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Chatbots in Urology: A Bibliometric and Trend Analysis of the Emerging Landscape (2023-2025)

Ürolojide Sohbet Robotları: Gelişen Alanın Bibliyometrik ve Trend Analizi (2023-2025)

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Abstract

Objective: Chatbot applications powered by large language models (LLMs) have garnered growing interest in healthcare, including urology. Although recent studies suggest potential roles in patient education, decision support, and medical training, no bibliometric analysis has yet evaluated the research landscape within urology. This study aims to comprehensively reveal the current research trends and scientific contributions related to chatbots in urology.
Materials and Methods: A comprehensive bibliometric analysis was conducted using the Web of Science Core Collection (Urology and Nephrology section) to identify original articles on chatbot use in urology published between January 2023 and May 2025. Data were analyzed using the Bibliometrix R package and the Biblioshiny interface. Key metrics included publication trends, citation data, keyword networks, authorship patterns, and international collaboration rates.
Results: A total of 81 original articles met the inclusion criteria. The annual growth rate in publication output was 45.3%, with an average of 10.6 citations per article. Most articles appeared in Science Citation Index Expanded indexed journals. The United States (32.1%) and Türkiye (25.9%) were the most prolific countries. However, international collaboration remained low (23.5%). Urolithiasis, prostate cancer, and urinary incontinence were leading clinical themes. Keyword network analysis identified clusters focused on patient education, decision support, and chatbot performance.
Conclusions: This study offers a foundational understanding of chatbot-related research in urology and highlights the need for enhanced international collaboration, clinical validation, and data integration to fully realize their transformative potential.

Keywords: chatbot, large language models, artificial ıntelligence, urology, bibliometric analysis, ChatGPT

Özet

Amaç: Tüm tıp alanlarında olduğu gibi ürolojide de yapay zekâ destekli sohbet robotlarına olan ilgi giderek artmaktadır. Son çalışmalar, bu teknolojilerin hasta eğitimi, klinik karar destek sistemleri ve tıp eğitimi gibi alanlarda potansiyel roller üstlenebileceğini öne sürse de üroloji alanındaki araştırma eğilimlerini değerlendiren kapsamlı bir bibliyometrik analiz henüz yapılmamıştır. Bu çalışma, ürolojide yapay zekâ destekli sohbet robotlarına yönelik mevcut araştırma eğilimlerini ve bilimsel katkılarını kapsamlı bir biçimde ortaya koymayı amaçlamaktadır.
Gereçler ve Yöntemler: Ürolojide yapay zekâ destekli sohbet robotlarının kullanımıyla ilgili Ocak 2023 ile Mayıs 2025 tarihleri arasında yayımlanmış özgün makaleleri belirlemek amacıyla Web of Science Core Collection (Üroloji ve Nefroloji bölümü) veri tabanı kullanılarak kapsamlı bir bibliyometrik analiz gerçekleştirildi. Veriler, Bibliometrix R paketi ve Biblioshiny arayüzü ile analiz edildi. Yayın eğilimleri, atıf verileri, anahtar kelime ağları, en çok katkı veren yazarlar ve uluslararası iş birliği oranları başlıca incelenen metriklerdi.
Bulgular: Çalışmaya toplam 81 özgün makale dâhil edildi. Bu alandaki makalelerdeki yıllık yayın artış oranı %45,3 olarak saptandı. Makale başına ortalama 10,6 atıf yapılmış olduğu görüldü. Makalelerin çoğunun Science Citation Index Expanded indeksli dergilerde yayımlandığı görüldü. Amerika Birleşik Devletleri (%32,1) ve Türkiye (%25,9) en üretken ülkelerdi. Uluslararası iş birliği oranının düşük olduğu gözlendi (%23,5). Üriner sistem taş hastalığı, prostat kanseri ve üriner inkontinans en sık çalışılan klinik temalar arasındaydı. Anahtar kelime ağı analizi, hasta eğitimi, karar destek sistemleri ve yapay zekâ destekli sohbet robotlarının performansı odaklı kümelenmeler olduğunu ortaya koydu.
Sonuç: Bu çalışma, ürolojide yapay zekâ destekli sohbet robotlarının kullanımıyla ilgili araştırma eğilimlerine dair temel bir bakış sunmakta ve bu teknolojilerin dönüştürücü potansiyelinin tam olarak ortaya çıkarılabilmesi için uluslararası iş birliğinin güçlendirilmesi, klinik doğrulama ve veri entegrasyonu gereksinimlerini vurgulamaktadır.

Anahtar kelimeler: sohbet robotları, büyük dil modelleri, yapay zeka, üroloji, bibliyometrik analiz, ChatGPT

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Introduction

In recent years, rapid advances in artificial intelligence (AI) technologies, particularly large language models (LLMs), have transformed the landscape of information processing and decision making across various fields, including healthcare [1]. Since its release, the first globally recognized LLM-based chatbot, ChatGPT, developed by OpenAI in November 2022, has garnered millions of users [2]. Subsequently, several other chatbots have been introduced, including Copilot (formerly Bing Chat, developed by Microsoft in February 2023), Claude (developed by Anthropic in March 2023), and Gemini (formerly Bard, developed by Google in December 2023). These chatbots have demonstrated a remarkable capability to understand and generate human-like texts across diverse domains. Recent studies have shown that chatbots perform exceptionally well in comprehending medical concepts [3].

In the field of urology, chatbot applications remain relatively nascent but are rapidly gaining attention. Emerging research suggests that chatbots can assist in patient counseling for various urological conditions, including benign prostatic hyperplasia, urinary incontinence, erectile dysfunction, and prostate cancer [4-6]. For instance, chatbots can be trained to provide interactive explanations about treatment options, potential side effects, or preprocedural preparations for interventions, such as onabotulinum toxin injections, sacral neuromodulation, or robotic radical prostatectomy [7,8]. They may also aid in interpreting laboratory or imaging results, guiding patients on medication adherence or follow-up schedules, and supporting lifestyle interventions for recurrent stone disease or lower urinary tract symptoms (LUTS) [9,10]. Additionally, from a professional education perspective, chatbots are being explored as tools for medical students and urology residents, including guideline-based content and clinical case simulations [11]. Recent investigations have also assessed whether chatbot responses align with clinical practice guidelines, such as those issued by the European Association of Urology [12].

Bibliometrics, a snapshot of scholarly literature within a defined period, offers a quantitative method for analyzing scientific output and research trends. This strategy allows scholars to uncover prominent authors, high-impact journals, notable institutions, and emerging research themes by analyzing indicators, such as publication volume, citation trends, and co-authorship patterns [13].

Despite growing interest in this subject, no comprehensive assessment has yet been conducted on chatbot-related scientific output in the field of urology. Our study represents the first bibliometric analysis specifically focused on this emerging area. Understanding the development of this interdisciplinary field, situated at the intersection of urology, artificial intelligence, and digital health, is essential to guide future research directions and facilitate clinical integration.

Material and Methods

For this research, the Urology and Nephrology section of the Web of Science (WoS) Core Collection was chosen as the principal data source due to its broad scope and established credibility as a trusted citation index in academic research. This section was specifically preferred because it includes the majority of the leading journals in the field of urology. Additionally, WoS offers robust tools for bibliometric visualization, citation tracking, and trend analysis, making it particularly well suited for examining the evolving research landscape in this domain.

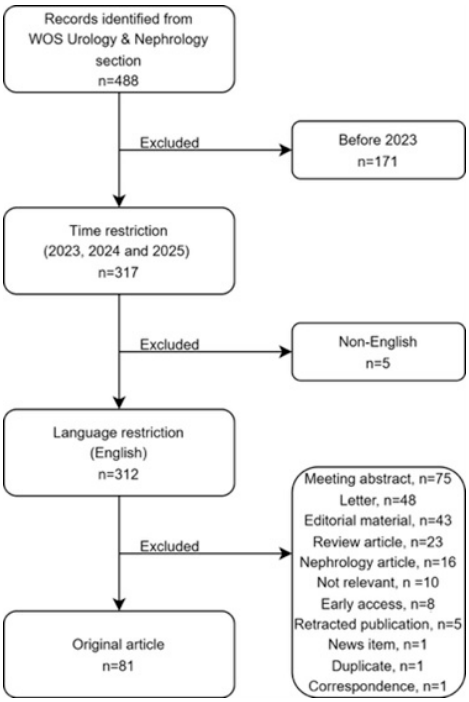

Figure 1. Flowchart of the study

Data were retrieved in a single session on May 21, 2025, to ensure consistency and eliminate the risk of database updates affecting the analysis. A study selection flowchart outlining the identification process of relevant original articles is presented in **Figure 1**. The search strategy applied was TS = "open AI" OR "ChatGPT" OR "Claude" OR "Gemini" OR "Bard" OR "Copilot" OR "Bing Chat" OR "large language model" OR "LLM" OR "chatbot." This query was designed to capture the most prominent and frequently referenced chatbot platforms in the literature.

Given that the first globally recognized chatbot, ChatGPT, was launched in November 2022 and that the earliest publications on chatbot-related research in urology began appearing in 2023, the inclusion period was set to begin in 2023. Publication dates were determined based on the articles' first online publication (excluding early access status).

The inclusion criteria consisted of original research articles in English that focused specifically on chatbots in the field of urology. After excluding 171 articles published before 2023, five non-English publications, and 231 documents that did not meet the eligibility criteria, 81 original articles were included in the final analysis.

The bibliometric analysis was conducted using the Bibliometrix R package [14]. Additionally, the Biblioshiny web application was employed to provide an interactive graphical user interface within the R environment (version 4.4.3), accessed through the RStudio platform (version 2025.05.0).

According to the decision of the Aydin Adnan Menderes University Non-Interventional Ethics Committee, the study

did not require ethical approval, as it involved no human participants, patient data, personal data, animal experiments, or interventional procedures. All analyses were performed using publicly accessible publication records from the Web of Science Core Collection (WoSCC).

Results

Between January 2023 and May 21, 2025, 81 original articles on this topic were identified in the Urology and Nephrology section of the WoS Core Collection. Supplementary material provides a chronological listing of the included articles related to chatbot research in urology.

Publication Trends

Of the 81 articles reviewed, 70 were indexed in the Science Citation Index Expanded (SCIE), while 11 were listed under the Emerging Sources Citation Index (ESCI). Publication output grew at an annual rate of 45.3%, with each article receiving an average of 10.6 citations.

The earliest chatbot-related research publication in the field of urology was the article titled "ChatGPT Performance on the American Urological Association Self-assessment Study Program and the Potential Influence of Artificial Intelligence in Urologic Training" by Deebel et al., which appeared in Urology in May 2023. Including 14 additional papers published in the same year, the total number of studies for 2023 reached 15. This number increased significantly to 54 in 2024, and by May 21, 2025, 13 more studies had been published (**Figure 2**).

Given the growing interest in this topic and the presence of eight additional original articles currently available as early access (thus excluded from the analysis), it is likely that the number of publications in this field will continue to rise sharply in the near future.

Author Analysis

A total of 559 authors contributed to the included studies. Only one article was single authored, indicating that the vast majority of the research was conducted collaboratively. Furthermore, 23.5% of the publications involved international co-authorship, reflecting a limited level of cross-border collaboration.

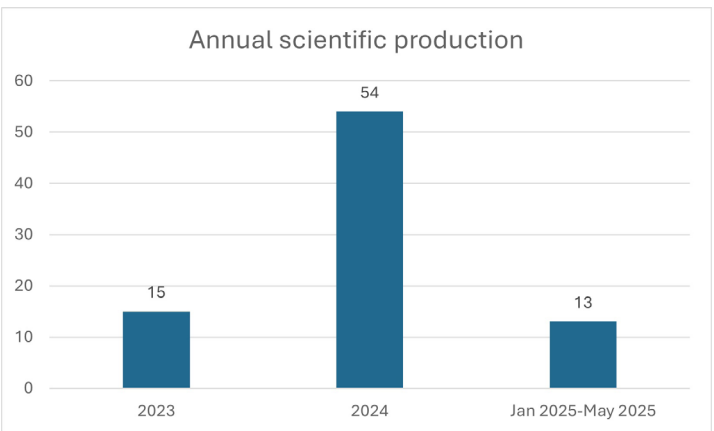

Figure 2. Publication trends for chatbots in the urology field from January 2023 to May 2025

Table 1. Top 10 most productive authors on chatbot-related research in urology

Authors	Articles (N=81), n (%)	Total citations	Local H-index
Caglar U	6 (7.40)	125	5
Ozgor F	6 (7.40)	125	5
Sarilar O	5 (6.2)	87	4
Yildiz O	4 (4.9)	109	4
Ayranci A	4 (4.9)	111	4
Cacciamani G E	3 (3.7)	166	3
Cakir H	3 (3.7)	54	2
Dogan C	3 (3.7)	17	2
Halis A	3 (3.7)	16	1

Table 1 presents the top 10 most productive authors alongside their total citations and local H-index (a combined measure of a researcher's publication output and the number of citations each publication receives) on chatbot-related research. The most prolific contributors were Caglar U. and Ozgor F., each with six publications and 125 total citations, resulting in a local H-index of five. They were followed by Sarilar O. (five articles, 87 citations), Yildiz O. (four articles, 109 citations), and Ayranci A. (four articles, 111 citations), each demonstrating strong scholarly influence. Notably, Cacciamani G. E., with only three publications, accumulated the highest citation count (166) among all listed authors, indicating a high citation-per-article ratio and impactful research contributions.

A collaboration network analysis was performed on 56 authors who contributed to at least two publications. As illustrated in **Figure 3**, the co-authorship network revealed the presence of several distinct clusters, suggesting a fragmented but moderately interconnected research landscape. The largest cluster, represented by brown nodes, demonstrated dense internal connections, indicating a strong pattern of collaboration among its members.

Several other medium-sized clusters also displayed high intragroup collaboration while showing limited connectivity with other clusters. This reflects a structure characterized by localized or institution-specific research efforts with relatively low intergroup interaction. In addition, a number of smaller, isolated clusters were observed, suggesting that some researchers tend to collaborate in small, closed teams rather than engage in broader collaborative networks.

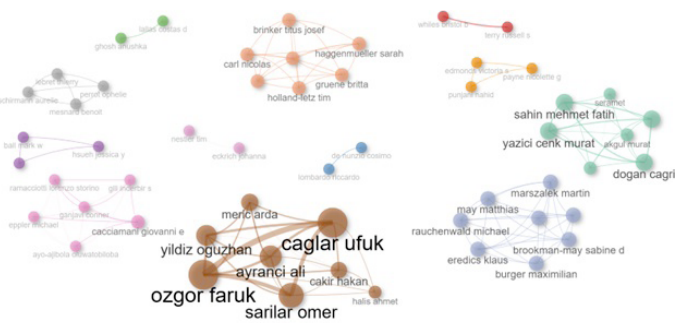

Figure 3. Collaboration network analysis of 56 authors who contributed to at least two publications on this topic

Table 2. Top 10 most productive countries based on corresponding authors' affiliations on chatbot-related research in urology

Country	Articles (N=81), n (%)	SCP	MCP	MCP %
United States	26 (32.1)	21	5	19,2
Türkiye	21 (25.9)	21	0	0
Germany	7 (8.6)	3	4	57,1
China	5 (6.2)	5	0	0
Brazil	3 (3.7)	0	3	100
Canada	3 (3.7)	2	1	33,3
Italy	3 (3.7)	2	1	33,3
Australia	2 (2.5)	2	0	0
France	2 (2.5)	1	1	50
Spain	2 (2.5)	2	0	0

SCP: single country publication, MCP: multiple country publication

Country Analysis

Table 2 lists the top 10 most productive countries in chatbot-related research according to the corresponding author's affiliation. Among 23 countries, the United States led the ranking with 26 articles, representing 32.1% of the total output. This comprised 21 single-country publications (SCPs) and five multiple-country publications (MCPs), resulting in an MCP ratio of 19.2%.

Türkiye ranked second, with 21 articles (25.9%), all of which were SCPs, indicating a strong national contribution but limited international collaboration. Germany followed with seven articles (8.6%), including three SCPs and four MCPs, reflecting a notably high MCP rate of 57.1% and suggesting substantial international engagement. Notably, although Brazil contributed only three articles, they were all classified as MCPs, reflecting a 100% international collaboration rate.

This distribution highlights the prominent role of the United States and Türkiye in driving research on chatbot applications, particularly in the field of urology. Their leadership underscores the two countries' growing academic engagement with AI in clinical contexts.

An international collaboration map was drawn based on the cooperation relationships between countries, with thicker lines indicating more collaboration. Many countries/regions have engaged in relevant cooperation, among which the United States, Germany, Italy, and Brazil have the most frequent collaborations, as shown in **Figure 4**.

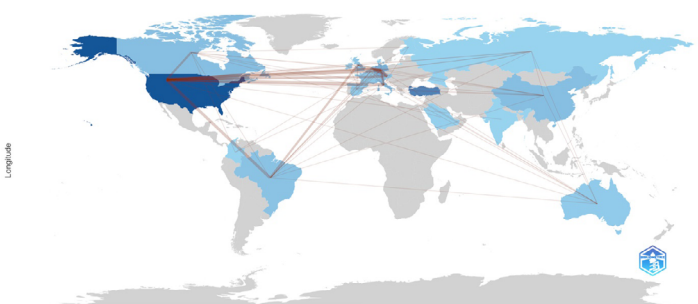

Figure 4. Country collaboration map

Table 3. Top 10 most productive institutions on chatbot related research in urology

Institutions	Articles (N=81), n (%)
Istanbul Haseki Training and Research Hospital (Türkiye)	5 (6.2)
Icahn School Of Medicine at Mount Sinai (United States)	4 (4.9)
Acibadem Hospitals Group (Türkiye)	3 (3.7)
Namik Kemal University (Türkiye)	3 (3.7)
Ruprecht Karls University Heidelberg (Germany)	3 (3.7)
Sapienza University Rome (Italy)	3 (3.7)
State University System of Florida (United States)	3 (3.7)
University of Florida (United States)	3 (3.7)
University of Health Sciences Turkey (Türkiye)	3 (3.7)
University of Munich (Germany)	3 (3.7)

WoS: Web of Science

Analysis by Institutions

Table 3 presents the top 10 most productive institutions in chatbot-related research. Among the 202 institutions identified, Istanbul Haseki Training and Research Hospital ranked first, contributing five articles and accounting for 6.2% of total publications. The Icahn School of Medicine at Mount Sinai followed closely with four articles (4.9%). Notably, both the United States and Türkiye, leading countries in the country-level analysis, also occupy top positions at the institutional level. Eight other institutions shared the third position, each contributing three articles (3.7%).

Source Analysis

The analysis of journal distribution revealed a clear concentration of chatbot-related research in urology in SCIE-indexed journals. Among the 33 unique journals identified in this study, 27 were indexed in the SCIE, while the remaining 6 were indexed in the ESCI.

Among the group of top 10 journals based on publication volume, the World Journal of Urology published the highest number of original articles (n = 14), while the journal Urology stood out with the highest citation count, 161 citations from six articles, indicating strong visibility and influence in the field (**Table 4**).

All but one of the top 10 journals (Urology Practice, indexed in ESCI) were SCIE indexed. The 2023 Journal Impact Factors of the top 10 journals ranged from 0.8 to 5.1. According to the quartile distribution based on the urology and nephrology category in the WoS, three journals were classified as Q1, four as Q2, two as Q3, and one as Q4. These findings indicate that chatbot-related research in urology is being published across a diverse spectrum of journals with varying levels of impact.

Table 4. Top 10 journals on chatbot-related research in urology

Sources	Articles (N=81), n (%)	Total citations	Local H-index	Journal impact factor 2023 (Index)	Journal citation reports quartile (WoS Urology&Nephrology section)
World Journal of Urology	14 (17.2)	82	5	2.8 (SCIE)	2
Journal of Endourology	8 (9.9)	36	4	2.9 (SCIE)	1
Urology	6 (7.4)	161	4	2.1 (SCIE)	2
Urology Practice	6 (7.4)	83	3	0.8 (ESCI)	4
Clinical Genitourinary Cancer	3 (3.7)	20	2	2.3 (SCIE)	2
European Urology Open Science	3 (3.7)	10	2	3.2 (SCIE)	1
International Urology and Nephrology	3 (3.7)	19	2	1.8 (SCIE)	3
Prostate	3 (3.7)	9	2	2.6 (SCIE)	2
Prostate Cancer and Prostatic Diseases	3 (3.7)	99	3	5.1 (SCIE)	1
BMC Urology	2 (2.47)	9	1	1.7 (SCIE)	3

Citation Analysis

Table 5 presents the top 10 most globally cited original articles on chatbot-related research in urology. These articles collectively reflect the growing academic engagement with chatbots in urology. The most cited article, published by Davis et al. in The Journal of Urology (2023), received 69 citations, making it the leading contribution in this field. It was followed by Cocci et al.'s 2024 article in Prostate Cancer and Prostatic Diseases, which garnered 69 citations as well, sharing the top position in terms of citation impact.

Keyword Analysis

Figure 5 displays a word cloud featuring the 50 most frequently used author keywords in original articles on chatbot-related research in urology. As anticipated, the most prominent terms included "artificial intelligence," "ChatGPT," "urology," "large language models," and "chatbot," underscoring the primary themes explored in the analyzed literature. Closely related terms, such as "natural language processing," "Copilot," "Claude," "Bard," and "Gemini," indicate the diversity of chatbots being explored in urology research.

Table 5. Top 10 cited original articles on chatbot-related research in urology

Original articles	Total citations
Davis R, 2023, J Urol	69
Cocci A, 2023, Prostate Cancer Prostatic Dis	69
Coskun B, 2023, Urology	59
Whiles Bb, 2023, Urology	56
Eppler M, 2023, Eur Urol	55
Caglar U, 2023, J Pediatr Urol	44
Eppler Mb, 2023, Urol Pract	42
Deebel Na, 2023, Urology	40
Cakir H, 2023, Int Urol Nephrol	38
Gabriel J, 2023, Int Urol Nephrol	34

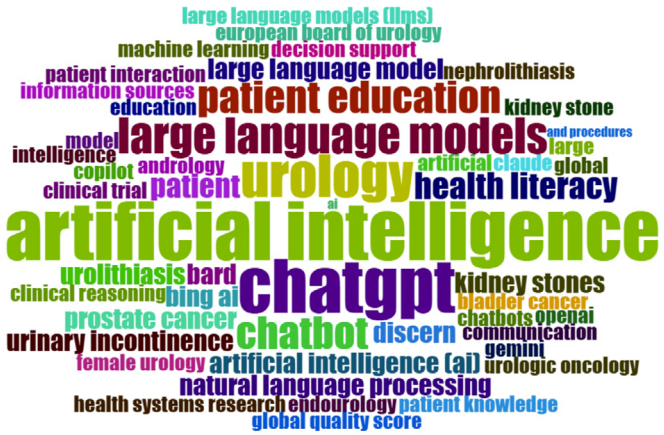

Figure 5. Word cloud of the 50 most prominent keywords

The appearance of clinical keywords such as "prostate cancer," "urinary incontinence," "bladder cancer," and "urolithiasis" suggests that these technologies are being applied across a range of urological subspecialties. In parallel, the frequent use of terms such as "patient education," "health literacy," "communication," and "patient interaction" highlights a strong interest in the use of chatbots to enhance patient engagement and understanding. Furthermore, keywords such as "clinical reasoning," "decision support," and "health systems research" point to an emerging role of chatbots in supporting clinical workflow and healthcare delivery.

Figure 6 illustrates the co-occurrence network of the most prominent authors' keywords generated from the included publications. The terms "artificial intelligence" and "ChatGPT"

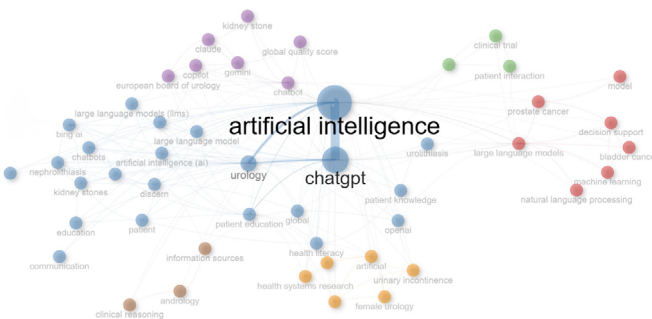

Figure 6. Co-occurrence network of authors' keywords

are centrally positioned and strongly connected, confirming their dominant role as focal points in chatbot-related urology research. Several major thematic clusters emerged in the network. The blue cluster centers around clinical and technological terms such as "patient," "kidney stones," "communication," and "nephrolithiasis," suggesting active research at the intersection of AI technologies and urolithiasis. The orange cluster includes terms like "health literacy," "patient knowledge," "information sources," and "urinary incontinence," emphasizing the patient-centered dimension of chatbot use in functional urology. The green cluster highlights keywords such as "clinical trial," "patient interaction," and "decision support," pointing to the experimental and assistive clinical roles of AI. The red cluster features more technical and disease-specific terms like "prostate cancer," "natural language processing," and "machine learning," suggesting research on specific AI technologies in the context of uro-oncology. The purple cluster is populated by various chatbot platforms, including "Claude," "Gemini," and "Copilot," indicating comparative or multi-platform evaluations.

Discussion

Summary of Key Results

This bibliometric study provides the first snapshot of chatbot-related research in urology. In this study, we comprehensively evaluated the scientific output related to chatbot applications in the field of urology between January 2023 and May 2025. A total of 81 original articles were identified from the Urology and Nephrology section of the WoS Core Collection. The analysis revealed a rapid increase in publication volume, with a 45.3% annual growth rate. Most studies were published in journals indexed in the SCIE, spanning a broad range of impact levels.

The United States and Türkiye emerged as the leading contributors, accounting for nearly 60% of all publications. Notably, institutions such as the Istanbul Haseki Training and Research Hospital (Türkiye) and the Icahn School of Medicine at Mount Sinai (United States) played pivotal roles in driving research output. While countries such as the United States, Germany, Italy, and Brazil exhibited strong international collaboration networks, the overall rate of cross-border co-authorship remained limited to 23.5%.

Keyword and co-occurrence network analyses highlighted that chatbot research in urology centers on both technological development and clinical application. While common terms pointed to the core technologies and tools used, cluster analyses emphasized subspecialty applications, including urolithiasis, uro-oncology, andrology, and functional urology.

Citation analysis showed that the most highly cited articles were generally among the first publications addressing chatbot use in the field of urology. Their high citation counts in such a limited timeframe are unsurprising, as these foundational studies drew attention to a novel and rapidly evolving subject.

Study Implications

The analysis revealed a rapid increase in publication volume, with a 45.3% annual growth rate. This substantial growth highlights the dynamic evolution of AI applications in urology, indicating a shift from experimental concepts to practical clinical tools. Supporting this trend, a global survey involving 456 urologists reported that nearly half of the participants already use LLMs in academic practice [15].

As evidenced by the included studies, numerous investigations involving chatbots have been conducted across various urological subspecialties, including uro-oncology [16], pediatric urology [5], andrology [17], urololithiasis [18], male LUTS [19], and female urology [20]. This diversity, also reflected in the keyword analysis, suggests that chatbot applications powered by LLMs hold promise for implementation across the full spectrum of urological practice.

The prominence of patient education and health literacy themes in the keyword analysis underscores a fundamental shift toward patient-centered care facilitated by AI technologies. Chatbots offer unprecedented opportunities to provide personalized, accessible, and consistent information to patients with urological diseases [21]. However, the successful implementation of these tools requires careful consideration of patient safety, data privacy, and the maintenance of the physician–patient relationship [22].

Limited international collaboration underscores the need for a more robust and globally integrated research agenda in this emerging field. Establishing international research networks could accelerate knowledge exchange and facilitate cross-border studies, which are essential for standardizing chatbot development and implementation in urological practice.

The diversity of chatbot platforms identified in this analysis highlights both opportunities and challenges for clinical integration. While this variety offers flexibility in selecting appropriate tools for specific applications, it also creates fragmentation that may hinder standardization efforts.

Clinical and Ethical Considerations

The reliability of AI chatbots as clinical decision-support tools remains uncertain. Several independent evaluations have shown that although large language models can produce medically coherent answers, they frequently generate inaccurate statements or "hallucinations," which limits their suitability for unsupervised clinical use. Gilson et al. demonstrated that ChatGPT's performance on medical examination questions was inconsistent and often lacked source transparency [23]. Huh similarly reported that ChatGPT provided partially incorrect or unverifiable responses in medical education settings, despite appearing confident and fluent [24]. Beyond accuracy, recent analyses of advanced models such as Med-PaLM have shown improved but still imperfect clinical reasoning, reinforcing that LLMs are not yet reliable for autonomous decision-making [25].

Ethically, the absence of verifiable citations, potential embedded biases, and unclear accountability frameworks pose challenges for integrating chatbots into patient pathways. Experts emphasize that AI should function strictly as an adjunct, supporting but never replacing clinician judgment, until robust regulatory, validation, and monitoring systems are established [26].

Future Research Priorities

Beyond the identified need for enhanced international collaboration, future research should prioritize prospective clinical trials comparing chatbot-assisted versus traditional care pathways, with a focus on patient-centered outcomes, such as satisfaction, adherence to treatment recommendations, and clinical efficacy.

Multicenter validation studies across diverse patient populations are essential to ensure the generalizability and equity of chatbot applications. Additionally, comprehensive health economic evaluations should be conducted, incorporating implementation costs, training demands, and long-term sustainability metrics. To support safe and effective integration into healthcare systems, regulatory framework development in collaboration with medical licensing authorities and AI safety organizations is also critically needed.

Despite the valuable insights provided, this bibliometric analysis has several limitations. First, the study was restricted to publications indexed in the Urology and Nephrology section of the WoS Core Collection. Consequently, relevant studies published in other sections of WoS or indexed in other databases, such as Scopus, PubMed, or Embase, may have been overlooked, potentially leading to the omission of important contributions to the field. This limitation may have affected the comprehensiveness of the findings and the generalizability of the observed trends.

Second, although citation-based metrics are valuable for evaluating research impact, they may not accurately capture the practical relevance or scientific rigor of the studies. Frequently cited articles may owe their impact to novelty or timing rather than methodological rigor or clinical relevance.

Finally, the rapid pace of advances in LLM-based chatbots poses a challenge to the longevity of bibliometric findings as research trends and technological developments quickly evolve.

Conclusions

This study offers a foundational understanding of the current landscape of chatbot-related research in urology. It highlights not only the rapid growth and diverse thematic focus of this emerging field but also the gaps in international collaboration. As conversational AI technologies continue to evolve, future research should prioritize cross-institutional partnerships, deeper clinical evaluations, and broader database integration to enhance the scope and impact of scholarship in this area. These efforts will be essential to the full realization of the potential of LLM-based chatbots in transforming urological care and education.

Ethics Committee Approval: According to the decision of the Aydin Adnan Menderes University Non-Interventional Ethics Committee, the study did not require ethical approval, as it involved no human participants, patient data, personal data, animal experiments, or interventional procedures. All analyses were performed using publicly accessible publication records from the Web of Science Core Collection (WoSCC).

Informed Consent: An informed consent was obtained from all the patients.

Publication: The results of the study were not published in full or in part in form of abstracts.

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