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ORIGINAL RESEARCH ARTICLE

Evaluating Clarity and Quality of Sinus Augmentation Information Online

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Abstract

Purpose: This study evaluates the transparency, information quality, and readability of English-language websites concerning maxillary sinus augmentation, aiming to distinguish between clinical and blog-type websites. The findings underscore the importance of improving online health information to support informed decision-making and enhance health literacy.
Materials and Methods: In August 2024, an internet search was conducted using Google Chrome along with Google, Bing, Yahoo, and Yandex search engines, employing specific keywords related to maxillary sinus augmentation. Websites were independently evaluated by two observers using established tools, including the JAMA benchmarks, DISCERN, QUEST, and EQIP, to assess transparency, information quality, and adherence to evidence-based practices. Readability was assessed using the Flesch–Kincaid tests, Gunning-Fog Index, SMOG, Coleman-Liau Index, and Automated Readability Index. Statistical comparisons were performed using non-parametric tests.
Results: Among the 137 websites analyzed, 21.89% to 24.08% achieved scores above the 75th percentile for transparency and information quality, as evaluated by JAMA, DISCERN, QUEST, and EQIP tools. Blog-like websites scored significantly higher than clinical websites across all assessment tools ($p<0.05$), indicating better transparency and content quality. However, blog-like sites also required a higher educational level for comprehension compared to clinical websites ($p<0.05$), which may limit accessibility for some readers.
Conclusions: Individuals searching for information on sinus augmentation surgery have roughly a one-in-four or one-in-five chance of finding websites that adhere to acceptable standards of content quality and transparency. While blog-type websites provide superior content quality and transparency, they often require higher literacy levels, potentially excluding a portion of the population. These findings call for the development of standardized guidelines to ensure that online health information is both high-quality and accessible, ultimately improving patient education, health literacy, and decision-making.

Keywords: Attitude to health; Health information systems; Information seeking behavior; Internet-based intervention; Sinus floor augmentation

Introduction

The maxillary sinus, one of four pairs of paranasal sinuses, is located in the maxilla near the nasal bones and orbits. As the largest and pyramid-shaped sinus, its apex points toward the zygomatic process, and its base is part of the lateral nasal wall.[1] It is lined with a thin mucous membrane and contains air, contributing to skull weight reduction and voice tone modulation. Sinus floor augmentation aims to increase bone volume in the posterior maxilla, primarily for dental implant placement.[2] This procedure typically involves lifting the sinus membrane to insert bone graft material. Techniques vary, including the lateral window approach, creating an opening in the sinus wall, and the osteotome technique, which taps the sinus floor through the alveolar ridge.[3] While effective, the procedure carries risks such as sinus membrane perforation, infection, bleeding, or postoperative sinusitis, affecting graft and implant success. Thus, meticulous planning and execution are essential to mitigate these risks.[4] Effective patient communication regarding the procedure, potential complications, and postoperative care is paramount. This process involves outlining benefits and risks, setting realistic expectations, and providing comprehensive pre- and post-operative instructions to foster informed consent and enhance patient satisfaction and trust.[5,6]

The shift from traditional professional-patient interactions to

relying on internet searches for health information represents a significant change in how individuals access health knowledge. The technological evolution has led many to seek medical data online. The internet might be a crucial health information resource. However, this shift can also lead to incorrect diagnoses, inappropriate self-treatments, and increased anxiety.[5] As of August 2024, there were 5.35 billion internet users worldwide, which corresponds to 66.2% of the global population (https://www.statista.com). Based on Eurostat data, on average, 55% of Europeans between the ages of 16 and 74 looked up health-related information on the internet in 2022. Specifically, more than 70% of individuals in Finland, the Netherlands, Denmark, and Norway engaged in seeking health information online in 2023 (https://ec.europa.eu/eurostat). In 2017, 74.4% of the US population turned to the internet first for health information.[7] In certain Asian countries, the tendency to seek health information online is even more pronounced, ranging from 79% to 86%.[8,9]

Readability and transparency are essential components of effective health communication. The reliability of online health information depends on its transparency about authorship, sourcing, conflict of interest disclosures, and its adherence to evidence-based content.[10] The readability of health websites has a crucial role in ensuring that information is accessible and comprehensible to the public.[11] High readability ensures that medical information is accessible to a wide audience, enabling patients to understand complex procedures and make informed decisions. These factors significantly influence the effectiveness and trustworthiness of online health resources, highlighting the importance of evaluating websites to prevent misinformation and empower patients in making informed health decisions.[12]

While sinus floor augmentation is a well-established procedure[13], the quality of online information available to patients remains inconsistent. Previous research has highlighted gaps in the availability, transparency, and readability of online health information, particularly in areas such as post-operative care, risks, and complications for other dental and surgical procedures.[14] Studies focusing on orthognathic surgery and dental implants have shown that many websites fail to meet quality standards, lack clear authorship or citations, and present information at a readability level unsuitable for the general public.[15,16] Similarly, there is a lack of comprehensive evaluation of websites related specifically to sinus augmentation. This study aims to comprehensively assess the transparency, information quality, and readability of English-language websites on this subject. It also seeks to identify discrepancies between clinical and blog-type websites and their impact on patient education and decision-making. The null hypothesis is that there is no significant difference between the two website categories concerning transparency, information quality, and readability.

Material and Methods

Website search and selection process

An internet search was conducted in August 2024 by using the latest version of Google Chrome (version 120.0.6099.217), which has a market share of 62.85% as of 2023. Google (www.google.com), Bing (www.bing.com), Yahoo (www.yahoo.com), and Yandex (www.yandex.com) search engines were included in the analysis. The keywords "maxillary augmentation," "sinus lift surgery," "maxillary sinus augmentation," "sinus augmentation," and "sinus floor augmentation" were employed. To ensure a comprehensive search, the virtual private network settings were altered during the process. The search protocol included all web pages displayed by the search engines. Websites were excluded from consideration if they were inaccessible, not pertinent to the search, presented in a language other than English, solely contained video content, or were dedicated to scientific publications such as academic journals or textbooks. Additionally, mobile browsing data was excluded from the research.

Evaluation protocols and website categorization

Two observers independently evaluated the first 20 websites, and their level of agreement was assessed using the intraclass correlation coefficient. Given that these values were acceptably high (0.86 to 0.94), the remaining websites were assessed based on the consensus between both observers. Depending on their characteristics, they were classified into two broad categories: clinical websites and blog-like information websites. Clinical ones were defined as those associated with healthcare providers, clinics, or hospitals. These sites were characterized by professional domain names, and their content primarily focused on promoting clinical services or treatments. Blog-like websites were defined as those created by individuals, patient advocates, or non-clinical organizations with the primary goal of sharing experiences, personal insights, or general information. These sites were characterized by a narrative or informal tone in their writing, often focusing on opinion sharing.

Transparency and information quality evaluation

The Journal of the American Medical Association (JAMA) benchmarks focus on authorship identification, attribution, disclosure, and currency. For each of these four criteria, a website can be scored with a 0 (information absent) or a 1 (information present). These questionnaire items can be treated as categorical variables, or their sums can be considered a scalar variable, ranging from 0 to 4.[17] The DISCERN tool comprises 16 items divided into two main subdomains. The sum of the first 8 items indicates the reliability of the information (DISCERN-REL), including the clarity of its aims and the accuracy of its sources. The sum of the next 7 items is used to assess the depth and balance of information provided on treatment choices (DISCERN-INFO). Each question is rated on a scale from 1 to 5, leading to a possible score range between 16 and 80, with higher scores denoting more reliable and useful content.[18] The Quality Evaluation Scoring Tool (QUEST) assesses the adherence to seven quality domains, with points assigned according to the degree of compliance with best practices. The score range is from 0 to 28, with higher scores indicating better quality.[19] The Ensuring Quality Information for Patients (EQIP) tool focuses on their relevance, readability, and reliability. This tool uses a scoring system where each item or criterion is rated on a scale, often from 1 to 4 or 1 to 5; total scores range from 0 to 100, with higher scores indicating better quality.[20]

Interpretation of the assessment tools

In this study, a quantitative methodology is employed to analyze the performance of the JAMA, DISCERN, QUEST, and EQIP tools, focusing on their 75th percentile. The scores at or above this percentile were categorized as "above average." Since no universal cut-off standards have been defined, this approach utilizes the upper quartile to highlight high-performing entities. Similar methods have been applied in prior studies to categorize and interpret the quality of health information available online.[21] This approach provides an objective framework for identifying websites that meet or exceed acceptable quality standards.

Readability evaluation

The readability of the websites was assessed using multiple established instruments: the Flesch–Kincaid Reading Ease, Flesch–Kincaid Grade Level, Gunning-Fog Index, Simple Measure

of Gobbledygook, and the Automated Readability Index. These tools evaluate readability based on sentence structure, word complexity, and syllable count, providing estimates of the educational level required to comprehend the content. These calculations were conducted using the online WebFX Readability Test Tool (www.webfx.com/tools/read-able/).

The Flesch–Kincaid readability tests, comprising the Flesch Reading-Ease and the Flesch–Kincaid Grade Level, are designed to gauge the difficulty of understanding English passages.[22] The formula for the Flesch-Kincaid Reading Ease is as follows: 206.835-1.015×(words/sentences)-84.6×(syllables/words). Scores range from 0 to 100, with higher scores denoting easier readability. The Flesch-Kincaid Grade Level, which indicates the U.S. school grade level necessary for comprehension, offers an additional metric. The formula for calculating the Flesch-Kincaid Grade Level is given as 0.39×(words/sentences) +11.8×(syllables/words)-15.59. The Gunning Fog Index estimates the number of years of formal education required to understand a text upon first reading. To calculate the Gunning Fog Index, the number of words and syllables in a text passage of at least 100 words is counted. The total number of words is divided by the number of sentences to determine the Average Sentence Length (ASL). Then, the number of words that have three or more syllables, excluding proper nouns, compounds made of simple words, hyphenated words, and two-syllable verbs that become three with '-es' or '-ed,' is counted. This number, divided by the total word count, yields the Percentage of Hard Words (PHW). To finalize the calculation, ASL is added to PHW, and the sum is multiplied by 0.4. Simple Measure of Gobbledygook (SMOG) is best suited for texts of 30 sentences or more. The length of 10 sentences at the beginning, middle, and end of the text, totaling 30 sentences, is counted. Every word with three or more syllables is counted. The square root of this number is then taken and rounded to the nearest 10, and three is added to this figure. It measures the number of years of education that an average person needs to understand a text. The Coleman-Liau Index is a readability metric that emphasizes character count and benefits from computerized assessments to evaluate characters with greater ease and accuracy. This formula facilitates the automated calculation of writing samples, expressed as 5.89×(characters/words)-0.3×(sentences/words)-15.8. This index provides a score indicative of the U.S. school grade level required for understanding the text.[23] The Automated Readability Index (ARI) is a tool specifically designed to assess the readability of text, measuring its comprehension ease. ARI offers an estimate of the U.S. grade level needed for understanding a particular piece of text. The formula for the Automated Readability Index is defined as 4.71×(characters/words) +0.5×(words/sentences)-21.43. The ARI score thus obtained acts as an indicator of the age at which a reader is expected to understand the text.[24,25]

Statistical analysis

IBM SPSS v20.0 software (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY, USA), was used for statistical analysis. Mean and standard deviation, median, and frequency were used for descriptive statistics. The normality of the continuous variables was checked with Shapiro-Wilk test and graphic methods. The Mann-Whitney U test was employed for non-parametric data comparisons. The strength and significance of bivariate correlations were evaluated with the Spearman correlation coefficient. The significant correlation strengths were interpreted as follows: up to 0.19 as very weak, 0.20 to 0.39 as weak, 0.40 to 0.59 as moderate, 0.60 to 0.79 as strong and higher than 0.80 as very strong.[26] The confidence interval was set to 95%, and $p<0.05$ was considered significant.

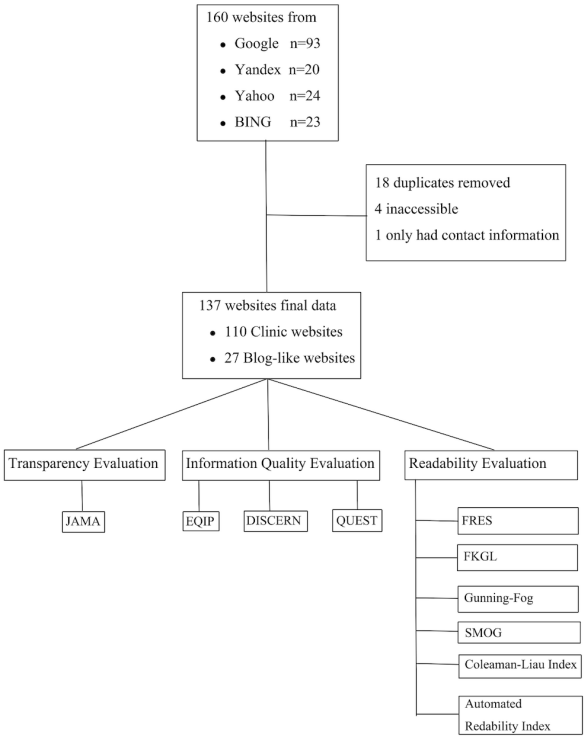

Figure 1. Study flowchart demonstrating the website selection, categorization and evaluation protocols (JAMA: Journal of American Medical Association, EQIP: Ensuring Quality Information for Patients, QUEST: Quality Evaluation Scoring Tool, FRES: Flesch Reading Ease Score, FKGL: Flesch-Kincaid Grade Level, SMOG: Simple Measure of Gobbledygook).

Results

160 pages were found to be eligible for inclusion criteria. 93 results were found in Google, 20 in Yandex, 24 in Yahoo, and 23 in Bing search engines. 4 of them could not be opened, and 1 of them had only a contact number. After removing overlapping titles, 137 websites were used for the study. Out of the 137 (N=137) websites, 110 were categorized as clinical (n=110) and 27 as blog sites (n=27) (Figure 1).

The analysis revealed that blog-like websites consistently outperformed clinical websites in transparency and content quality, as measured by JAMA, DISCERN, QUEST, and EQIP tools, with statistically significant differences across all instruments ($p<0.001$). For example, the average DISCERN score for blog sites was 47.51 ± 12.58, significantly higher than the 31.84 ± 8.07 for clinical sites, indicating superior reliability and depth of information in blogs. Similarly, the QUEST scores for blog-like sites (14.00 ± 6.07) far exceeded those for clinical websites (5.38 ± 3.29). In addition, based on the DISCERN tool, 18.51% of the blog sites and 60% of the clinic websites did not mention any risks of treatments (Figure 2) (Table 1).

Per JAMA, 24.08% of scales were rated as above average, surpassing the 75th percentile. DISCERN, EQIP, and QUEST followed with 23.35%, 22.62%, and 21.89% of scales classified as above average, respectively.

In terms of readability, the content of clinical websites was found to be more accessible, with lower Gunning-Fog Index and SMOG scores indicating an educational level closer to the recommended 8th-grade standard. However, blog-like websites, while offering higher quality content, required a slightly higher educational level for comprehension ($p<0.001$). These findings highlight the trade-off between content quality and readability across the two types of websites (Figure 3) (Table 1).

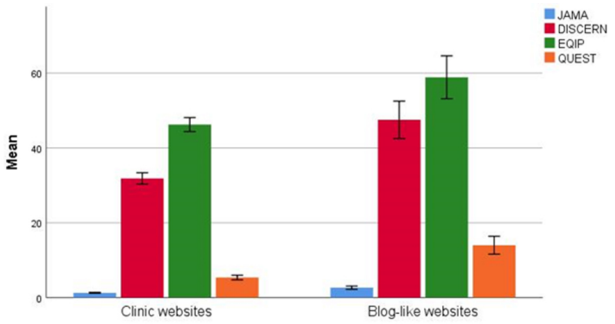

Figure 2. Bar graphic representation of the transparency and content quality assessment instruments stratified by the website types (JAMA: Journal of American Medical Association, EQIP: Ensuring Quality Information for Patients, QUEST: Quality Evaluation Scoring Tool).

Table 1

Assessment instrument	Clinic websites	Blog-like websites	Total scores
JAMA Benchmarks	1.28±0.69A	2.67±1.07a	1.55±0.95
DISCERN total	31.84±8.07A	47.51±12.58a	34.93±11.02
DISCERN reliability	17.60±4.26A	26.70±6.46a	19.39±5.98
DISCERN treatment	11.95±3.91A	17.88±6.68a	13.12±5.14
EQUIP	46.24±9.84A	58.88±14.48a	48.73±11.96
QUEST	5.38±3.29A	14.00±6.07a	7.08±5.25
FRES	55.36±13.46	54.63±7.54	55.22±12.50
FKGL	7.71±2.07	7.99±1.20	7.76±1.93
Gunning-Fog Index	8.13±2.25A	9.65±1.77a	8.43±2.24
SMOG Index	6.79±1.25A	7.46±1.11a	6.92±1.25
Coleman-Liau Index	13.53±2.76	13.30±1.39	13.49±2.54
Automated Readability Index	6.53±2.54	6.57±1.44	6.54±2.36

Mean and standard deviations of the transparency, content quality and readability assessment instruments stratified by the type of websites. Values followed by an uppercase letter indicate significant differences from its lowercase counterpart written in the same row (JAMA: Journal of American Medical Association, EQIP: Ensuring Quality Information for Patients, QUEST: Quality Evaluation Scoring Tool, FRES: Flesch Reading Ease Score, FKGL: Flesch-Kincaid Grade Level, SMOG: Simple Measure of Gobbledygook).

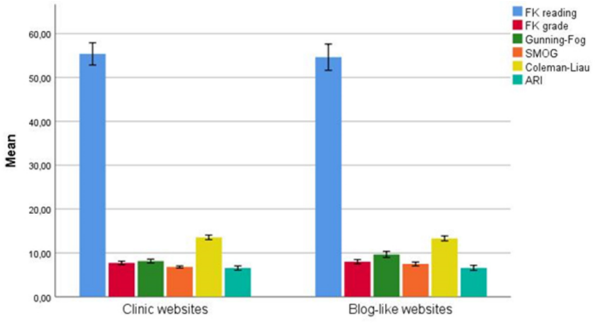

Figure 3. Bar graphic representation of the readability assessment instruments stratified by the website types (FK: Flesch-Kincaid, SMOG: Simple Measure of Gobbledygook, ARI: Automated Readability Index).

There were moderate to strong positive correlations among JAMA, DISCERN, QUEST, and EQIP scores (rho: 0.43 to 0.71, p<0.001 for each pairwise comparison). The same tools were also found to be positively but weakly correlated with Gunning-Fog readability index scores (rho: 0.16 to 0.20, p<0.05 for each pairwise comparison) (Table 2).

Discussion

Sinus floor augmentation is a well-established and elective surgical procedure based on strong clinical evidence.[13,27] However, laypersons informed about the potential for undergoing such surgery typically seek extensive information on its risks and benefits, often turning to internet resources.[28,29] This study focuses on this particular issue.

The scientific method allowed for verification of the integrity of material published online. The JAMA benchmark criteria serve as an effective tool for evaluating the transparency and reliability of online information.[17] DISCERN facilitates the evaluation of the reliability and quality of patient education materials, especially those concerning treatment options.[18] The QUEST aims to assess the quality of online health information for both researchers and clinicians.[19] EQIP has been developed for use by patient information managers and healthcare professionals, and it requires at least some knowledge of the topics.[20] These assessment tools were used together to offer a more comprehensive view of information transparency and content quality. The total scores of these scales were found to be positively correlated. On the other hand, apart from Weil et al.[21], who had presented an arbitrary categorization of DISCERN scores, there is a lack of normative data-based threshold standards for these assessment tools. The present study, therefore, implemented its own 75th percentile range-based categorization. According to this criterion, individuals searching online for information on sinus lifting have a 20% to 25% chance of encountering relatively transparent information sources. However, this may be an overestimate, as our data includes 137 relevant results, and 97% of people typically only visit the first 10 websites listed by search engines.[30]

Despite the importance of quality control measures, this study found that online resources on sinus augmentation failed to meet acceptable transparency and information quality standards. This finding aligns with previous reports indicating that digital health information, particularly in dentistry and oral surgery, is inconsistent in accuracy, readability, and reliability.[14,16] Studies on other dental procedures, such as orthodontic treatments and peri-implantitis, report similar deficiencies, highlighting the broader challenges faced in online patient education.[31–33] Although the present study is the first related to sinus augmentation websites, content analysis is a common research area in oral and maxillofacial surgery. Meade and Dreyer[34], using DISCERN, have found that the quality of online information on ectopic and impacted maxillary canines was insufficient in terms of content and readability. Similarly, a recent study by Yoo et al.[16] assessed YouTube videos on sinus elevation procedures and found that most did not meet educational quality standards. These findings suggest that a significant number of online resources across dental and maxillofacial surgery topics fail to provide accurate, patient-friendly information. Engelmann et al.[35] and Lee et al.[36] criticized the lack of information related to post-operative care and complications on websites about orthognathic surgery. Websites on dental implants share similar drawbacks. Leira et al.[37], using the same instruments as this study, revealed that the websites regarding peri-implantitis did not meet the information quality standards. More recently, Rehman et al.[38] pointed out that only 6.8% of 118 dental practice websites in the United Kingdom covered all implant-related complications. These studies also indicated that most websites do not list the author, source, or publication date. The findings of the present study were consistent with this trend, as the overall quality of information and transparency was found to be below acceptable standards with

Table 2

		JAMA	DISCERN	EQIP	QUEST	GUNNING-FOG
JAMA	rho	1	0,605**	0,525**	0,717**	0,197*
	p		<0.001	<0.001	<0.001	0,021
DISCERN	rho	0,605**	1	0,874**	0,591**	0,207*
	p	<0.001		<0.001	<0.001	0,015
EQIP	rho	0,525**	0,874**	1,000	0,513**	0,185*
	p	<0.001	<0.001		<0.001	0,030
QUEST	rho	0,717**	0,591**	0,513**	1	0,166*
	p	<0.001	<0.001	<0.001		0,050
GUNNING-FOG	rho	0,197*	0,207*	0,185*	0,166*	1
	p	0,021	0,015	0,030	0,050	

Presentation of the significant correlations and their Spearman correlation (rho) coefficients among study variables. The correlation strengths were interpreted as follows: up to 0.19 as very weak, 0.20 to 0.39 as weak, 0.40 to 0.59 as moderate, 0.60 to 0.79 as strong and higher than 0.80 as very strong (**Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level. JAMA: Journal of American Medical Association, EQIP: Ensuring Quality Information for Patients, QUEST: Quality Evaluation Scoring Tool).

respect to each assessment tool. This may be due to editorial policies that favor anonymity, ensure impartiality, and minimize the influence of individual authors' reputations or credentials. Naming authors or changing dates could lead to legal and credibility issues. In addition, continuously updating websites makes it difficult to document exact update dates. To avoid seeming outdated, some sites claim frequent content reviews without specifying dates.

Misinformation in medical content can have serious psychological effects, including increased patient anxiety, distrust in healthcare providers, and misinformed decision-making.[39,40] Patients who encounter conflicting or unreliable health information online may either avoid necessary treatments due to fear or seek unnecessary procedures based on misleading claims.[5,8] In terms of sinus augmentation, exaggerated claims about success rates, underreporting of potential complications, or misinformation about post-operative recovery can directly influence patient perceptions and treatment choices. The need for credible, accessible, and standardized online medical resources is therefore critical for ensuring informed patient decisions and reducing unnecessary fear.

Another important consideration is the variation in online health information quality and accessibility across different regions. High-income countries generally provide more comprehensive and transparent health information. However, resources in lower-income regions are often incomplete, outdated, or poorly structured.[41] The problem can be even more pronounced in multilingual countries or regions with lower literacy levels. Non-English medical content tends to be less detailed and lacks the quality controls found in English-language sources.[42] Addressing these problems through international collaboration and language-specific readability guidelines could significantly improve global patient education.

The present study categorized websites into clinical and blog-like informational sites. The analysis revealed that blog-like websites outperformed clinical ones based on criteria from the JAMA, DISCERN, EQIP, and QUEST instruments. The superior performance of blog sites in transparency may be attributed to their primary focus on disseminating information rather than promoting clinical services. Blog sites often prioritize content aimed at engaging and educating readers, incorporating clear authorship attributions, detailed disclosure statements, frequent updates, and discussions on risks and complications. In contrast, clinical websites may focus more on their services and treatments, often presenting information in a more generalized or marketing-oriented format. They could also be intending to provide detailed information during face-to-face interactions with patients. It is hypothesized that these sites often employ similar software templates and may be motivated by financial expectations. These factors could explain the sparse information on risks, complications, and alternative treatments. Additionally, clinical sites may avoid detailed disclosures, such as listing authors or publication dates, to maintain a uniform authoritative voice or mitigate liability concerns. These distinctions likely contribute to the observed differences in transparency between the two website types.

Our analysis indicated that the textual content of websites was suitable for an 8th-grade reading level or below. This finding aligns with the guidelines of the American Medical Association and the National Institutes of Health, which recommend that patient materials be readable at levels between the sixth and eighth grades.[43] However, although the blog-like information websites scored higher on the JAMA, DISCERN, QUEST, and EQIP instruments, the level of education required to comprehend them, as indicated by the SMOG and Gunning Fog indexes, was higher than the clinical ones, suggesting a 9th-grade level. Put simply, as the quality of content improves, so does the level of education needed to understand it. Schwarzbach et al.[44] found a positive correlation between the QUEST score and the FKGL score of 27 sites and a negative correlation with the FRES score. Similar to our findings, other studies have indicated that certain readability tests may exhibit significant differences among them even when there is no significant correlation between quality assessment tools and readability metrics.[45,46] The number and diversity of the websites included in this study might have contributed to this finding. This perspective also underscores the need for improved readability standards in the development of online health resources. Ensuring readability levels appropriate for a broader audience could make high-quality content accessible to a wider range of users, particularly those with lower health literacy.[10] Establishing standardized readability guidelines could facilitate the creation of more reliable online health information, ultimately improving patient decision-making and health outcomes.

Although a significant volume of studies exists in current literature, their impact on daily practice remains minimal. This underscores the necessity for standardized methodologies. First, clinical websites could incorporate features such as named authors, citations of reliable sources, and regular content updates to enhance trust and credibility. Second, the use of informed consent forms could serve as a potential initial step. Mandating the inclusion of these forms on clinical websites, in formats that are easily visible and accessible, could prompt patients to seek more detailed information. This, in turn, may encourage providers to present more comprehensive details regarding risks and complications. On the other hand, the findings of this study must be considered within the context of algorithmic influences that shape the presentation of information on search engines. Blog sites, often optimized for user engagement and search engine ranking, may outperform clinical websites in visibility and perceived transparency. Conversely, clinical websites, which may not prioritize search engine optimization, could be underrepresented despite offering credible content. These algorithmic dynamics highlight to optimize the search engine's visibility while maintaining high standards of transparency and quality. Moreover, regulators could implement accreditation systems

or quality seals for health websites that meet predefined criteria. Encouraging collaboration between healthcare providers, patient advocacy groups, and technology companies could enable the creation of evidence-based online health resources. Future regulations can mitigate misinformation, promote informed decision-making, and ultimately improve patient outcomes.

Technological advancements may be used to improve the quality of online health information.[47] While currently considered a threat to information authenticity, artificial intelligence (AI) also holds significant potential for improving its accessibility, readability, and accuracy. It can simplify complex medical terminology[48] as well, making it understandable for individuals with lower health literacy. AI can be used to address the lack of real-time content updates, which was a key issue identified in this study. Furthermore, AI-powered content analysis and fact-checking algorithms can ensure that online materials meet established quality benchmarks such as JAMA, DISCERN, QUEST, and EQIP.[49] Additionally, AI can help credible clinical websites rank higher in search results by enhancing search engine optimization strategies.[50] As such technologies continue to evolve, their integration into online health content development could standardize educational resources.

This study has several inherent limitations. The selection process of websites may not fully capture how patients typically find these resources, as variations in search terms, geographic location, and the presence of ad blockers can significantly affect the results. The exclusion of mobile browsing data may impact the generalizability of our findings, since browsing behaviors and website presentations often vary between desktop and mobile platforms. Furthermore, the search engine personalization, influenced by factors such as user history, location, and browsing behavior, may have impacted the search results obtained in this study. Although efforts were made to minimize this effect by using a virtual private network and clearing browser cache before each search, complete elimination of personalization bias cannot be guaranteed. Another limitation lies in the study's reliance on quantitative measures for assessing information quality and readability, potentially neglecting the qualitative aspects of user experience and understanding. Furthermore, the classification into clinical and blog-type websites, while useful, might oversimplify the diverse landscape of online health information, ignoring other valuable sources such as patient forums or professional organizations. Lastly, our analysis was constrained to English-language websites, possibly omitting high-quality information available in other languages, which could be particularly relevant in multilingual regions or among non-English speaking populations seeking sinus augmentation information.

Conclusion

Individuals searching for information on sinus augmentation surgery have roughly a one-in-four or one-in-five chance of finding websites that adhere to acceptable standards of content quality and transparency. While blog-type websites provide superior content quality and transparency compared to their clinical counterparts, they often require higher literacy levels, potentially excluding a portion of the population. These findings call for the development of standardized guidelines to ensure that online health information is both high-quality and accessible, ultimately improving patient education, health literacy, and decision-making.

Ethical Approval

Ethical approval was not required for this study.

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Methodology : All Authors
Investigation : All Authors
Data Curation : All Authors
Writing Original Draft : All Authors
Review & Editing : All Authors

Conflict of Interest

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