).

Overall satisfaction and quality of life

Overall satisfaction with PSMA-RLT was high (mean 4.47 ± 1.13; $n = 36$), with 33 of 36 respondents (91.7%) assigning scores ≥ 4. A single patient-reported item addressing perceived well-being since therapy initiation showed generally favorable ratings (mean 4.14 ± 1.03; $n = 37$), with 31 of 37 patients (83.8%) reporting stable or improved well-being (scores ≥ 4). All patient-reported outcomes are detailed in Table 1.

Qualitative analysis of patient responses

Sixteen of the 37 patients (43.2%) provided free-text comments. The predominant theme was overall satisfaction with care and communication, reported in 9 of 16 comments (56.3%). Expressions of satisfaction with care or treatment were identified in 10 of 16 comments (62.5%), and 5 of 16 (31.3%) conveyed marked gratitude toward the healthcare teams; these categories were not mutually exclusive. Patients often highlighted the clarity of explanations, the quality of support, and the comfort provided throughout the therapeutic process.

Treatment-related symptoms were mentioned less frequently. Xerostomia, sometimes associated with taste alteration or persistent dry eyes, was reported in 2 responses (12.5%). Regarding organizational aspects, 2 patients (12.5%) considered the length of hospitalization (2 to 3 nights) excessive or restrictive, one of whom explicitly referred to the psychological burden related to in-hospital isolation. No comments indicated misunderstanding of radioprotection measures or major difficulty applying safety instructions at home.

Clinician-reported implementation perspectives

Quantitative clinician results are summarized in Table 2.

Table 2 Clinician-reported referral patterns and implementation constraints for PSMA radioligand therapy among oncologists ($n = 7$) and nuclear medicine physicians ($n = 6$)

Domain	Item	*n/N* (%)
Referral practice	Regular referral among oncologists	7/7 (100%)
Structural barriers	Limited treatment capacity (oncologists)	3/7 (42.9%)
Structural barriers	Treatment-room limitation (nuclear medicine physicians)	4/6 (66.7%)
Organizational barriers	Scheduling and workflow constraints (nuclear medicine physicians)	3/6 (50.0%)
Organizational barriers	Radioprotection-related logistical complexity (nuclear medicine physicians)	2/6 (33.3%)
Evidence considerations	Insufficient clinical data in specific scenarios (oncologists)	3/7 (42.9%)
Economic factors	Reimbursement or cost concerns (oncologists)	2/7 (28.6%)
Demand trajectory	Significant increase in demand (nuclear medicine physicians)	6/6 (100%)

Likert-scaled clinician items were rated 1–5. Interdisciplinary collaboration (nuclear medicine physicians): mean 3.83 ± 0.75, median 4 (IQR 3–4), $n = 6$. Communication with patients regarding radiation protection: mean 4.33 ± 0.52, median 4 (IQR 4–5), $n = 6$. Demand trajectory was assessed only in the nuclear medicine physician questionnaire and was not assessed as an equivalent item in the oncology questionnaire

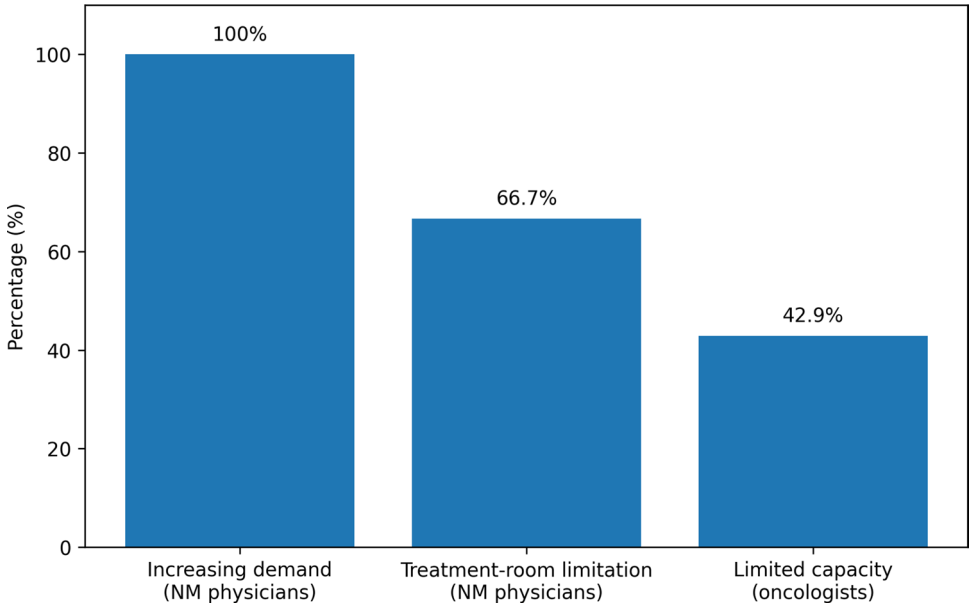

Fig. 1 Nuclear medicine physician-reported increase in demand for [177Lu]Lu-PSMA-617 radioligand therapy, treatment-room limitations reported by nuclear medicine physicians, and limited treatment capacity reported by oncologists

Participants

Thirteen of the 18 invited clinicians completed the survey (overall response rate 72.2%), including 7 of 8 oncologists (87.5%) and 6 of 10 nuclear medicine physicians (60.0%). All respondents were actively involved in PSMA-RLT referral or administration within established Swiss cancer care networks spanning the three major linguistic regions of the country.

Referral patterns and interdisciplinary collaboration

All oncologists (7 of 7, 100%) reported regularly referring patients for PSMA-RLT. Referral timing varied across institutions, ranging from post-taxane integration to later-line positioning after exhaustion of alternative therapeutic options. Interdisciplinary collaboration between oncology and nuclear medicine was generally rated positively by nuclear medicine physicians (mean 3.83 ± 0.75; median 4 [IQR 3–4]; $n = 6$), with 4 of 6 respondents assigning scores ≥ 4 on the 5-point scale, and communication with patients regarding radiation protection was rated highly (mean 4.33 ± 0.52; median 4 [IQR 4–5]; $n = 6$) (Table 2). Standardized referral pathways were reported as fully or partially implemented in most institutions.

Structural capacity constraints

Limited treatment capacity was reported as a barrier by 3 of 7 oncologists (42.9%). Among nuclear medicine physicians, treatment-room availability was identified as the primary implementation constraint by 4 of 6 respondents (66.7%) (Fig. 1). All six nuclear medicine physicians (100%) reported a significant increase in demand for PSMA-RLT. Demand trajectory was not assessed as an equivalent item in the oncology questionnaire.

Organizational and economic barriers

Scheduling and workflow coordination challenges were reported by 3 of 6 nuclear medicine physicians (50.0%). Radioprotection-related logistical complexity was cited by 2 of 6 respondents (33.3%). Among oncologists, insufficient clinical data in specific scenarios was reported by 3 of 7 respondents (42.9%), and reimbursement or cost-related concerns were identified by 2 of 7 respondents (28.6%).

Qualitative analysis of clinician responses

Among nuclear medicine physicians, 2 of 6 respondents (33.3%) provided free-text comments, emphasizing treatment-room limitations and the need for structural adaptation as case volume increases. Among oncologists, 5 of 7 respondents (71.4%) provided open-ended feedback, focusing on coordination between services, maintenance of streamlined referral pathways, and management of increasing referral pressure. No clinician expressed skepticism regarding the therapeutic value of PSMA-RLT.

Discussion

This multistakeholder evaluation integrates patient-reported experience from a single Swiss tertiary center with clinician perspectives collected across Switzerland. Three central observations emerge. First, patients reported high satisfaction and a strong understanding of communication and radioprotection measures. Second, clinicians reported broad clinical acceptance and routine referral practices. Third, despite this clinical alignment, structural capacity limitations and workflow constraints were identified as the dominant barriers to program expansion. Together, these findings suggest that while the clinical integration of PSMA-RLT appears well established among the surveyed stakeholders, health-system readiness may represent an important limiting factor for further expansion, with infrastructure and organizational capacity emerging as primary determinants of real-world scalability.

Patient experience and clinician alignment

From the patient perspective, the high levels of satisfaction and expressed gratitude reflect strong acceptability and the effectiveness of structured communication. Communication of radiation risk in nuclear medicine remains complex, and prior work has documented limited patient awareness and frequent misconceptions (Pandit and Vinjamuri 2014, Ribeiro et al. 2020); in radiation oncology settings, structured and patient-centered education improves comprehension and reduces confusion (Schnitzler et al. 2017, Dong et al. 2014). In the present cohort, nearly all patients considered the pre-therapy information adequate. These observations, which derive from a single tertiary center and should not be generalized to the national patient population, suggest that structured multidisciplinary communication frameworks can support safe outpatient or short-stay management without compromising reassurance, adherence, or satisfaction. Certain organizational aspects — particularly the duration of hospitalization and isolation — were nonetheless identified as areas for improvement.

From the clinician perspective, universal referral among surveyed oncologists reflects the rapid integration of PSMA-RLT into therapeutic algorithms following VISION and TheraP (Sartor et al. 2021, Hofman et al. 2021), consolidated by guideline incorporation and expert consensus (Parker et al. 2020, Gillessen et al. 2025). Clinicians did not

identify therapeutic uncertainty as a primary barrier; instead, implementation challenges were predominantly structural. Variability in referral timing across institutions indicates ongoing evolution in positioning within treatment sequences and adaptation to individual patient needs. As ongoing trials explore earlier-line integration and combination strategies, referral dynamics may shift further, potentially intensifying infrastructure demand.

Infrastructure pressure, definitions, and theranostic scalability

The dominant barrier identified by clinicians was structural capacity, particularly treatment-room availability and workflow constraints. For clarity, in this work "structural capacity" refers to the physical infrastructure required for PSMA-RLT delivery — including the availability of radiation-shielded treatment rooms, radiopharmaceutical preparation facilities, and monitoring equipment — whereas "organizational constraints" denote workflow-level barriers such as personnel availability, scheduling coordination between oncology and nuclear medicine services, radiopharmaceutical logistics, and interdisciplinary communication. This demand–capacity imbalance reflects a broader phenomenon accompanying the rapid expansion of theranostics (Herrmann et al. 2020, Jadvar 2016, Fanti et al. 2018).

These findings position PSMA-RLT within an implementation science framework, in which scalable delivery depends less on the efficacy of the therapeutic agent than on infrastructure readiness, organizational capacity, workforce development, and the distinction between initial adoption and sustained integration of a complex health innovation. Radioligand therapy differs fundamentally from conventional systemic oncology treatments, requiring radiation-protected facilities, strict regulatory compliance, specialized personnel, and coordinated multidisciplinary workflows; current EANM and SNMMI guidelines emphasize that safe and effective implementation depends on adequate infrastructure and workforce capacity (Kratochwil et al. 2023). When therapeutic innovation progresses faster than structural adaptation, access disparities may emerge, as previously observed with other high-impact oncologic innovations (Maio et al. 2020). Strategic capacity planning — including anticipation of demand, expansion of radiation-protected facilities, workforce training, and optimization of care pathways — will therefore be essential to support sustainable and scalable implementation. Given the rapid expansion of oncologic indications, current inpatient-based models may prove insufficient should PSMA-RLT or related radioligand therapies extend to higher-prevalence malignancies.

International variability in hospitalization and radioprotection models

Although this study reflects the Swiss context, the alignment observed between clinical confidence and structural constraints likely extends beyond a single healthcare system. An international survey of 95 theranostic centers reported that approximately 48% deliver PSMA radioligand therapy on an outpatient basis, while others maintain short inpatient stays of 1–3 days depending on national regulations (Farolfi et al. 2024). This heterogeneity reflects differing national radiation protection frameworks rather than differences in clinical practice alone. The relatively low-energy beta-emission profile of Lu-177, together with its physical half-life of approximately 6.7 days, results in modest

environmental radiation exposure compared with higher-energy radionuclides, and outpatient administration is feasible in many regulatory contexts.

Outpatient or short-stay approaches have already been implemented in several countries. In Italy and the United States, same-day discharge is feasible when external radiation levels comply with regulatory thresholds, enabling safe outpatient management (Zagni et al. 2024, Poschenrieder et al. 2024). In France and Spain, adapted protocols have reduced hospitalization duration through optimized radioprotection strategies and clinical workflows (Zagni et al. 2024, Poschenrieder et al. 2024). In Australia, [177Lu]Lu-PSMA-617 therapy is frequently delivered as a day-care procedure, integrating treatment, monitoring, and patient education within a single visit (Emmett et al. 2017); comparable same-day discharge approaches have been adopted in countries such as Sweden and the Netherlands where permitted by regulatory frameworks. In contrast, countries such as Germany continue to require hospitalization for at least 48 h due to stricter radiation protection regulations, resulting in higher infrastructure demands (Kurth et al. 2021). In Switzerland, current practice still relies on inpatient administration in radiation-shielded rooms. The high level of patient understanding and adherence to radioprotection measures observed in this single-center cohort suggests that shorter-stay or outpatient models could be explored without compromising safety, leveraging structured patient education and standardized follow-up to optimize resource utilization.

Implications for the expanding theranostic landscape

PSMA-RLT represents a prototype for molecularly targeted radiopharmaceutical therapy. The expansion of somatostatin receptor-targeted therapies and emerging fibroblast activation protein-targeted approaches further illustrates the rapid evolution of theranostics (Strosberg et al. 2017, Chandekar et al. 2023). As indications broaden across tumor types, cumulative infrastructure and resource requirements are expected to increase, suggesting that theranostics should be viewed not as a set of emerging therapies but as a distinct treatment paradigm with system-level implications. In parallel, the development of next-generation PSMA-targeting radioligands, including alpha-emitting compounds and agents beyond [177Lu]Lu-vipivotide tetraxetan, reflects a transition toward a more diversified therapeutic platform. Supporting this evolution will require coordinated strengthening of radionuclide supply chains (Giammarile et al. 2024) and implementation of standardized dosimetry frameworks (Zhang-Yin 2024). Future research should prioritize multicenter patient surveys, the development and validation of PSMA-RLT-specific patient-reported outcome instruments, and the integration of patient-reported experience with prospective objective toxicity monitoring.

Strengths and limitations

This study integrates patient-reported and clinician-reported perspectives, providing one of the first multistakeholder evaluations of PSMA-RLT implementation in routine clinical practice, and combines quantitative and qualitative analyses to contextualize findings across levels of care.

Several important limitations must be emphasized. The patient survey was monocentric and the response rate was low (24.3%), so the patient-reported findings reflect a single tertiary center and cannot be generalized to the national patient population. The voluntary, partly retrospective design introduces multiple sources of bias. Survivorship

bias arises from restricting the survey to patients alive at the time of contact: patients with rapid clinical deterioration or death were not represented, likely leading to an overestimation of satisfaction, tolerability, and perceived clarity of communication. Positivity bias may further arise from the voluntary response format, whereby patients with more favorable experiences may have been more likely to respond, and nonresponse bias cannot be excluded given the low response rate. Because the survey combined retrospective and prospective phases with no maximum interval set between treatment and questionnaire completion, the variable elapsed time represents a potential source of recall bias. The low response rate likely reflects the advanced age and disease stage of the population and the reliance on postal distribution during the retrospective phase; language was unlikely to be a primary barrier, as the questionnaire was available in French and English and all patients treated at CHUV receive care in French.

A further important limitation is the exploratory nature of the questionnaires, which were specifically developed for this study and did not undergo formal psychometric validation or pilot testing. Consequently, the results should be interpreted as descriptive measures of patient and clinician perceptions rather than standardized patient-reported outcome assessments. In addition, the perceived side-effect burden reflects subjective patient experience and was not correlated with laboratory, dosimetric, renal, hepatic, or hematologic parameters; subjective reporting may not distinguish treatment-specific adverse effects from general hospitalization-related discomfort. The clinician cohort was small ($n = 13$) and drawn from high-volume centers, and may not capture the perspectives of smaller institutions; nevertheless, respondents represent active stakeholders directly involved in PSMA-RLT referral and delivery. During the study period, the institutional hospitalization pathway evolved from an approximately 48-hour stay to an approximately 20-hour stay. Because questionnaire responses were collected anonymously and were not linked to individual treatment records, hospitalization duration could not be retrospectively assigned to individual respondents. Consequently, the number of respondents undergoing each hospitalization regimen and potential differences in patient-reported experience between the two groups could not be determined. In light of these limitations, conclusions — including those regarding clinician acceptance and implementation barriers — should be regarded as preliminary observations requiring confirmation in larger, multicenter studies.

Conclusion

In this exploratory multistakeholder evaluation of PSMA radioligand therapy implementation in Switzerland, patients at a single tertiary center reported high satisfaction and a strong understanding of structured communication and radioprotection measures, with most experiencing minimal difficulty applying these measures at home. In parallel, clinician perspectives collected nationally suggested broad therapeutic integration while identifying structural capacity limitations and organizational constraints as key barriers to expansion. The apparent mismatch between increasing clinical demand and available infrastructure underscores a central implementation challenge in contemporary theranostics. Although preliminary and requiring confirmation in larger, multicenter studies, these findings suggest that ensuring sustainable growth of PSMA radioligand therapy programs will require strategic investment in treatment capacity, workforce

development, and coordinated interdisciplinary pathways to support equitable and scalable access.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s41824-026-00338-z.

Supplementary Material 1

Author contributions

M.J., N.S., and N.C. contributed to study conception and design. M.T., A.F., R.M., N.S.S., N.S., N.C., and M.J. contributed to data collection. M.J. performed the statistical analysis. N.C., M.J., and N.S. drafted the manuscript. All authors critically revised the manuscript for important intellectual content and approved the final version.

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Data availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval

This study was conducted in accordance with the Swiss Human Research Act and the Ordinance on Human Research with the Exception of Clinical Trials. Due to its observational design, fully anonymized data collection, and absence of interventional procedures, the Cantonal Research Ethics Committee of Vaud (CER-VD) waived the requirement for formal ethical approval; no formal approval number was assigned under this waiver.

Consent to participate

Participation in both surveys was voluntary. Completion of the questionnaire was considered informed consent for the use of anonymized data for research purposes.

Consent for publication

Not applicable.

Conflict of interest

The authors declare that they have no competing interests relevant to this work.

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References

Chandekar KR, Prashanth A, Vinjamuri S, Kumar R (2023) FAPI PET/CT imaging—an updated review. Diagnostics 13:2018

Di Maio M, Perrone F, Conte P (2020) Real-world evidence in oncology: opportunities and limitations. Oncologist 25:e746–e752

Dong S, Butow PN, Costa DSJ, Dhillon HM, Shields CG (2014) The influence of patient-centered communication during radiotherapy education sessions on post-consultation patient outcomes. Patient Educ Couns 95:305–312

Emmett L, Willowson K, Violet J, Shin J, Blanksby A, Lee J (2017) Lutetium 177 PSMA radionuclide therapy for men with prostate cancer: a review of the current literature and discussion of practical aspects of therapy. J Med Radiat Sci 64(1):52–60

Fanti S, Minozzi S, Antoch G, Banks I, Briganti A, Carrio I et al (2018) Consensus on molecular imaging and theranostics in prostate cancer. Lancet Oncol 19:e696–e708

Farolfi A, Armstrong WR, Djaileb L, Gafita A, Hotta M, Allen-Auerbach M et al (2024) Differences and common ground in 177Lu-PSMA radioligand therapy practice patterns: international survey of 95 theranostic centers. J Nucl Med 65(3):438–445

Fizazi K, Herrmann K, Krause BJ, Eiber M, O'Sullivan JM, Chi KN et al (2023) Health-related quality of life and pain outcomes with [177Lu]Lu-PSMA-617 plus standard of care versus standard of care alone (VISION): a randomised, phase 3 trial. Lancet Oncol 24:152–164

Fizazi K, Chi KN, Shore ND, Herrmann K, de Bono JS, Castellano D et al (2025) Final overall survival and safety analyses of the phase III PSMAfore trial of [177Lu]Lu-PSMA-617 versus change of androgen receptor pathway inhibitor in taxane-naïve patients with metastatic castration-resistant prostate cancer. Ann Oncol 36:1319–1330

Giammarile F, Paez D, Zimmermann R, Cutler CS, Jalilian A, Korde A et al (2024) Production and regulatory issues for theranostics. Lancet Oncol 25(6):e260–e269

Gillessen S, Turco F, Davis ID, Efstathiou JA, Fizazi K, James ND et al (2025) Management of patients with advanced prostate cancer. Report from the 2024 Advanced Prostate Cancer Consensus Conference (APCCC). Eur Urol 87:157–216

Herrmann K, Kraeber-Bodéré F, Eiber M et al (2020) Theranostic concepts in nuclear medicine. Eur J Nucl Med Mol Imaging 47:2905–2907

Hofman MS, Emmett L, Sandhu S, Iravani A, Joshua AM, Goh JC et al (2021) [177Lu]Lu-PSMA-617 versus cabazitaxel in patients with metastatic castration-resistant prostate cancer (TheraP): a randomised, open-label, phase 2 trial. Lancet 397:797–804

Jadvar H (2016) Radiotheranostics in prostate cancer: introduction and overview. J Nucl Med 57:1S–2S

Kratochwil C, Fendler WP, Eiber M, Baum R, Bozkurt MF, Czernin J et al (2019) EANM procedure guidelines for radionuclide therapy with 177Lu-labelled PSMA-ligands (177Lu-PSMA-RLT). Eur J Nucl Med Mol Imaging 46:2536–2544
Kratochwil C, Fendler WP, Eiber M, Hofman MS, Emmett L, Calais J et al (2023) Joint EANM/SNMMI procedure guideline for the use of 177Lu-labeled PSMA-targeted radioligand therapy (177Lu-PSMA-RLT). Eur J Nucl Med Mol Imaging 50:2830–2845
Kurth J, Heuschkel M, Tonn A, Schildt A, Hakenberg OW, Krause BJ et al (2021) Streamlined schemes for dosimetry of 177Lu-labeled PSMA targeting radioligands in therapy of prostate cancer. Cancers (Basel) 13(15):3884
Mench A, Winters C, Mittra E, Szidonya L, Hess C, Barbon D et al (2025) Navigating radiation safety after radiopharmaceutical therapies: proposed workflow and essential guidelines for nonspecialists. J Nucl Med 66:990–994
Novartis Pharmaceuticals. An international prospective open-label, randomized, phase III study comparing [177Lu]Lu-PSMA-617 plus standard of care versus standard of care alone in adult male patients with metastatic hormone-sensitive prostate cancer (PSMAddition). ClinicalTrials.gov. 2021. NCT04720157. https://clinicaltrials.gov/study/NCT04720157. Accessed 13 Aug 2026.
Pandit M, Vinjamuri S (2014) Communication of radiation risk in nuclear medicine: are we saying the right thing? Indian J Nucl Med 29:131–134
Parker C, Castro E, Fizazi K, Heidenreich A, Ost P, Procopio G et al (2020) Prostate cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. Ann Oncol 31:1119–1134
Poschenrieder A, Taleska J, Schaetz L (2024) 177Lu-PSMA (R)evolution in cancer care: is it really happening? J Nucl Med 65(9):1340–1342
Ribeiro ASF, Husson O, Drey N, Murray I, May K, Thurston J et al (2020) Radiation exposure awareness from patients undergoing nuclear medicine diagnostic 99mTc-MDP bone scans and 2-deoxy-2-(18F)fluoro-D-glucose PET/computed tomography scans. Nucl Med Commun 41:582–588
Sartor O, de Bono J, Chi KN, Fizazi K, Herrmann K, Rahbar K et al (2021) Lutetium-177-PSMA-617 for metastatic castration-resistant prostate cancer. N Engl J Med 385:1091–1103
Schnitzler L, Smith SK, Shepherd HL, Shaw J, Dong S, Carpenter DM et al (2017) Communication during radiation therapy education sessions: the role of medical jargon and emotional support in clarifying patient confusion. Patient Educ Couns 100:112–120
Strosberg J, El-Haddad G, Wolin E, Hendifar A, Yao J, Chasen B et al (2017) Phase 3 trial of 177Lu-Dotatate for midgut neuroendocrine tumors. N Engl J Med 376:125–135
Zagni F, Vetrone L, Farolfi A, Vadalà M, Rizzini EL, Golemi A et al (2024) Feasibility of 177Lu-PSMA administration as an outpatient procedure for prostate cancer. J Nucl Med 65(12):1848–1849
Zhang-Yin J (2024) Lutetium-177-prostate-specific membrane antigen radioligand therapy: what is the value of post-therapeutic imaging? Biomedicines 12:1512

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