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Online Interest in Urology Residency: A Comprehensive Analysis of Current Internet Temporal and Geographic Patterns

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Abstract: Urology is one of the most competitive specialties in medicine, creating a challenge for prospective students looking to secure a residency position. Our study aims to assess online interest in urology residency by querying online interaction with search terms and criteria for urology residency programs. Utilizing Google Trends analysis from 2011 to 2024, this study examined urology-related search volume indexes, as well as temporal and geographical patterns. Furthermore, the number of residency positions from the American Urological Association database for the 2022 match process was evaluated. Our analysis of temporal trends revealed increased interest in urologist salaries from 2011 to 2019, followed by a decline from 2019 to 2023. Interest in urology-related interviews, applications, research, and letters increased in 2019, marked by the start of the COVID-19 pandemic. California, New York, and Texas had the lowest interest-to-position (IP) ratio, while Maryland, New Jersey, and Virginia had the highest IP ratio. Our analysis reveals an evolving interest in salaries, residency programs, and USMLE Step 1 changes in areas connected with urology. We report key geographical areas with high urology residency interest and low numbers of programs, implying a need for expanded residencies in underserved yet high-interest areas. Awareness and continued interest monitoring after the COVID-19 pandemic is critical for understanding interest in urology applicants.

Keywords: Google Trends; urology residency; urology; urology match; urology application



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1. Introduction

Urology has long been known as one of the most competitive specialties in medicine, as evidenced by several metrics such as average match rate, USMLE Step scores, number of publications, percentage of Alpha-Omega-Alpha (AOA) matriculants, and the percentage of applicants from a top 40 NIH-funded medical school [1]. The Urology Residency Match of 2023 comprised 551 qualified applicants vying for 383 spots, resulting in a match rate of only 69.5% [2]. This creates a challenge for highly competitive applicants looking to secure a position in a urology residency program. The value and weight placed on various factors of a prospective urology resident's application, such as substantial research experience, high academic performance, and holistic characteristics, have changed over time and are yet to be fully quantified. Increasing interest in the field, paired with the competitive nature of the urology residency match process, has likely driven a surge in online research about the field and its residency application process. Thus, utilizing online search inquiries and patterns could suggest how these factors have shifted for urology applicants and residency programs. This study aims to provide insights into the evolving landscape of urology residency applications by examining the search behaviors of prospective applicants.

We used Google Trends to conduct this analysis. Google Trends offers insights into search behavior across the United States, showcasing data on geographical and temporal patterns of search term volumes. This tool is essential for monitoring public interest,

particularly in medical education and training, where research in this manner is rapidly expanding. Although limitations for Google Trends' reliability and quality are questioned, this is a rapidly evolving field that continues to help evaluate behavioral changes and conduct research using previously inaccessible data [3–5]. Furthermore, studies have shown that online resources are the most utilized when researching residency programs [6,7].

Previous studies have leveraged Google Trends to assess interest in specific residency programs within the United States. For instance, previous research has examined interest in Orthopedic Surgery Residency and Plastic Surgery Residency [8,9]. However, there is a gap in understanding the interest in urology, which is among the most competitive specialties.

Google Trends has been used in urology to focus on patient demands across different states in the U.S. However, there is a lack of insight into the interest of prospective students in residency programs [10]. Understanding this interest can illuminate potential trends in filling the gaps within residency positions. As the value and weight of various factors in urology residency applications continue to evolve, there has been a surge in online research about the field and its application process. Analyzing online search inquiries and patterns can provide valuable insights into how these factors have shifted for urology applicants and residency programs.

By assessing the current state of urology residency interest, we aim to provide insights into how prospective applicants navigate their journey into the field while comparing this approach with selection criteria utilized by urology residency programs.

2. Materials and Methods

Many search terms related to urology, including research, salary, application, residency, rankings, interviews, step 2, length, match, step 1, aways, letters of recommendation, and AOA, were chosen. Google Trends was used to query all search terms related to urology in the United States [11]. Google Trends searches were collected from 1 January 2011 to 1 January 2024 to determine urology SVI's temporal and geographical interest. The choice of 1 January 2011 as the starting point for Google Trends data collection is due to significant improvements in geographical assignment accuracy made by Google around that time. This ensures that the data collected provide more reflective changes in search behaviors over time, aligning with our study's objectives of analyzing post-improvement trends in prospective urology residency applicants.

Within Google Trends, each data point is normalized by dividing by the total searches of the geography and time range it represents to compare relative popularity. The resulting values are scaled from 0 to 100 based on the topics' proportion to all searches on all topics to generate a "search volume index" (SVI). Google Trends only produces data for terms with a sufficient SVI.

The number of residency positions in 2022 was collected from the American Urological Association (AUA), "Urology Residency Programs section" [2]. The program state, name, and "Number of Resident Positions per year" were collected from this dataset. Residency programs without a specified number of residency spots did not participate in the 2023 Match Process. Data collection involved accessing and compiling information from the AUA's official records, which are generally reliable within the urology community. However, potential inaccuracies in reporting by individual programs, updates after data collection, and variations in reporting formats across programs may affect data consistency and comparability. An Interest-to-Position (IP) ratio was calculated by dividing state-specific SVI in "Urology Residency" by the number of urology residency positions in each state to compare geographic SVI with the availability of residency positions.

3. Results

3.1. Temporal Interest

"Urologist salary" had an overall increase in search volume, starting at SVI of 32 in January 2011, peaking at 100 at November 2015, then gradually declining to an SVI of 55 in January 2024 (Figure 1A) Urology-related searches for interviews, applications,

research, and letters display SVI increases from 2019 to 2022. The “Urology interview” SVI increased from a peak SVI of 40 in June 2019 to a peak of 69 in October 2021. The “Urology application” SVI increased from a peak SVI of 31 in September 2019 to 100 in September 2023. The “Urology research” SVI peak in February 2019 was 55, while it was 67 in May 2023. The “Urology letters” SVI increased from a peak of 74 in March 2019 to a peak SVI of 100 in January 2022 (Figure 1B–E). Notable increases in the “Urology Match” SVI occurred every early spring month, from February to April (Figure 1F). A notable decrease in the “Urology step 1” SVI from a peak SVI of 53 in March 2021 to an SVI of 0 from April 2023 to January 2024 was seen. Contrarily, the SVI for “Urology Step 2” increased from a peak interest of 22 in June 2020 to a peak SVI of 62 in July 2023. The “Urology Step 1” and “Urology Step 2” SVI temporal trends are shown in Figure 2.

For the terms “urology length”, “urology rankings”, “urology aways”, and “urology residency”, the search volumes for each demonstrated variability over time (Supplemental Figure S1). The SVI appears sporadic and inconsistent, characterized by substantial periods of inactivity interspersed with short-lived peaks.

3.2. Geographic Interest

The top five states with the highest SVI in “urology residency” were Michigan (100), Pennsylvania (83), New York (83), Ohio (83), and Maryland (83) (Table 1).

Table 1. Search volume interest (SVI) by state for “Urology Residency” search term. Search volume interest for all states with available search interest and residency position data for “Urology Residency” search term. Values produced by Google Trends and ordered in descending order.

| “Urology Residency” Search Term SVI | |
|-------------------------------------|---------------------------|
| State | Search Volume Index Value |
| Michigan | 100 |
| Pennsylvania | 83 |
| New York | 83 |
| Ohio | 83 |
| Maryland | 83 |
| Massachusetts | 66 |
| Illinois | 66 |
| New Jersey | 66 |
| North Carolina | 50 |
| Virginia | 50 |
| California | 33 |
| Texas | 33 |
| Florida | 33 |
| Georgia | 33 |

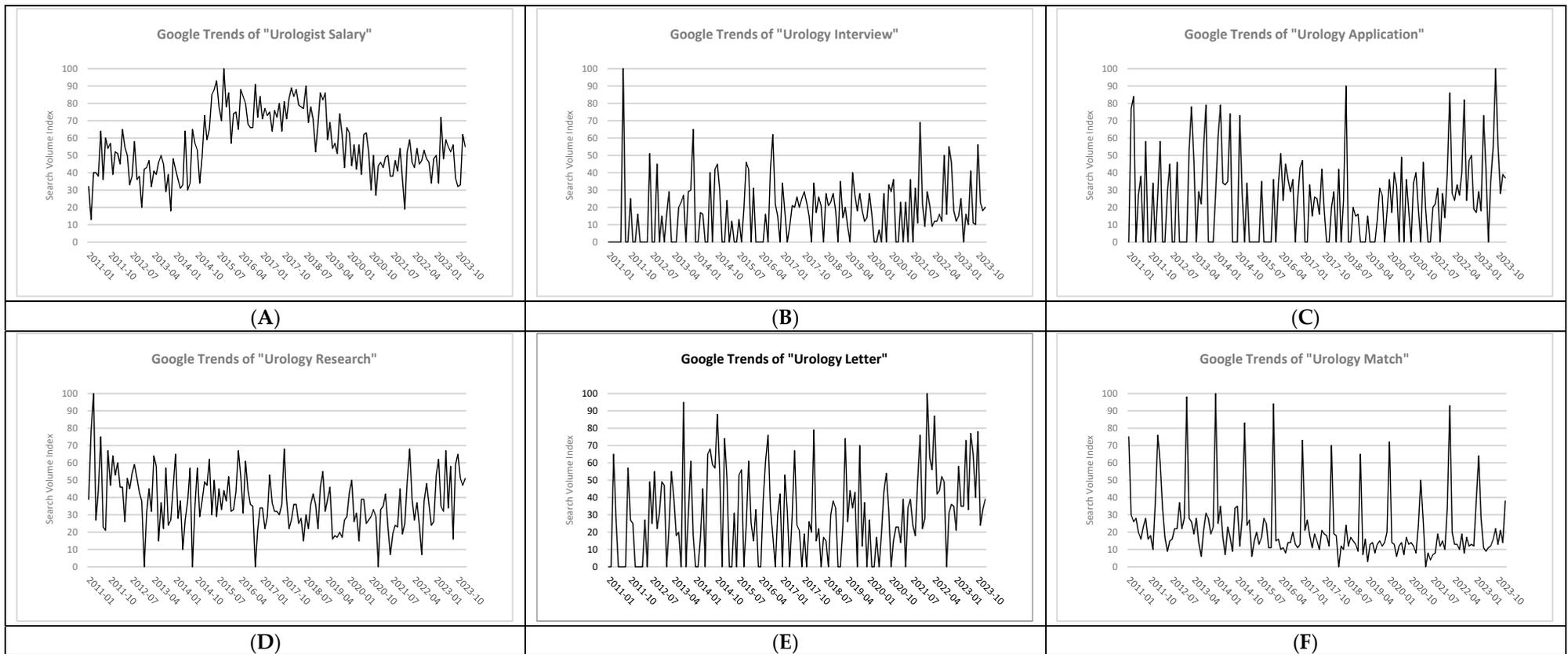


Figure 1. Google Trends search volume index (SVI) for search term results over time from January 2011 to January 2024. (A) Urologist Salary; (B) Urology Interview; (C) Urology Application; (D) Urology Research; (E) Urology Letter; (F) Urology Match.

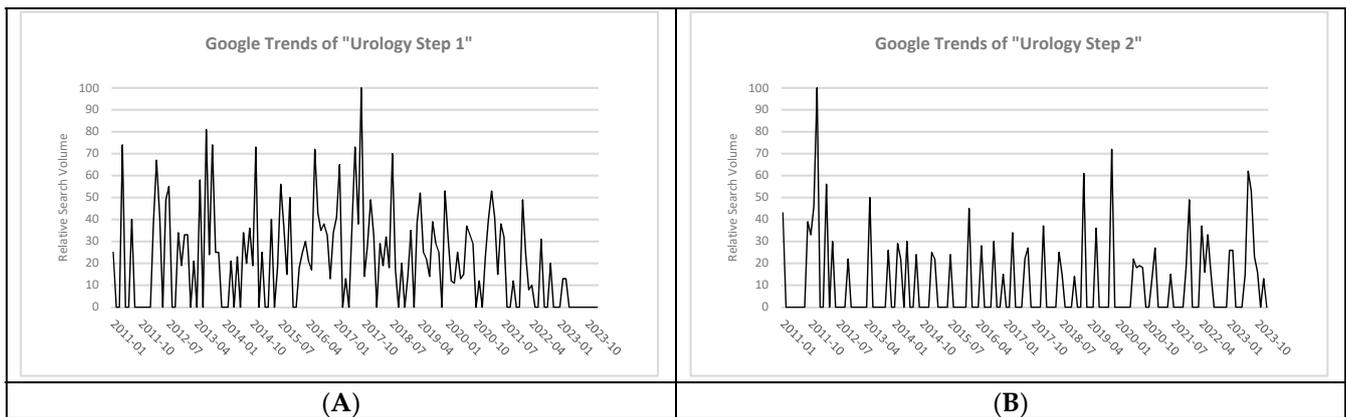


Figure 2. Google Trends search volume index (SVI) for Step 1 and Step 2 Search Terms results over time from January 2011 to January 2024. (A) Urology Step 1; (B) Urology Step 2.

Urology residency program PGY-1 positions varied by state. New York (N = 45), California (N = 37), Texas (N = 27), Pennsylvania (N = 25), and Michigan (N = 21) have the top five most combined PGY-1 urology resident positions (Figure 3).

By contrast, Alaska, Delaware, Idaho, Montana, North Dakota, South Dakota, Nevada, and Wyoming have no urology residency programs. However, limited urology residency positions in a state did not necessitate a subsequent decrease in urology search interest. For example, states with less than ten urology residency positions, such as Virginia, Connecticut, Missouri, Maryland, and New Jersey, had a much higher IP ratio than states with greater numbers of urology residency positions, such as New York, California, and Texas (Table 2).

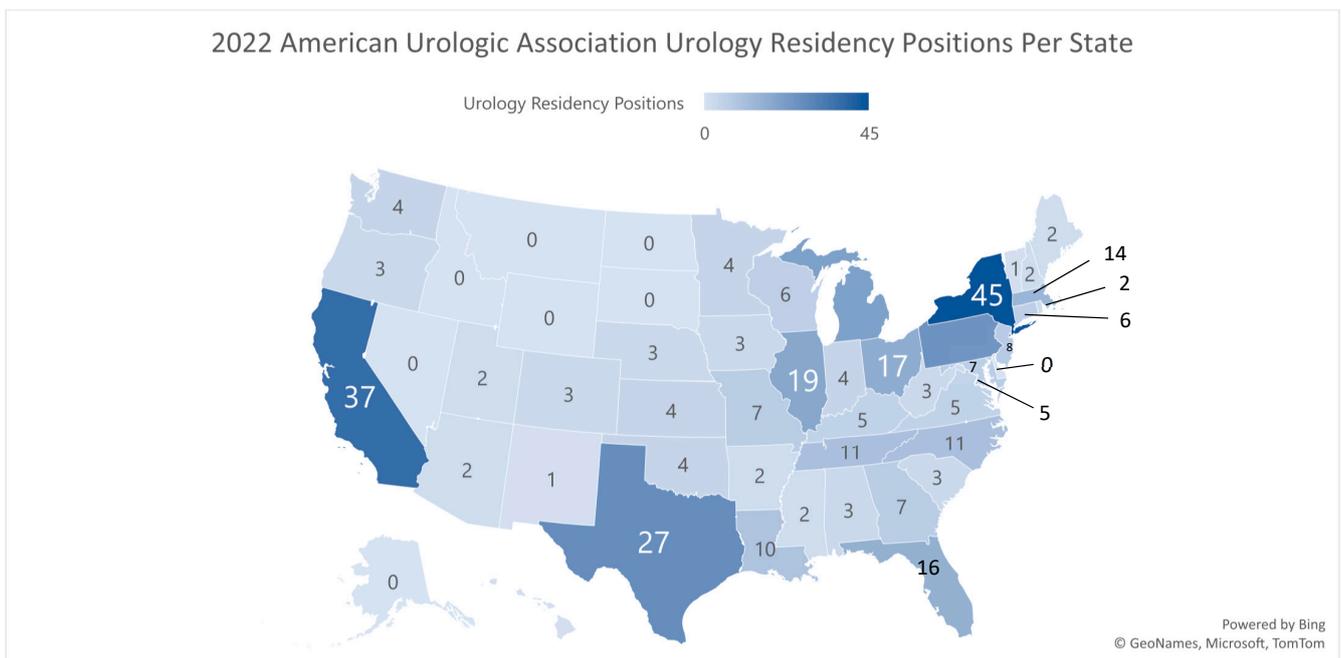


Figure 3. Geographic trends for urology residency positions obtained by the American Urologic Association (AUA). “www.auanet.org/meetings-and-education/for-residents/urology-residency-and-fellowship-programs/” (Accessed on 25 January 2024)”.

Table 2. Interest-to-position ratio by state for “Urology Residency” search term. Interest-to-position (IP) ratio for all states with available search interest and residency position data for “Urology Residency” search term. IP ratio is calculated by dividing a state’s SVI for urology residency by residency positions offered. IP ratios are ordered in descending order.

| “Urology Residency” Search Term IP | |
|------------------------------------|----------------------------|
| State | Interest-to-Position Value |
| Maryland | 11.86 |
| New Jersey | 8.25 |
| Virginia | 10 |
| Ohio | 4.88 |
| Michigan | 4.76 |
| Massachusetts | 4.71 |
| Georgia | 4.71 |
| North Carolina | 4.55 |
| Illinois | 3.47 |
| Pennsylvania | 3.32 |
| Florida | 2.06 |
| New York | 1.84 |
| Texas | 1.22 |
| California | 0.89 |

4. Discussion

To our knowledge, this study is the first to analyze changes in internet search interest for terms related to urology residency, among other associated factors. Our findings show general seasonality in many terms, peaking in SVI during the first few months of the year (January–March) and seeing a resurgence towards the year’s end.

4.1. The Urology Salary

Salary is considered an indicative measure of interest in the medical field due to its direct correlation with financial motivation and stability. A systematic review of factors influencing medical students’ subspecialty choice found that compensation was the second most critical factor behind academic interests [12]. Similar to other surgical subspecialties, urology salary SVI’s upward interest from 2011 to 2019 implies the centrality of compensation in career choices within the field of urology [8,9].

However, the COVID-19 pandemic has potentially reordered these priorities, as evidenced by a declining SVI for urology salaries post-2019 (Figure 1A). Several external factors, from increased healthcare challenges to shifts in medical education, could underpin this interest. The pandemic has shed light on the challenges and risks faced by healthcare professionals, including urologists. According to the 2020 Medscape National Survey of 15,181 physicians, including 119 urologists, the field of urology ranked the highest in burnout and suicide [13]. Similar to other specialties, urologists experienced significant workforce disruption due to the COVID-19 pandemic, potentially contributing to decreases in income, health, and lifestyle [14,15]. While the healthcare system as a whole has rebounded from the impacts of COVID-19, it is uncertain to what degree the pandemic has had lasting influence on current interest in urology residency. Additionally, the pandemic has significantly impacted medical education and training, leading to limitations in clinical experience and exposure to different medical specialties. Several studies have found decreased exposure to urology in U.S. medical schools during pre-clinical and clinical years [16–18]. Increased early exposure in medical school has been shown to be positively correlated with increased interest in career considerations in urology for medical students [19]. These findings suggest a need for further research to explore more specific reasons behind the declining interest in urology salary since the COVID-19 pandemic, especially in comparison to other specialties. Understanding these factors can be crucial in developing more effective interventions and addressing concerns for aspiring urologists.

Furthermore, studies have evaluated the barriers and significant financial undertaking applicants endure when securing a urology residency spot. In 2020, urology applicants applied to 74 programs on average, an increase from prior years [20]. This signifies increased financial costs due to the application fees associated with the increasing number of applications. Additionally, it was found that urology applicants may spend upwards of \$7000 on the urology match process [21]. Understanding these financial constraints could lend credence to the rise in urology salary interest in our analysis and the regional preferences exhibited by applicants. However, the modern era of remote interviewing certainly plays a key role in mitigating the cost burden.

4.2. Interest in Residency Programs

In our analysis of the relationship between SVI for “urology residency” and the number of residency spots per state, we observed potential disparities in the distribution of urology training programs and urologic services across the United States (Tables 1 and 2, Figure 3). Certain states, including Maryland, Virginia, New Jersey, Ohio, and Michigan, demonstrated a comparatively high IP ratio, indicating a potential gap in the availability of urologic training opportunities in the Midwest and East Coast of the United States. Conversely, California, New York, and Texas exhibited the lowest IP ratios, suggesting that search volume may be generated from other states with prospective residents moving to these regions (Table 2). Further investigation is needed to explore the underlying causes of these differences and develop strategies to address them, ultimately improving access to urology training and services nationwide. This mismatch between supply and demand highlights the importance of considering regional preferences and ensuring the availability of urology residency programs in areas with the highest interest. Furthermore, this suggests prospective resident physicians often consider relocation to pursue urology as their specialty of choice.

The distribution of urology residency programs and the subsequent workforce has significant implications for healthcare access, particularly in underserved areas. Studies have shown that exposure to underserved areas during residency training can lead to a greater likelihood of practicing in these areas [22]. However, the geographic distribution of physicians, particularly in rural areas, remains a challenge, with some specialties not diffusing to the most rural areas [23]. These findings underscore the need for targeted strategies to address geographic disparities in residency program distribution and to recruit and retain physicians in underserved areas.

Despite only a slight increase in residency positions over time, Google Trends data show a rise in SVI for “urology interview”, “urology application”, “urology research”, and “urology letters” since the start of the COVID-19 pandemic (Figure 1B–E). This rise in interest indicates that medical students and aspiring urologists actively seek information and opportunities in the field. Addressing the barriers that deter students from choosing urology is essential, including the application process, gender, socioeconomic factors, and candidates from minority-underrepresented backgrounds [20]. Understanding the factors that motivate medical students and residents when deciding on residency positions is crucial. Strategies to attract medical students can include clinical exposure, educational tools, and mentorship programs. Further research is necessary to understand the factors contributing to the distribution disparity between urology residency programs and areas of high interest.

4.3. Change in Step 1 Score Reporting

On 12 February 2020, the Federation of State Medical Boards (FSMB) and the National Board of Medical Examiners® (NBME®) announced that Step 1 score reporting would change from a three-digit numeric score to pass/fail. On 26 January 2022, Step 1 officially became pass/fail, shifting the importance of this exam to become a competitive applicant for residency spots. As Google Trends shows, SVI in urology Step 1 scores declined in 2020, while Step 2 interest increased (Figure 2). Before the pass/fail change to the USMLE Step

1 exam, the reported score was a significant barrier for medical students not meeting the “score cutoffs” desired by residency programs across a subset of specialties.

The average Step 1 score from 2011 to 2015 was 243 for those matching into urology residency programs [24]. A large survey of urology residency program directors reported that a lower USMLE Step 1 score was one of the disadvantageous criteria for interview selection in the application process [25]. The impact of the pass/fail change on competitiveness is still evolving and may vary across programs and institutions. The use of the USMLE Step 1 score in residency selection has been a topic of debate, with its use, validity, and holistic approach to the evaluation of applicants questioned [26,27]. However, others suggest that the predictive validity of the NBME scores supports the use of USMLE scores as part of the review process [28]. Despite this, it is clear that the implications of the USMLE Step 1 scoring change are significant, and further research is needed to understand its impact on residency selection criteria and applicant competitiveness. This highlights the shift in focus required by urology residency directors towards other factors such as clinical experiences, research, letters of recommendation, and away rotations, which may gain more significance in the selection process to determine the level of competitiveness for an applicant in urology residency positions. The change may lead to a more equitable evaluation of candidates and broaden the pool of applicants. Further research is needed to fully assess the long-term effects of this change on the competitiveness of urology and other medical specialties.

4.4. Urology Match Rate

Regarding the urology match rate, a notable increase in SVI occurs around the early spring months of February through April (Figure 1F). This coincides with the urology match process, which traditionally culminates in late January, suggesting that individuals may seek match rate information during or immediately after the match process. Various methodologies rank urology residency programs among outlets such as Doximity, the U.S. News & World Report, and others. A study by Feinstein et al. found that residency program size (total number of residents) was a significant predictor of Doximity rank even after adjusting for various factors [29]. Among the 28 specialties analyzed, Urology was found to have the greatest correlation between residency program size and Doximity ranking. Assessing the interrelationship between Google user interest and accessing these online resources is essential. Applicants may be interested in these rankings to judge how these programs differ in academics, research, patient care, etc.

A range of studies have shed light on the factors influencing the urology residency match process. One study discovered a positive correlation between the rankings of urology programs and the medical schools attended by their residents, indicating a preference for higher-ranked medical institutions [30]. This observation is in line with another study that identified predictors of match success, such as honors grades, away sub-internships, and USMLE Step 1 scores [31]. However, there is also a call for a more streamlined application process, advocating for fewer applications and regional interviews [32]. Additionally, the importance of interview day structure, diverse faculty, program culture, surgical training, and research in the selection of residency programs has been emphasized [33]. These findings underscore the complex interplay of factors in the urology match process, including program reputation, match success rates, and applicant preferences.

4.5. Limitations and Future Directions

While our study offers many strengths, it is important to acknowledge our limitations. For instance, biases in online search behavior, such as demographic or geographic biases, could influence our findings. Additionally, the limitations of Google Trends, such as its inability to provide detailed context behind search trends limits our ability to identify user intent or classification (residency applicant vs. curious patient). These considerations are crucial for interpreting the findings accurately and ensuring the validity of the study's conclusions.

Our study allows practicing urologists to leverage these insights to mentor and support aspiring urology applicants. While being aware of the concerns and interests highlighted in our study, such as the impact of the USMLE Step 1 score transition to pass/fail or the emphasis on research opportunities, urologists can provide targeted guidance and mentorship to medical students navigating the residency application process. As the landscape of residency application continues to evolve, future research should investigate other important factors not investigated in this study, including preference signaling, dedicated research years, and post-residency fellowship training to understand unique factors influencing specialty choice.

5. Conclusions

This study examined the online search interest for urology residency, providing insights into prospective urology applicants' methods in assessing the urology application and match process. Through querying Google, a dominant information source, we evaluated the current interest in urology as a specialty from the perspective of prospective residents. We discerned a consistent volume in search terms relating to urology residency applications, underlining students' sustained interest despite the competitive nature of the urology matching process. Our analysis of Google Search data particularly emphasized areas like urology salary, residency programs, and the USMLE Step 1 score transition to pass/fail, highlighting the nuances of interest and concerns of prospective applicants. Search volumes and Google Trends for "urology residency, application, research, and letters" suggest an active pursuit of urology residency information and opportunities in the field. These findings highlight the dynamic nature of interest in urology as a medical specialty. Our study provides actionable insights for program directors, school administrators, and practicing urologists. Understanding online search trends can help tailor recruitment strategies and mentorship efforts. Our study's novelty lies in its real-time view of applicant interests. Future research should explore longitudinal trends and qualitative analyses. Overall, our findings contribute to evidence-based improvements in urology residency recruitment and education.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/ime3020014/s1>, Figure S1: Google Trends search volume index (SVI) for search term results over time from January 2011 to January 2024.

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