

# Global Public Interest in Prostate Cancer Imaging: A Google Trends Analysis of PSMA PET and Conventional Modalities (2010–2025)

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## ABSTRACT

**Purpose:** This study evaluates global public interest in Prostate-Specific Membrane Antigen Positron Emission Tomography (PSMA PET) imaging compared with traditional prostate cancer imaging modalities using Google Trends data from 2010 to 2025, and examines how digital engagement aligns with key clinical milestones. Unlike previous Google Trends studies focusing on general oncology awareness, this analysis uniquely applies infodemiology to molecular imaging adoption, linking public search behavior with technological and regulatory milestones in nuclear medicine.

**Methods:** This observational infodemiology study analyzed Google Trends data for four search terms: 'PSMA PET Scan', 'MRI Prostate Cancer', 'Bone Scan Prostate Cancer', and 'Prostate Cancer Scan' from January 2010 to April 2025. Average interest scores were calculated for pre- and post-milestone periods. Linear regression estimated PSMA PET growth rates post-2020, and milestone-aligned surge analysis quantified changes surrounding key clinical events including the proPSMA trial publication, FDA approval, and guideline updates. The term "Prostate Cancer Scan" was included to represent general, non-specialist public searches about diagnostic imaging for prostate cancer, serving as a broad comparator for population-level awareness.

**Results:** PSMA PET search interest increased markedly after March 2020, with sustained monthly growth observed ( $R^2=0.87$ ). By 2023, public interest in PSMA PET surpassed that of bone scans and approached levels seen for MRI in prostate cancer. The FDA approval of Gallium-68 PSMA-11 in December 2020 was associated with the most notable increase in search volume, whereas the publication of updated clinical guidelines demonstrated a more modest immediate effect. Overall, average search interest values (on the normalized 0–100 scale) were as follows: Prostate Cancer Scan (44.9), MRI Prostate Cancer (40.8), PSMA PET Scan (20.6), and Bone Scan Prostate Cancer (13.7).

**Conclusion:** PSMA PET has rapidly captured public interest parallel to its clinical validation and regulatory approval, reflecting its expanding role in prostate cancer imaging. Infodemiology provides a concise, data-driven lens for monitoring innovation diffusion, supporting public awareness, evidence generation, and equitable access to molecular imaging.

**Keywords:** Prostate cancer, PSMA PET, infodemiology, trends, medical imaging

## ÖZET

**Amaç:** Bu çalışma, 2010–2025 yılları arasındaki Google Trends verilerini kullanarak Prostat Spesifik Membran Antijeni Pozitron Emisyon Tomografisi (PSMA PET) görüntülemesine yönelik küresel halk ilgisini geleneksel prostat kanseri görüntüleme yöntemleriyle karşılaştırmayı ve dijital etkileşimin klinik dönüm noktalarıyla nasıl örtüştüğünü incelemeyi amaçlamaktadır. Önceki Google Trends çalışmalarından farklı olarak, bu analiz infodemioloji yaklaşımını nükleer tıpta moleküler görüntüleme teknolojilerinin benimsenmesine uygulamakta ve halkın arama davranışlarını teknolojik ve düzenleyici gelişmelerle ilişkilendirmektedir.

**Yöntemler:** Bu gözlemsel infodemioloji çalışması, Ocak 2010-Nisan 2025 döneminde dört arama terimi için Google Trends verilerini analiz etti: 'PSMA PET Tarama', 'MRG Prostat Kanseri', 'Kemik Sintigrafisi Prostat Kanseri' ve 'Prostat Kanseri Tarama'. Kilometre taşı öncesi ve sonrası dönemler için ortalama ilgi skorları hesaplandı. Doğrusal regresyon 2020 sonrası PSMA PET büyüme oranlarını tahmin etti ve kilometre taşı hizalı artış analizi proPSMA çalışması yayını, FDA onayı ve kılavuz güncellemeleri dahil önemli klinik olaylar çevresindeki değişiklikleri ölçtü. Prostat Kanseri Taraması terimi, prostat kanseri için tanısal görüntüleme hakkındaki genel, uzman olmayan halk aramalarını temsil etmek üzere dahil edilmiştir ve popülasyon düzeyinde farkındalık için geniş bir karşılaştırmacı işlevi görmektedir.

**Bulgular:** PSMA PET arama ilgisi Mart 2020 sonrası dramatik şekilde arttı ve sürekli aylık büyüme gösterdi ( $R^2=0.87$ ). 2023'e kadar PSMA PET ilgisi kemik sintigrafisi seviyelerini aştı ve MRG ilgisine yaklaştı. Galyum-68 PSMA-11'in FDA onayı en güçlü kamu yanıtını üretirken, kılavuz güncellemeleri minimal doğrudan etki gösterdi. Genel ortalama ilgi sıralaması: Prostat Kanseri Tarama (44.9), MRG Prostat Kanseri (40.8), PSMA PET Tarama (20.6) ve Kemik Sintigrafisi Prostat Kanseri (13.7) idi.

**Sonuç:** PSMA PET, klinik doğrulama ve düzenleyici onaylarla paralel olarak halk ilgisini hızla artırmış, prostat kanseri görüntülemesinde giderek genişleyen bir role ulaşmıştır. Infodemioloji, yeniliklerin yayılımını izlemek için veri odaklı bir yaklaşım sunarak toplum farkındalığı, bilimsel kanıt üretimi ve ileri moleküler görüntüleme teknolojilerine eşit erişim arasındaki köprüyü güçlendirebilir.

**Anahtar Kelimeler:** Prostat kanseri, PSMA PET, infodemioloji, eğilimler, tıbbi görüntüleme

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**Received:** 29.05.2025

**Accepted:** 23.10.2025

**P**rostate cancer remains one of the most common malignancies affecting men worldwide, with imaging playing a crucial role in diagnosis, staging, and treatment planning. Over the past decade, significant advancements in prostate cancer imaging have transformed clinical practice, with Prostate-Specific Membrane Antigen (PSMA) Positron Emission Tomography (PET) emerging as a revolutionary diagnostic tool (1,2). This molecular imaging technique targets PSMA, a transmembrane protein overexpressed in most prostate cancer cells, offering unprecedented sensitivity and specificity for detecting primary and metastatic disease.

The evolution of prostate cancer imaging has progressed from conventional anatomical techniques such as bone scintigraphy and Computed Tomography (CT) to more sophisticated functional and molecular imaging modalities (3). Multiparametric Magnetic Resonance Imaging (mpMRI) has become established as a valuable tool for local staging and lesion characterization, while bone scans have traditionally been used to detect skeletal metastases. However, the introduction of PSMA PET has fundamentally altered the diagnostic landscape by offering superior detection rates, particularly for small-volume metastatic disease that may be missed by conventional imaging (4).

The clinical adoption of PSMA PET has been accelerated by pivotal studies demonstrating its diagnostic advantages. The proPSMA trial, published in *The Lancet* in March 2020, was a landmark randomized study that demonstrated the superior accuracy of PSMA PET/CT compared to conventional imaging for staging high-risk prostate cancer.(1) This was followed by the FDA approval of Gallium-68 PSMA-11 as the first PSMA-targeted PET imaging agent in December 2020, and subsequent incorporation into European Association of Urology (EAU) guidelines in 2021 (5). These milestones have catalyzed the integration of PSMA PET into routine clinical practice across many regions.

While clinical adoption of new imaging technologies is typically measured through metrics such as utilization rates, reimbursement data, and clinical guideline updates, these traditional indicators often lag behind real-world implementation and may not capture public awareness and interest. In the digital age, online search behavior provides a real-time, population-level lens into awareness, information-seeking patterns, and potential disparities in knowledge about medical innovations. This approach,

known as infodemiology, leverages digital footprints to understand health information patterns and has been increasingly recognized as a valuable complement to traditional epidemiological methods (6,7).

Google Trends, a publicly available tool that provides normalized search volume data, offers unique insights into public interest in health topics over time (7). Previous studies have demonstrated correlations between Google search volumes and disease incidence, healthcare utilization, and public response to health policy changes (8). For emerging medical technologies like PSMA PET, analyzing search trends can provide insights into the diffusion of innovation, public awareness, and potential gaps in health communication.

The present study aims to evaluate and compare global public interest in PSMA PET imaging with traditional prostate cancer imaging modalities (MRI, bone scan, and general prostate cancer scans) from 2010 to 2025 using Google Trends data. By aligning temporal search patterns with key clinical milestones, we seek to understand how digital engagement reflects—and possibly predicts—the evolution of imaging practice in nuclear medicine. This analysis may provide valuable insights for stakeholders involved in technology dissemination, patient education, and health policy development in the rapidly evolving field of prostate cancer imaging (4,9).

## Materials and Methods

### Study Design

This observational infodemiology study was conducted using publicly available data from Google Trends (<https://trends.google.com>), a web-based tool that provides normalized search interest data based on the relative popularity of search queries over time. The study period spanned from January 2010 to April 2025, encompassing the emergence and clinical integration of PSMA PET imaging for prostate cancer.

### Data Collection

The analysis focused on four search terms relevant to prostate cancer imaging: 'PSMA PET Scan', 'MRI Prostate Cancer', 'Bone Scan Prostate Cancer', and 'Prostate Cancer Scan'. These terms were selected to represent the primary imaging modalities used in prostate cancer management, with 'Prostate Cancer Scan' serving as a general category

encompassing various imaging techniques. All searches were conducted in May 2025, with worldwide geographic parameters to capture global interest patterns.

Data were extracted from the 'Interest over Time' section of Google Trends, which provides a normalized score (0–100 scale) for each search term. This normalization process adjusts search volumes relative to the highest search volume within the specified time period and region, with 100 representing peak popularity and 0 indicating insufficient search volume. Each data point represents the average monthly normalized interest, resulting in 183 monthly data points per term over the 15-year study period.

### Data Processing and Analysis

The extracted data were processed and analyzed using Microsoft Excel (Microsoft Corporation, Redmond, WA) and Python 3.11 with pandas (version 2.2.6) and matplotlib (version 3.8.0) libraries. The following analyses were performed:

- 1. Descriptive Statistics:** Average interest scores were calculated for each search term over the entire study period (2010–2025), as well as for pre-milestone (before March 2020) and post-milestone (March 2020 onward) periods to quantify changes in public interest.
- 2. Trend Visualization:** Time series plots were generated to visualize the temporal patterns of search interest for all four terms, with key clinical milestones overlaid to contextualize changes in public interest.
- 3. Regression Analysis:** Linear regression was performed to estimate the slope of change in 'PSMA PET Scan' interest following the publication of the proPSMA trial (March 2020 onward) (1). The regression model used months since March 2020 as the independent variable and normalized search interest as the dependent variable, with  $R^2$  calculated to assess goodness of fit.
- 4. Milestone-Aligned Surge Analysis:** For each key milestone, the average search interest in the three months before and after the event was calculated to quantify immediate changes in public interest. The milestones included:
  - Publication of the proPSMA trial in The Lancet (March 2020) (1)
  - FDA approval of Gallium-68 PSMA-11 (December 2020)
  - European Association of Urology (EAU) guideline updates (March 2021) (5)

All data were normalized by Google's internal algorithms, reflecting relative—not absolute—search volume (7). This normalization accounts for overall growth in internet usage and search volume over time, allowing for meaningful comparisons across the study period.

## Results

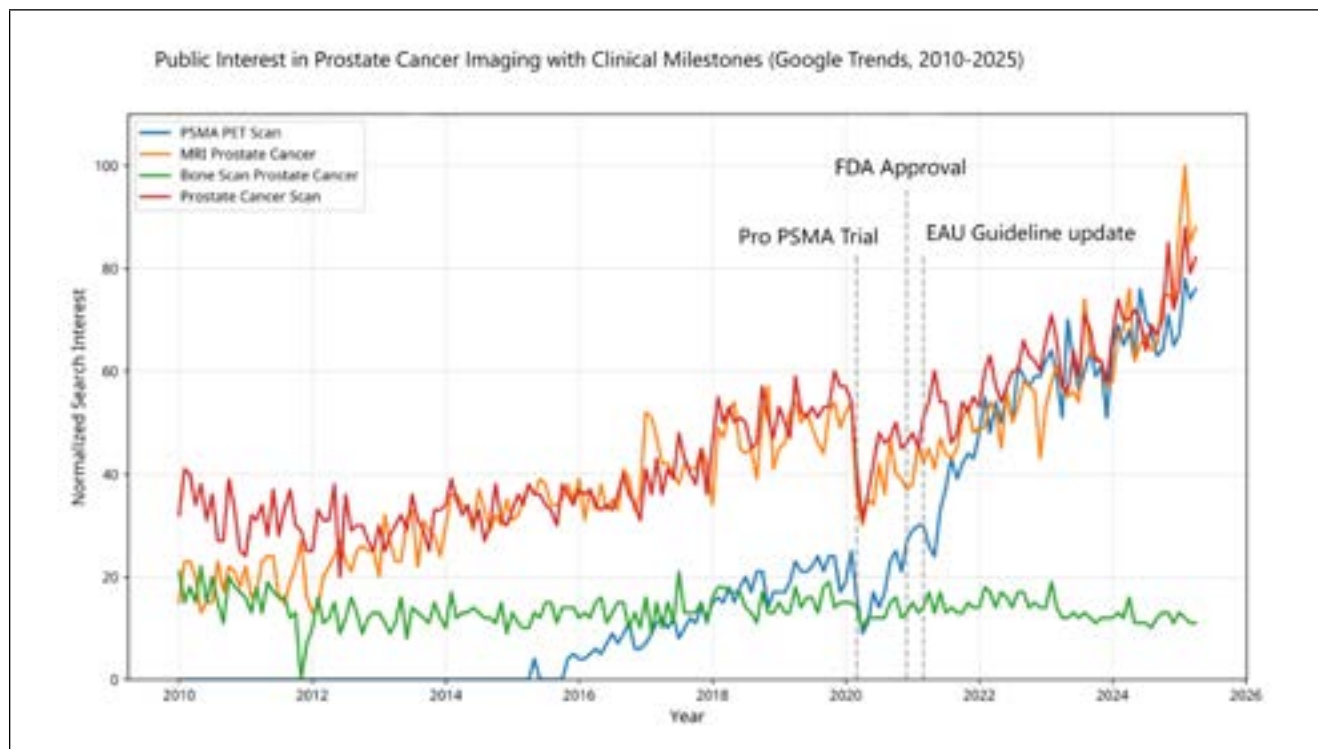
### Overall Search Interest Trends

A total of 183 monthly data points per term were analyzed over the 15-year period from January 2010 to April 2025. Figure 1 illustrates the temporal trends in normalized search interest for all four imaging modalities, with key clinical milestones overlaid. Throughout the study period, 'Prostate Cancer Scan' consistently demonstrated the highest public interest, with an overall average normalized score of 44.9 (Table 1). 'MRI Prostate Cancer' showed the second highest interest level with an average score of 40.8, while 'Bone Scan Prostate Cancer' maintained relatively stable but lower interest levels (average 13.7). 'PSMA PET Scan' exhibited the most dramatic change in search patterns over time, beginning with minimal interest (score of 0) in 2010 and rising to compete with other modalities by 2025.

**Table 1:** Average Interest Scores for Prostate Cancer Imaging Modalities (Google Trends, 2010–2025)

Imaging Modality	Overall Average (2010–2025)	Pre-2020 Average	Post-2020 Average	Percent Change (%)
PSMA PET Scan	20.6	5.9	49.6	739.5
MRI Prostate Cancer	40.8	33.5	55.3	65.3
Bone Scan Prostate Cancer	13.7	13.8	13.5	-2.2
Prostate Cancer Scan	44.9	37.3	59.7	59.9

*\*Note: Values represent normalized Google Trends search interest on a scale of 0–100.\**



**Figure 1:** Public Interest in Prostate Cancer Imaging with Clinical Milestones (Google Trends, 2010-2025)

Figure 1 illustrates the temporal trends in normalized search interest for all four imaging modalities (PSMA PET Scan, MRI Prostate Cancer, Bone Scan Prostate Cancer, and Prostate Cancer Scan) from January 2010 to April 2025. The graph includes vertical dashed lines marking three key clinical milestones: the publication of the proPSMA trial in *The Lancet* (March 2020), FDA approval of Gallium-68 PSMA-11 (December 2020), and European Association of Urology (EAU) guideline updates (March 2021). The y-axis represents normalized search interest on a scale of 0-100, and the x-axis represents time in years.

The temporal analysis revealed distinct phases in public interest for PSMA PET imaging. From 2010 to 2015, search interest was virtually nonexistent, with normalized scores of 0 across most months. A modest emergence of interest was observed between 2015 and 2018, with sporadic search activity yielding normalized scores between 1 and 15. From 2018 to early 2020, a gradual increase in interest was noted, with normalized scores consistently reaching the 15-25 range. The most striking change occurred from March 2020 onward, coinciding with the publication of the proPSMA trial (1), after which a sustained upward trajectory was observed.

#### Pre- and Post-2020 Comparison

Comparative analysis of pre-2020 and post-2020 periods revealed substantial differences in search patterns (Table 1). Prior to March 2020, 'PSMA PET Scan' had the lowest average interest score (5.9) among all modalities. In contrast, the post-2020 period showed a dramatic increase in PSMA PET interest to an average of 49.6, representing a 739.5% increase—by far the largest percentage change among all imaging modalities. 'MRI Prostate Cancer' and 'Prostate Cancer Scan' also showed notable increases

in the post-2020 period (65.3% and 59.9% increases, respectively), while 'Bone Scan Prostate Cancer' showed a slight decrease of 2.2%.

By 2023, 'PSMA PET Scan' search interest had surpassed 'Bone Scan Prostate Cancer' and began to approach or occasionally exceed interest levels for 'MRI Prostate Cancer'. The most recent data from early 2025 showed 'PSMA PET Scan' consistently achieving normalized scores in the 70-80 range, indicating substantial public interest comparable to other established imaging modalities.

#### Regression Analysis

Linear regression analysis of 'PSMA PET Scan' interest in the post-2020 period revealed a monthly growth rate of 0.98 units on the normalized scale ( $R^2 = 0.87$ ). This strong positive correlation indicates a consistent and statistically significant upward trend in public interest following the publication of the proPSMA trial.(1) The high  $R^2$  value suggests that time since the publication of this landmark study explains a substantial proportion of the variance in PSMA PET search interest.

### Milestone-Aligned Surges

Analysis of search interest surrounding key clinical milestones revealed variable patterns of public response:

1. proPSMA Trial Publication (March 2020) (1): Contrary to expectations, the three months following publication showed a 40.98% decrease in average search interest for 'PSMA PET Scan' compared to the three months prior (from 20.33 to 12.00).
2. FDA Approval of Gallium-68 PSMA-11 (December 2020): A 24.64% increase in average search interest was observed in the three months following approval compared to the three months prior (from 23.00 to 28.67). This surge suggests that regulatory approval generated substantial public attention, possibly reflecting increased media coverage and clinical discussions.
3. EAU Guidelines Update (March 2021) (5): A slight decrease of 6.98% in average search interest was noted in the three months following the guideline update compared to the three months prior (from 28.67 to 26.67). This modest change suggests that clinical guideline updates may have less immediate impact on public interest compared to regulatory approvals.

Despite these short-term fluctuations around specific milestones, the overall trajectory of PSMA PET search interest showed a strong upward trend from 2020 to 2025, indicating growing public awareness and interest that extended beyond immediate responses to individual events.

## Discussion

This study provides a comprehensive analysis of global public interest in prostate cancer imaging modalities from 2010 to 2025, with a particular focus on the emergence of PSMA PET as a revolutionary diagnostic tool. The findings demonstrate a remarkable increase in public interest in PSMA PET imaging following key clinical milestones, reflecting the growing awareness and potential adoption of this technology in clinical practice.

### Interpretation of Findings

The dramatic rise in PSMA PET-related search interest (739.5% increase post-2020) represents one of the most

significant shifts in public attention toward a novel imaging modality observed in recent years. This surge coincides with pivotal developments in the clinical validation and regulatory approval of PSMA PET (1,4), suggesting a strong relationship between scientific advancement, regulatory decisions, and public awareness. The consistent monthly growth rate of 0.98 units post-2020 indicates sustained rather than transient interest, which may reflect genuine integration into clinical practice rather than merely short-lived media attention.

Interestingly, the pattern of public interest does not perfectly align with the timing of individual clinical milestones. The unexpected decrease in search interest following the publication of the proPSMA trial in March 2020 (1) likely reflects the overwhelming impact of the COVID-19 pandemic on health information-seeking behaviors during this period. As global attention shifted toward pandemic-related concerns, interest in other health innovations, including PSMA PET, may have been temporarily suppressed. This contextual factor highlights the importance of considering broader societal events when interpreting digital health information trends (7,8).

The more substantial increase in search interest following FDA approval compared to EAU guideline updates (5) suggests that regulatory decisions may generate greater public attention than clinical practice recommendations. This pattern aligns with previous research on health innovation diffusion, which has shown that regulatory approvals often receive more media coverage and public attention than subsequent clinical guideline integrations. The finding has implications for how new imaging technologies are communicated to the public and how health communication strategies might be optimized around different types of clinical milestones.

The relative stability of bone scan interest, with a slight decline of 2.2% in the post-2020 period, may reflect the gradual replacement of this conventional modality with more advanced techniques (9,10). In contrast, MRI maintained strong interest throughout the study period with a substantial increase post-2020, suggesting its continued relevance in the prostate cancer imaging landscape even as newer modalities emerge. This pattern aligns with current clinical practice, where MRI remains a cornerstone of local staging while PSMA PET increasingly dominates for metastatic disease evaluation (9,10).

### *PSMA PET Adoption and Public Interest*

The trajectory of PSMA PET search interest provides valuable insights into the diffusion of this imaging innovation. The minimal interest prior to 2015 reflects the early research phase when PSMA PET was primarily confined to academic and specialized centers (11). The gradual emergence of interest between 2015 and 2018 coincides with early clinical studies demonstrating the potential advantages of PSMA PET over conventional imaging (2,11). The acceleration post-2020 aligns with the transition from research validation to clinical implementation, catalyzed by the proPSMA trial (1), regulatory approvals, and guideline endorsements (5).

By 2023, PSMA PET search interest had surpassed bone scan interest and began to approach MRI interest levels, suggesting a significant shift in public awareness and potentially clinical practice. This pattern mirrors the clinical adoption curve of PSMA PET, which has increasingly replaced conventional imaging for biochemical recurrence and initial staging of high-risk disease in regions where it is available. Recent studies have demonstrated that PSMA PET can detect metastatic disease in up to 84% of patients with high-risk biochemically recurrent prostate cancer that appears non-metastatic on conventional imaging (4), highlighting its superior sensitivity. The continued growth through 2025 suggests that PSMA PET has not yet reached a plateau in public interest or clinical adoption, indicating ongoing diffusion of this technology.

The substantial increase in general 'Prostate Cancer Scan' searches (59.9% post-2020) may reflect broader growing awareness about the importance of imaging in prostate cancer management. This trend could be partially attributed to increased public education about prostate cancer screening and diagnosis, as well as greater emphasis on precision medicine approaches that rely heavily on advanced imaging (9,12).

### *Limitations of Google Trends Analysis*

Several limitations should be considered when interpreting these findings. First, Google Trends data represent normalized search volumes rather than absolute numbers, making it difficult to quantify the exact magnitude of public interest (7,8). Second, search behavior may not perfectly correlate with clinical adoption or patient utilization of imaging modalities, as searches could be conducted by various stakeholders

including patients, family members, healthcare providers, researchers, and the general public.

The analysis lacks demographic specificity, preventing examination of how interest varies across different populations, geographic regions, or socioeconomic groups (7). This limitation is particularly relevant for PSMA PET, which has had variable availability and reimbursement status across different healthcare systems (9). Additionally, the search terms selected may not capture all relevant queries related to these imaging modalities, and variations in terminology or language preferences could influence the observed patterns.

The coincidence of the COVID-19 pandemic with key PSMA PET milestones complicates interpretation of the immediate impact of these developments on public interest. The pandemic substantially altered health information-seeking behaviors and healthcare utilization patterns, potentially masking or amplifying the effects of specific clinical milestones on search interest (8).

Finally, as Google Trends data are primarily derived from English-language queries, search behaviors from non-English-speaking regions may be underrepresented, which could affect the global generalizability of the findings.

### *Implications for Health Policy and Education*

Despite these limitations, this analysis offers valuable insights for stakeholders involved in health technology dissemination, patient education, and policy development. The findings suggest that public interest in novel imaging technologies like PSMA PET can grow rapidly following key clinical and regulatory milestones, indicating a need for proactive patient education and healthcare provider training to address this interest (9,13).

For health policymakers and insurers, the trajectory of public interest may serve as an early indicator of growing demand for new imaging technologies, potentially informing decisions about resource allocation, reimbursement policies, and healthcare infrastructure development (9). The sustained growth in PSMA PET interest suggests that demand for this modality may continue to increase, necessitating consideration of access and equity issues, particularly in regions where availability remains limited.

From a research perspective, this study demonstrates the value of infodemiology approaches in monitoring the public response to medical innovations (6,7). Future studies could expand on this work by examining regional variations in interest, correlating search patterns with clinical utilization data, and exploring the content of online discussions about prostate cancer imaging to better understand public perceptions and information needs.

## Conclusion

This Google Trends analysis reveals a dramatic transformation in public interest in PSMA PET imaging for prostate cancer. Our findings demonstrate exponential growth in search interest since 2020, closely aligned with key scientific publications and regulatory approvals. The sustained upward trajectory indicates genuine public engagement that extends beyond transient media attention. While traditional imaging modalities maintain higher overall search volumes, PSMA PET has rapidly gained momentum in public consciousness. This digital engagement pattern mirrors real-world clinical adoption, suggesting strong correlation between public awareness and technology diffusion. Healthcare providers should anticipate increased patient inquiries and prepare appropriate educational resources. Our analysis supports the value of infodemiology methods for monitoring health technology adoption. Digital engagement patterns provide early indicators of public interest that can inform resource allocation, educational priorities, and health policy development in the evolving field of molecular imaging.

## Declarations

### Funding

No funding was received for conducting this study.

### Conflicts of Interest/Competing Interests

The authors declare that they have no conflict of interest.

### Ethics Approval

Although this study was based on publicly available, aggregated, and anonymized Google Trends data that does not involve identifiable human subjects, ethical approval was nonetheless obtained from Acıbadem

Mehmet Ali Aydınlar University Medical Research Evaluation Board(ATADEK), under approval number 2025-07/286, May 8<sup>th</sup>, 2025. This was done to ensure adherence to institutional policies and ethical research standards.

### Availability of Data and Material

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

### Authors' Contributions

Tansel ÇAKIR conceived and designed the study, performed data analysis, and drafted the manuscript.

Hakan ÇAKIR contributed to data collection, analysis, and interpretation, critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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