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Prostate Cancer Health Information on Google Using the Quality Evaluation Scoring Tool (Quest): A Cross-Sectional, Multilingual Analysis

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Abstract

Background/Objectives: The internet is a major source of health information, including prostate cancer, but the quality of such content is inconsistent and may influence patient decision-making. This study aimed to evaluate the quality of online prostate cancer information by language, location, and user mode ("Logged off" vs. "Anonymous") using the Google search engine. **Methods**: We conducted a cross-sectional, observational study between 5 and 11 December 2022, evaluating Google search results for prostate cancer information across three European cities (Basel, Munich, and Paris) and three languages (English, German, and French) in both "Logged off" and "Anonymous" user modes. A total of 900 websites (450 per mode) were retrieved and classified as: (1) university, (2) hospital, (3) governmental/medical societies, (4) industrial/commercial/NGOs, or (5) other. Website quality was assessed using the validated QUEST, which evaluates authorship, attribution, conflicts of interest, currency, and evidence. Inclusion rates and QUEST scores were compared across languages, locations, and categories using Kruskal-Wallis tests with multiple comparison adjustments. A total of 900 websites (450 per mode) were retrieved in English, German, and French from searches conducted in Basel, Munich, and Paris. Websites were classified as: (1) university, (2) hospital, (3) governmental/medical societies, (4) industrial/commercial/NGOs, or (5) other. Quality was assessed using the QUEST, which evaluates authorship, attribution, conflicts of interest, currency, and evidence. Inclusion rates and QUEST scores were compared across languages, locations, and categories using Kruskal-Wallis tests with multiple comparison adjustments. **Results**: Inclusion rates were high for both modes (Logged off: 86%; Anonymous: 85%). Location-based differences were significant for Basel ($p = 0.04$) and Paris ($p = 0.02$), while language-based differences were not significant. In "Logged off" mode, Category 1 achieved the highest median QUEST score (18.3), followed by 3 (17.8), while Category 2 scored lowest (14.2). Differences were significant ($\chi^2 = 50$, $p < 0.001$), particularly between Categories 2 vs. 3 and 2 vs. 4 ($p < 0.001$). Similar patterns were observed in the "Anonymous" mode. **Conclusions**: Online prostate cancer information varies substantially in quality. French-language sites, despite high inclusion rates, were of lower quality, while English and German content more frequently met high-quality standards. University websites were the most reliable, hospital websites the least. Language, location, and site type influence the accessibility and reliability of online prostate cancer information.

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1. Introduction

The internet has become a primary source of health information for many individuals, with a steadily increasing number of adults seeking health-related advice online over the past decades [1]. In 2020, Eurostat reported that 53% of EU citizens searched for health information online [2]. This trend is driven by various motivations, including the desire for reassurance, clarification, or diagnosis of physical symptoms, as well as guidance on whether to consult a medical professional [3]. However, despite the convenience and accessibility of online resources, using the internet as a primary source of health information has its challenges. Many individuals lack medical expertise and may struggle to understand complex medical terminology [4], leading to the potential misinterpretation of critical health information. Furthermore, while some studies suggest that most medical websites offer high-quality information [5,6], others report that many online resources are inadequate or misleading [7–12], which can contribute to poor health decisions and adverse outcomes, especially in cases involving life-threatening symptoms such as chest pain [4].

There is a growing concern about the quality of health information available online, particularly for serious conditions such as prostate cancer, which is the second most common cancer in men [13]. The reliability of information on prostate cancer across different languages and websites, and its implications for patients, remains underexplored. Although previous studies have identified that younger individuals, women, and those with higher education levels are more likely to seek health information online [14–16], the quality and accessibility of prostate cancer-related information, specifically in various languages and regions, have not been adequately assessed. Studies have also shown that the quality of online health information can vary significantly depending on the website's affiliation [6], medical specialty [6], and language [17], yet little is known about how these factors influence the availability and quality of prostate cancer information online.

The Quality Evaluation Scoring Tool (QUEST) is a validated, quantitative framework for assessing the transparency and reliability of online health information [18]. Developed and tested by Robillard et al. [18]. It enables standardized comparison across different website types and medical topics. The aim of this study is to address this gap by assessing the quality of online prostate cancer information, specifically focusing on the effects of language (i.e., search terms) and location (i.e., search origin) on the accuracy and reliability of content. By providing a comprehensive overview of the current online information landscape on prostate cancer from the patient's perspective, this study seeks to highlight the challenges patients face in navigating online health information and offer insights into improving the accessibility and quality of information for this important health issue.

2. Materials and Methods

2.1. Study Design

We performed a cross-sectional, observational study between 5 and 11 December 2022. Three search terms, "Prostate cancer" (English), "Prostatakarzinom" (German), and "Cancer de la prostate" (French), were used to perform internet searches, as they represent simple and direct phrases likely to be used by patients when seeking information related to prostate cancer. These terms are among the most frequently used in each language to describe the condition and were chosen to reflect real-world search behavior. Because prostate cancer patients often seek information using general rather than medical terminology, these terms

were selected to closely mimic typical patient search patterns. Google [18] served as the search engine.

Searches were conducted in Basel (Switzerland), Munich (Germany), and Paris (France) to identify language- and location-dependent differences. Basel was included as the home city of the study authors and as a practical base for data collection. Paris, as the capital of one of the largest European countries, provided insight into prostate cancer information available to a large French-speaking population. Munich, as a major German city geographically close to Basel, enabled a comparative analysis within the German-speaking region.

Website evaluation was conducted by two independent assessors, both affiliated with a university hospital and experienced in the medical field. One assessor is a practicing physician, and the other is a PhD student and study nurse specializing in prostate cancer research. The evaluators travelled together to each city and performed on-site searches simultaneously under identical browser and device settings. To avoid misunderstandings, we clarified that each search mode was assessed by a single evaluator: N.J. conducted all "logged off" searches, and L.E. conducted all "anonymous" searches. Because each set of retrieved websites was therefore evaluated only once per mode, a formal inter-rater reliability analysis (e.g., Cohen's κ) could not be performed. All inclusion and exclusion decisions were subsequently reviewed and discussed with M.W. to ensure consistency and methodological transparency across both search modes. The study focused on websites in German, French, and English to reflect the linguistic diversity of the selected cities. German was included as the primary language of Basel and Munich, French as the primary language of Paris, and English as an international language of science and medicine widely used in Europe. This combination ensured coverage of diverse linguistic contexts and provided a broader understanding of the availability and quality of prostate cancer information across European regions.

2.2. Search Settings and Data Collection

Before the searches, cookies and browsing history were cleared, SafeSearch filters were disabled, the number of results was set to 50 per page, and both trending searches and spoken responses were turned off. Region settings were set to "current". Only organic links were included; featured snippets and links marked as advertisements were excluded.

Searches were carried out in both "Logged off" (signed out of the Google account) and "Anonymous" (incognito) mode. The rationale for using both modes was to reduce personalization bias. Search engines often personalize results based on previous searches, location, and browsing history. While this can improve relevance, it may also create a "filter bubble" that limits exposure to diverse perspectives. Anonymous mode reduces personalization by isolating searches from stored cookies and browsing history, resulting in a more neutral set of results.

In "Logged off" mode, the user is not signed into a Google account, which prevents access to personal account data, although some personalization still occurs based on IP address, location, device type, and cookies from previous interactions. In contrast, "Anonymous" mode creates a separate browsing session with no access to stored cookies, cache, or browsing history. Google and other websites treat this as a fresh session with limited personalization.

In each city, six searches were conducted (English, German, and French × Logged off and Anonymous), resulting in a total of 18 searches. For each search, the first 50 webpages were assessed, yielding up to 450 webpages per mode (150 webpages per language across the three cities). The digital archive "Wayback Machine" (http://www.archive.org, accessed on 18 October 2025) was used to store all included websites, enabling later re-

trieval and management. Data were collected on-site in the three cities under identical search settings.

2.3. Quality Evaluation Scoring Tool

Website quality was assessed using the Quality Evaluation Scoring Tool (QUEST) [18], which contains six dimensions—authorship, attribution, conflict of interest, currency, complementarity, and tone—evaluated on scales of 0–2 or 0–1, resulting in an overall score between 0 and 28 (see Supplementary Materials for a detailed description of the QUEST criteria).

Websites were additionally classified by affiliation: 1 = university; 2 = hospital; 3 = governmental/medical societies; 4 = industrial/commercial/non-governmental organizations; 5 = other. To avoid bias, each QUEST score was independently assigned by two evaluators.

Scoring categories:

- Low-quality websites: <14 points, generally lacking credibility and transparency
- Moderate-quality websites: 14–21 points, moderately reliable but with limitations
- High-quality websites: >21 points, well-referenced, expert-reviewed, and easily understandable

2.4. Statistical Analysis

Statistical analyses were conducted using R, version 4.0.5 for macOS. Non-parametric statistics were applied. Data are presented as raw values and percentages or Z scores, where indicated. Kruskal–Wallis tests with Bonferroni correction for multiple comparisons were used to compare languages, locations, and categories. Statistical significance was set at $p < 0.05$.

2.5. Use of Artificial Intelligence Tools

During manuscript preparation, ChatGPT (GPT-5.2., OpenAI, San Francisco, CA, USA) was used only to assist with language editing and stylistic refinement. No artificial intelligence tool was used for data analysis, study design, statistical evaluation, or interpretation of results. All scientific content, analyses, and conclusions were reviewed and verified by the authors, who take full responsibility for the integrity and accuracy of the manuscript.

3. Results

3.1. Overall Included Websites

In total, 900 websites, with 450 each for "Logged off" and "Anonymous" mode and their URLs were stored and subsequently evaluated (see Figure 1).

Independent of language and location, most included websites fall into category 4, followed by categories 3, 2, 5 and 1. The number and distribution of included websites for "Logged off" and "Anonymous" modes are highlighted in Tables 1 and 2, respectively. No significant differences were found between both modes. French-language websites had the highest inclusion rates ("Logged off" 91% [137/150]; "Anonymous" 90% [135/150]) compared to German (89% [133/150]; 89% [134/150]) and English (77% [115/150]; 76% [114/150]). Basel showed the highest city-level inclusion rates ("Logged off" 89% [133/150]; "Anonymous" 87% [131/150]), compared to Paris (84% [126/150]; 85% [127/150]) and Munich (84% [126/150]; 83% [125/150]). No significant differences in inclusion rates were found between languages ($p > 0.05$), but location-based differences were significant for Basel ($p = 0.04$) and Paris ($p = 0.02$).

Regardless of location, no significant differences were revealed between languages with respect to the number of included websites (Kruskal–Wallis chi-squared/df/p-value),

i.e., French ($3/2/p = 0.20$), German ($0.1/2/p = 0.90$) or English ($1/2/p = 0.60$) for "Logged off" and ($0.7/2/p = 0.70$) for "Anonymous", respectively. Regardless of language, location-dependent differences (i.e., only English vs. French) were found with respect to the number of included websites for "Logged off" (Basel: Z-Score 2.52, $p = 0.036$ *; Paris: Z-Score 2.72, $p = 0.02$) and "Anonymous" (Basel: Z-Score 2.4, $p = 0.049$; Paris: Z-Score 2.72, $p = 0.02$), respectively—both adjusted for multiple comparison using Bonferroni correction. However, this was not the case for Munich ($2/2/p = 0.40$). All post hoc comparisons are shown in Supplemental Table S1.
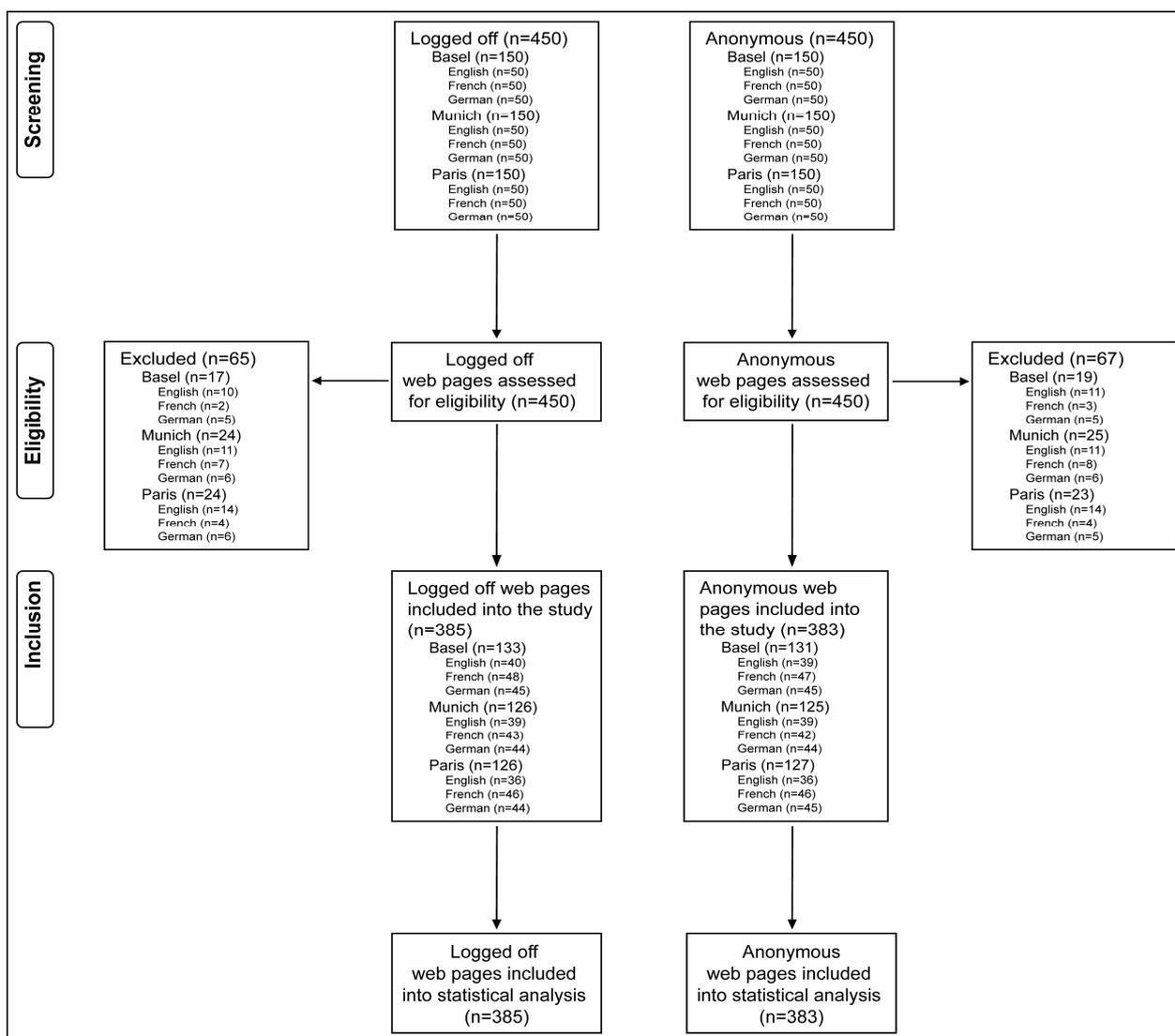

Figure 1. Study flow diagram. The overall inclusion rate of websites, independent of language and location, was 86% (385/450) for "Logged off" and 85% (383/450) for "Anonymous." Websites were excluded from analysis after initial identification if they did not contain valid or relevant information, were duplicate listings, required payment or subscription to access content, or were inaccessible (e.g., server error or denial of service). These exclusion criteria were applied consistently across all languages and locations to ensure data quality and comparability.

Table 1. Distribution of included websites according to language, location and category for anonymous search and logged off searches.

Languages (Post Hoc Locations) $	Category 1—University		Category 2—Hospital		Category 3—Governmental/Medical Professional Societies/Organizations		Category 4—Industrial/ Commercial/NGO		Category 5—Other		Overall Inclusions (%) #	
	A	L	A	L	A	L	A	L	A	L	A	L
					French							
Basel	0	0	11	9	5	6	24	23	7	10	47 (94)	48 (96)
Munich	0	0	8	8	7	8	20	19	7	8	42 (84)	43 (86)
Paris	0	0	6	6	6	7	23	21	11	12	46 (92)	46 (92)
					German							
Basel	0	0	12	13	9	9	17	16	7	7	45 (90)	45 (90)
Munich	1	1	13	13	10	10	14	14	6	6	44 (88)	44 (88)
Paris	0	0	15	15	11	11	12	13	7	5	45 (90)	44 (88)
					English							
Basel	0	0	5	5	10	10	21	22	3	3	39 (78)	40 (80)
Munich	0	0	5	5	13	13	18	18	3	3	39 (78)	39 (78)
Paris	0	0	5	5	9	10	19	17	3	4	36 (72)	36 (72)

Locations (post hoc languages) $	Category 1—University		Category 2—Hospital		Category 3—Governmental/Medical professional societies/Organizations		Category 4—Industrial/ Commercial/NGO		Category 5—Other		Overall Inclusions (%) #	
	A	L	A	L	A	L	A	L	A	L	A	L
					Basel							
French	0	0	11	9	5	6	24	23	7	10	47 (94)	48 (96)
German	0	0	12	13	9	9	17	16	7	7	45 (90)	45 (90)
English	0	0	5	5	10	10	21	22	3	3	39 (78)	40 (80)
					Munich							
French	0	0	8	8	7	8	20	19	7	8	42 (84)	43 (86)
German	1	1	13	13	10	10	14	14	6	6	44 (88)	44 (88)
English	0	0	5	5	13	13	18	18	3	3	39 (78)	39 (78)
					Paris							
French	0	0	6	6	6	7	23	21	11	12	46 (92)	46 (92)
German	0	0	15	15	11	11	12	13	7	5	45 (90)	44 (88)
English	0	0	5	5	9	10	19	17	3	4	36 (72)	36 (72)

$ unweighted with respect to search proportions, # max. 50 out of 50 pages includable. A = Anonymous search, L = Logged off search.

Table 2. QUEST scores—Proportions of website quality.

Logged Off	Basel			Location Munich			Paris		
Language	Low n (%)	Moderate n (%)	High n (%)	Low n (%)	Moderate n (%)	High n (%)	Low n (%)	Moderate n (%)	High n (%)
English	20 (50.0)	9 (22.5)	11 (27.5)	21 (53.8)	9 (23.1)	9 (23.1)	19 (52.8)	9 (25.0)	8 (22.2)
German	24 (53.3)	10 (22.2)	11 (24.4)	26 (59.1)	9 (20.4)	9 (20.4)	27 (61.4)	7 (15.9)	10 (22.7)
French	34 (70.8)	9 (18.8)	5 (10.4)	26 (60.5)	9 (20.9)	8 (18.6)	33 (71.7)	7 (15.2)	6 (13.0)

Anonymous	Basel			Location Munich			Paris		
Language	Low n (%)	Moderate n (%)	High n (%)	Low n (%)	Moderate n (%)	High n (%)	Low n (%)	Moderate n (%)	High n (%)
English	20 (51.3)	9 (23.1)	10 (25.6)	21 (53.8)	9 (23.1)	9 (23.1)	19 (52.8)	9 (25.0)	8 (22.2)
German	24 (53.3)	10 (22.2)	11 (24.4)	26 (59.1)	9 (20.4)	9 (20.4)	27 (61.4)	7 (15.9)	10 (22.7)
French	32 (68.1)	9 (19.1)	6 (12.8)	26 (60.5)	9 (20.9)	8 (18.6)	34 (73.9)	7 (15.2)	5 (10.9)

n = number of included websites (for each quality category). Data are presented as number of included websites and percentages.

3.2. QUEST Scores

3.2.1. Proportions of Website Quality

QUEST scores were calculated across six predefined quality dimensions, as illustrated in Supplementary Figure S1. Table 2 presents an overview of website quality proportions—categorized as low, moderate, and high—based on language and location. It highlights that a significant proportion of French websites were of low quality (60.5% to 73.9%), with only a small percentage meeting high-quality standard (10.4% to 18.6%), depending on the location and user mode. In contrast, both English and German websites had at least 20% rated as high quality (20.4% to 27.5%) and a notably smaller proportion classified as low quality (50.0% to 61.4%). The percentage of websites deemed moderate quality was similar across all three languages, ranging from 15.2% to 25.0%.

3.2.2. "Logged Off" Search

The overall inclusion rate was 85% (number of included websites = 383/number of all websites = 450). Across languages, inclusion rate was 91% (137/150), 89% (133/150), and 77 (115/150) for French, German and English, respectively. Across locations, inclusion rate was 89% (133/150) in Basel, and 84% (126/150) in Munich and Paris, respectively.

Independent of language and location, category 1 (27) highlighted the highest median QUEST score, followed by categories 3 (15, 10; 19), 4 (13, 10; 21), 2 (10, 7; 10) and 5 (10, 7; 15), respectively (see Figure 2). Overall QUEST scores did significantly differ between categories (Kruskal–Wallis chi-squared = 50, df = 4, $p < 0.001$; i.e., category 2 (hospital) vs. category 3 (governmental) Z-Score -6.02 ($p < 0.001$), and 2 vs. 4 (industrial) Z-Score -6.03 ($p < 0.001$), 2 vs. 5 (other) Z-Score -2.76 ($p = 0.034$), and 3 vs. 5 Z-Score 2.73 ($p = 0.039$). Independent of locations, significant differences between categories were revealed, i.e., French ($14/3/p = 0.002$), German ($26/3/p < 0.001$), and English ($8/3/p = 0.04$). Independent of languages, significant differences between categories were revealed, i.e., Basel ($14/3/p = 0.004$), Munich ($20/3/p < 0.001$), and Paris ($14/3/p = 0.002$). Across languages and locations, QUEST scores differed significantly between categories. Specifically, for the comparison of category 2 vs. 3, significant differences were found in French (Z-Score -3.36, $p = 0.005$), German (Z-Score -4.46, $p < 0.001$), Basel (Z-Score -2.98, $p = 0.017$), Munich (Z-Score -4.0, $p < 0.001$), and Paris (Z-Score -3.46, $p = 0.003$). Similarly, for the comparison of category 2 vs. 4, significant differences were observed in French (Z-Score -3.39, $p = 0.004$), German (Z-Score -4.09, $p < 0.001$), English (Z-Score -2.72, $p = 0.039$), Basel (Z-Score -3.42, $p = 0.004$), Munich (Z-Score -3.84, $p < 0.001$), and Paris (Z-Score -3.19, $p = 0.009$). All post hoc analyses were adjusted for multiple comparisons using Bonferroni correction, $p < 0.05$ (see Supplemental Table S3).
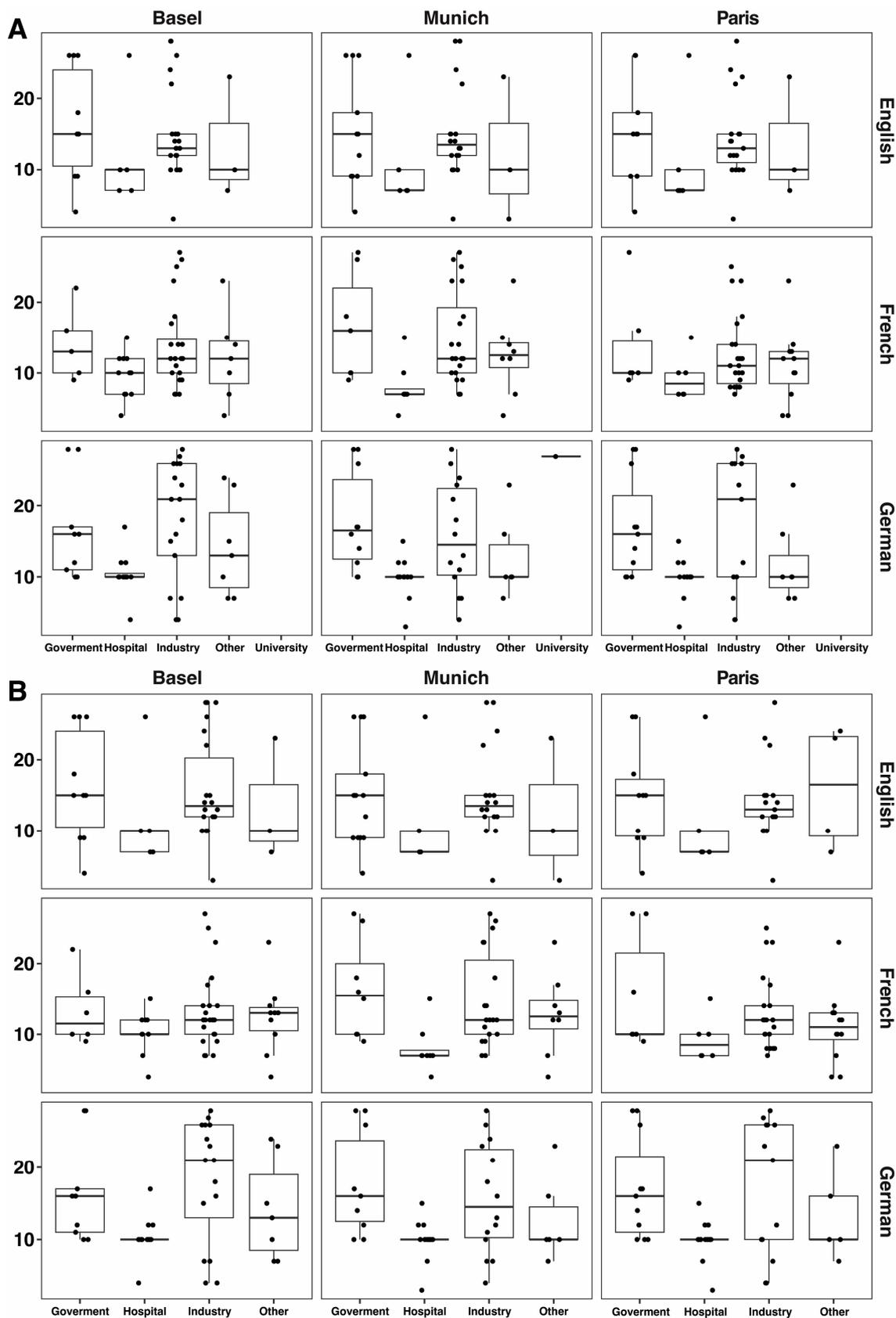
Figure 2. QUEST scores—Logged off (**A**) and Anonymous (**B**) search. Category 1 = University/Category 2 = Hospital/Category 3 = Governmental/medical professional societies/organizations/Category 4 = Industrial/Commercial/NGO/Category 5 = other. Supplementary Table S2 highlights all QUEST scores for Logged off and Anonymous searches.

3.2.3. "Anonymous" Search

The overall inclusion rate was 85% (number of included websites = 383/number of all websites = 450). Across languages, inclusion rate was 90% (136/150), 89% (133/150), and 76 (114/150) for French, German and English, respectively. Across locations, inclusion rate was 87% (131/150) in Basel, and 84% (126/150) in Munich and Paris, respectively.

Independent of location and language, category 1 (27) highlighted the highest median QUEST score, followed by categories 3 (15, 10; 19), 4 (13, 10; 21), 2 (10, 7; 10) and 5 (10, 7; 15). Overall QUEST scores did significantly differ between categories (50/4/$p < 0.001$), i.e., category 2 (hospital) vs. category 3 (governmental) Z-Score -3.28 ($p = 0.006$), 2 vs. 4 (industrial) Z-Score -3.74 ($p = 0.001$), 3 vs. 5 (other) Z-Score 3.1 ($p = 0.001$), and 4 vs. 5 Z-Score 2.7 ($p = 0.048$). Independent of locations, significant differences between categories were revealed, i.e., French (16/3/$p = 0.001$), German (25/3/$p = $ <0.001), and English (9/3/$p = 0.03$). Independent of languages, significant differences between categories were revealed, i.e., Basel (16/3/$p = 0.001$), Munich (20/3/$p < 0.001$), and Paris (14/3/$p = 0.003$). Across languages and locations, QUEST scores differed significantly between categories. Specifically, for the comparison of category 2 vs. 3, significant differences were found in French (Z-Score -3.28, $p = 0.006$), German (Z-Score -4.36, $p < 0.001$), Basel (Z-Score -3.24, $p = 0.007$), Munich (Z-Score -3.95, $p < 0.001$), and Paris (Z-Score -3.28, $p = 0.006$). Similarly, for the comparison of category 2 vs. 4, significant differences were observed in French Z-Score (-3.74, $p = 0.001$), German (Z-Score -3.99, $p < 0.001$), English (Z-Score -2.667, p 0.046), Basel (Z-Score -3.58, $p = 0.002$), Munich (Z-Score -3.91, $p < 0.001$), and Paris (Z-Score -2.96, $p = 0.018$). All post hoc analyses were adjusted for multiple comparisons using Bonferroni correction, $p < 0.05$ (see Supplemental Table S3).

4. Discussion

4.1. Main Findings

This study reveals notable disparities in the availability of online health information, as well as variations in website inclusion rates influenced by language, geographic location, and search modes ("Logged off" vs. "Anonymous"). French-language queries in Switzerland exhibited disproportionately high dropout rates, despite French being a primary language for 23% of the population [19]. In Basel, French terms were infrequently included in search results, reflecting the dominance of regional languages. Website inclusion rates differed significantly across languages and locations, with pronounced discrepancies observed in Basel and Paris, but not in Munich.

The majority of included websites were classified as category 4, followed by categories 3, 2, 5, and 1 across both search modes. Notably, commercial websites achieved higher QUEST scores, primarily due to their tendency to cite scientific evidence supporting their products. While deductions were applied for conflicts of interest, these did not sufficiently offset the elevated scores. These findings suggest that differences in language and geography may contribute to disparities in the quality and accessibility of online health information, although causal mechanisms cannot be inferred from this cross-sectional analysis.

4.2. QUEST Score Analysis

The data presented in Table S4 highlight substantial differences in the quality of online prostate cancer information across languages and locations. French-language websites consistently exhibited the highest proportion of low-quality content, with up to 73.9% falling into this category. This trend indicates a significant gap in the availability of reliable health information for French-speaking users, which may negatively impact informed decision-making and health literacy within this population.

In contrast, English and German websites demonstrated more favorable quality distributions, with at least 20% of sites rated as high-quality and up to 27.5% for English. Furthermore, the proportion of low-quality sites was lower in English and German (ranging from 50.0% to 61.4%), suggesting better access to trustworthy resources in these languages. Interestingly, the proportion of moderately rated websites remained relatively stable across all languages, indicating the persistence of a consistent middle tier of informational quality.

These findings highlight the pivotal role of language in determining the quality of online health information and emphasize the need for targeted interventions to enhance French-language resources, thereby promoting equitable access to reliable information.

Analysis of the QUEST scores revealed that websites classified under category 1 (university) attained the highest median scores, followed by categories 3 (governmental), 4 (industrial), 2 (hospital), and 5 (other). However, category 1 was excluded from subsequent analyses due to the inclusion of only a single website. Regardless of language or location, significant differences in QUEST scores were observed across website categories, reflecting variability in both quality and relevance. Hospital websites consistently received the lowest scores. Across all analyses, a consistent pattern emerged: category 2 (hospital) exhibited significantly lower QUEST scores compared to categories 3 (governmental) and 4 (industrial), across all languages and locations.

The low performance of hospital websites can largely be attributed to the frequent omission of critical information such as publication dates, authorship, and source references. This may stem from an implicit trust in institutional credibility, potentially leading to less rigorous content citation. Prior research has similarly identified quality disparities based on website affiliation [6,8].

To further substantiate this interpretation, we conducted an additional quantitative screening of hospital websites. Across both search modes, we identified 172 hospital website hits originating from 51 unique hospital domains. Of these, only nine websites included an update date (seven updated in 2025, one in 2021, and one in 2019), whereas 30 websites did not provide any update information. Twelve websites were no longer accessible at the time of reassessment. Among the 39 accessible websites, only three offered any references (containing 39, 7, and 2 citations, respectively). These patterns support the notion that hospital websites rely primarily on institutional authority rather than explicit attribution or citation practices, which in turn contributes to their comparatively lower QUEST scores.

Further analysis showed that QUEST scores also varied significantly by language and location. English- and German-language websites generally outperformed their French counterparts—an effect that persisted across all three locations (Basel, Paris, and Munich). This disparity may be partly explained by the relatively limited use of French in the global scientific community compared to English and German [20].

4.3. General Findings

Our data reveal a clear imbalance in the availability of online health information among the three predominant European languages: English, German, and French. For example, French-language search queries conducted in Switzerland were associated with particularly high dropout rates, despite French being the primary language for nearly a quarter of the population [19].

Moreover, our findings suggest that the dominant national language and English tend to prevail in search results. In Basel, the French term for prostate cancer (cancer de la prostate) was largely insignificant in search trends over the past five years [21] which is especially notable given the national relevance of the French language. This result may be partly attributed to Basel's location in the German-speaking region of Switzerland.

Additionally, the analysis demonstrated that commercial websites—those promoting products—generally received higher QUEST scores. These sites frequently cite scientific studies that support their offerings. Although penalties are applied within the "Conflict of interest" subcategory, they are often insufficient to counterbalance the elevated scores resulting from academic citations, thereby inflating the perceived quality of commercial content.

4.4. Limitations

Given the cross-sectional, observational design, our findings are descriptive and should not be interpreted causally.

This research highlights the persistent challenge of determining when information exceeds the comprehension threshold of lay audiences. At what point does health information become overly complex for non-experts? What separates broadly accessible knowledge from content tailored exclusively for academic or professional audiences? We contend that the QUEST score, while useful, has limitations in addressing such questions.

On the one hand, scientific papers that conform to standardized formatting and attribution practices reliably score above 20 on the QUEST scale. On the other hand, meticulously curated websites designed for the general public—despite being highly informative—tend to receive lower scores. This discrepancy is primarily due to the QUEST score's disproportionate weighting of the "attribution" criterion. The practice of enhancing credibility through references to scientific literature—a process we term "academizing"—is widely employed by commercial entities and contributes significantly to their higher QUEST scores.

Despite the originality of our findings, several limitations warrant consideration. First, the total sample size was relatively modest: 300 websites per language (English, German, and French), totaling 900. Only the first 50 search results per query were analyzed, corresponding to the first one or two Google result pages. This approach was chosen to reflect real-world user behavior, as most users rarely navigate beyond the initial search results. Nevertheless, this restriction limits the representativeness and generalizability of the findings, as potentially relevant but less visible websites were excluded from the analysis.

Future studies could broaden the sampling frame to include a larger number of search results or compare findings across multiple time points to account for temporal variation in Google algorithms. Second, the selection of cities poses a limitation. Among the three cities studied, only Paris serves as a national capital. Additionally, English is not an official language in any of the locations analyzed. It is conceivable that cities in English-speaking countries might yield different results.

Third, the study relied exclusively on the Google search engine. Although Google dominates the search engine market, alternative engines might have produced distinct outcomes. Incorporating other search platforms could have provided a more diversified perspective.

Fourth, the study employed only one evaluation tool—the QUEST score. The inclusion of multiple assessment instruments could have yielded a broader and potentially more nuanced evaluation of content quality.

The phenomenon we describe as "academizing," whereby commercial websites use extensive citations to enhance their perceived credibility, also carries methodological and policy implications. From a methodological standpoint, quality assessment tools such as QUEST may benefit from differentiating citation transparency from conflict-of-interest criteria to avoid overestimating the quality of commercially motivated content. From a policy perspective, implementing standardized online communication guidelines and independent quality indicators may help distinguish genuine evidence-based information from citation inflation. These refinements could contribute to more accurate public health communication and more equitable visibility of high-quality medical content.

5. Conclusions

This study underscores critical disparities in the quality and accessibility of online health information across linguistic and geographic contexts. Our findings reveal that French-language resources, particularly in Switzerland and Paris, are significantly under-represented and often of lower quality compared to English and German counterparts. Despite French being a widely spoken national language, its marginal presence in search results and high proportion of low-quality websites may reflect broader challenges related to language-dependent accessibility and representation in digital health content.

Furthermore, the quality of health information varied notably by website affiliation, with commercial sites often receiving higher QUEST scores due to their strategic use of scientific citations, despite potential conflicts of interest. Conversely, hospital websites consistently underperformed, likely due to insufficient source attribution, highlighting a potential gap in transparency and quality assurance from otherwise trusted institutions.

These findings illustrate the complex intersection of language, geography, website type, and information quality. They call for greater efforts to improve French-language online health resources, enhance quality standards across website categories—particularly in institutional settings—and ensure equitable access to trustworthy health information.

While the study provides valuable insights, limitations such as sample size, city selection, reliance on a single search engine, and the exclusive use of the QUEST score suggest the need for broader and more diversified future research. Ultimately, advancing health equity in the digital age will require not only technological improvements but also deliberate policy and content development strategies that address systemic disparities in language and access.

Based on these findings, several practical measures could improve the accessibility and reliability of online prostate cancer information. Public health authorities may consider strengthening multilingual health portals, particularly in French-speaking regions, to ensure equitable access to high-quality resources. Hospitals would benefit from structured web communication guidelines that promote transparent citation practices and regular content updates. Additionally, collaboration between search engine developers and medical societies could support algorithmic adjustments that prioritize verified, multilingual health information. Together, these efforts may reduce language-related disparities and enhance the overall quality of online patient education.

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