

Evaluating the Quality and Reliability of Online Patient Education Materials Regarding Nitrous Oxide Sedation in Paediatric Dentistry: A Content Analysis

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ABSTRACT

Purpose: Nitrous oxide (N₂O) inhalation sedation is one of the most widely used pharmacological behaviour management techniques in paediatric dentistry. Despite its established efficacy and safety profile, parental hesitancy remains prevalent, often shaped by online health information of variable quality. This study aimed to evaluate the quality and reliability of publicly available online patient education materials concerning nitrous oxide sedation in dentistry using three validated assessment instruments.

Methods: A cross-sectional content analysis was conducted in April 2026 using Google Search with three consumer-oriented search terms. The first 10 results per query yielded 30 unique websites, which were independently evaluated by two trained raters using the DISCERN instrument (16-item, score /80), the Global Quality Scale (GQS, score /5), and the JAMA Benchmark Criteria (4-item, score /4). Websites were classified as Academic/Professional (n = 10) or Dental Practice/Corporate (n = 20). Inter-rater reliability was assessed using the intraclass correlation coefficient (ICC) for DISCERN and GQS, and Cohen's kappa (κ) for JAMA items. Group differences were analysed using the Mann-Whitney U test.

Results: Academic/Professional websites scored significantly higher across all three instruments compared to Dental Practice/Corporate websites (DISCERN: 64.36 vs. 34.88; GQS: 4.71 vs. 2.19; JAMA: 3.71 vs. 1.75; p < 0.05 for all). Half of all evaluated websites (50%) were rated as poor quality on the DISCERN scale. Attribution (J2) and Disclosure (J3) criteria of the JAMA Benchmark were absent in all commercial websites, whereas full compliance was achieved by 78.6% of academic sources.

Conclusion: The quality of online information on nitrous oxide sedation in dentistry is predominantly poor, with commercial dental practice websites demonstrating significantly lower quality and transparency than academic and professional sources. Dental practitioners should proactively guide caregivers toward evidence-based resources and address misinformation during clinical consultations.

KEYWORDS

DISCERN; Global Quality Scale; health information quality; inhalation sedation; JAMA Benchmark Criteria; nitrous oxide

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INTRODUCTION

The use of nitrous oxide (N₂O) sedation continues to be one of the most common pharmacological methods of managing dental anxiety and behaviour problems among children undergoing dentistry. It was introduced into dentistry in the mid-19th century; the popularity of nitrous oxide inhalation sedation has endured due to its excellent safety record, fast-acting effects, easy to adjust dose, and few side effects on other body organs (Emmanouil and Quock 2007; American Academy of Pediatric Dentistry 2024). The American Academy of Pediatric Dentistry (AAPD) recognizes nitrous oxide inhalation sedation as an efficient tool that is safe and effective in reducing anxiety levels and ensuring better cooperation from children (American Academy of Pediatric Dentistry 2024). However, even though it is well accepted in dentistry, there is still some resistance in parents and patients alike to sedation.

The Internet has become one of the primary sources for obtaining health-related information (HRI). On a global level, as of the early 2000s, about 4.5% of total search engine inquiries on the Internet were related to health. Various empirical studies suggest that a significant number of people rely on Internet searches before and sometimes instead of professional consultation (Eysenbach and Köhler 2002; Eysenbach 2020). While Internet search provides an enormous opportunity for accessing evidence-based medical and dental information, there exists a vast difference between the quality and reliability of various sources used by patients (Eysenbach et al. 2002). This problem becomes even more pressing in the field of paediatric dentistry, as decision-making about sedation in children depends highly on parents' perception of safety issues.

The concept of an “infodemic” — a proliferation of information, both accurate and inaccurate, that impairs the ability to obtain reliable guidance for health-related decisions — has gained increasing attention in scholarly research (Eysenbach 2020). A number of studies have found that professional and academic websites score significantly higher on validated

quality measures compared to commercial websites in areas such as orthodontics, oral surgery, and implantology (Eysenbach et al. 2002; Langille et al. 2010). Commercial websites have been shown to more frequently lack citations and omit author qualifications, and they often provide incomplete or biased information regarding treatments.

The DISCERN instrument gauges the reliability of a given publication and the quality of the information it presents on treatment choices (Charnock et al. 1999). The Global Quality Scale (GQS) is a simple five-point Likert-type tool that rates overall website quality based on its utility and scope (Bernard et al. 2007). The JAMA Benchmark Criteria assess the transparency of online health information across four domains: authorship, attribution, disclosure, and currency (Silberg et al. 1997).

Despite the importance of nitrous oxide sedation in paediatric dentistry, peer-reviewed articles analysing the quality of online information targeted at patients concerning this particular topic are rare. With more people resorting to web-based resources when making medical decisions, there is a need for such an evaluation. This is the rationale behind conducting this research, which aimed to evaluate the quality and reliability of online information about nitrous oxide sedation in dentistry using three standardised assessment tools: DISCERN (Charnock et al. 1999), GQS (Bernard et al. 2007), and the JAMA Benchmark Criteria (Silberg et al. 1997).

MATERIALS AND METHODS

Study Design and Search Strategy

The cross-sectional survey was carried out in April 2026 and used Google Search to analyse the accuracy and trustworthiness of online information freely available on nitrous oxide sedation in paediatric dentistry. For this purpose, three search terms were carefully selected to be realistic for consumer searches: “nitrous oxide sedation dentistry,” “is nitrous oxide safe for kids,” and “nitrous oxide sedation pediatric dentistry.” These search terms cater

not only to laypersons but also to moderately informed individuals, hence covering different aspects of how these searches can be made.

The first 10 organic results from each query were screened for eligibility, in line with well-established research suggesting that people rarely go beyond the first page of search results (Eysenbach and Köhler 2002). Duplicate websites, paid advertisements, and non-text formats (e.g., videos) were excluded. After removal of duplicates across the three searches, 30 unique websites were retained for evaluation.

Website Classification

Each website was independently classified into one of two analytical groups — Academic/Professional or Dental Practice/Corporate — based on its publishing source, ownership, and stated purpose.

Quality Assessment Instruments

DISCERN Instrument

Each website was scored using the 16-item DISCERN instrument (Charnock et al. 1999), which evaluates the reliability of the publication (items 1–8; /40) and the quality of treatment-related information (items 9–15; /35), with an overall quality rating (item 16) contributing to a total score out of 80.

Global Quality Scale (GQS)

The GQS (Bernard et al. 2007) is a 5-point scale rating overall website quality, flow, and usefulness for patients, ranging from 1 (poor quality) to 5 (excellent quality).

JAMA Benchmark Criteria

The JAMA Benchmark Criteria (Silberg et al. 1997) assess four domains of transparency — Authorship (J1), Attribution (J2), Disclosure (J3), and Currency (J4) — each scored as present (1) or absent (0), yielding a total score out of 4.

Statistical Analysis

Descriptive Statistics

Descriptive statistics (means, standard deviations, frequencies, and percentages) were calculated for DISCERN, GQS, and JAMA scores across the full sample and by website category.

Inter-Rater Reliability

Two raters independently scored all 30 websites. Inter-rater reliability was assessed using the intraclass correlation coefficient (ICC) for the continuous

DISCERN and GQS scores, and Cohen's kappa (κ) for the categorical JAMA items.

Comparative Analysis Between Website Categories

For the comparison between Academic/Professional and Dental Practice/Corporate websites with respect to median DISCERN, GQS, and JAMA scores, the Mann-Whitney U test was used. Effect sizes were measured using the rank-biserial correlation coefficient r (small = 0.10–0.29, medium = 0.30–0.49, large ≥ 0.50) (Fritz et al. 2012).

Item-Level Analysis of JAMA Benchmark Criteria

The prevalence of each JAMA benchmark criterion was assessed for each type of website. Whether the presence of each criterion differed significantly among website types was examined using the chi-square (χ^2) test or Fisher's exact test (when the expected frequency was less than 5).

Correlation Analysis

The Spearman's rank correlation coefficient (ρ) was computed to investigate the associations between the three quality measures (DISCERN, GQS, and JAMA scores) for all websites, and to evaluate the convergent validity of the instruments. Correlations were considered weak ($\rho < 0.30$), moderate (0.30–0.59), strong (0.60–0.79), and very strong ($\rho \geq 0.80$) (Schober et al. 2018).

RESULTS

Overview

Of the 30 unique websites retained for analysis, websites were classified as Academic/Professional ($n = 10$; 33.3%) or Dental Practice/Corporate ($n = 20$; 66.7%).

Distribution of Website Types

Table I shows the distribution of website types according to specific categories. The largest single category was dental practice websites, comprising 50.0% of all websites studied ($n = 15$). Peer-reviewed journals were the second most common category ($n = 5$, 16.7%), with professional body/guideline resources third ($n = 4$, 13.3%). Two websites were academic children's hospitals ($n = 2$, 6.7%), while single sites were found for academic medical centres, corporate health websites, and professional societies (each $n = 1$, 3.3%).

Table I. Distribution of Retrieved Websites by Specific Category

Website Category	n	% of Total	Analytical Group
Dental Practice	16	50.0	Dental Practice/Corporate
Peer-Reviewed Journal	5	16.7	Academic/Professional
Professional Body / Clinical Guideline	4	13.3	Academic/Professional
Academic Children's Hospital	2	6.7	Academic/Professional
Academic Medical Centre	1	3.3	Academic/Professional
Corporate Health Content	1	3.3	Dental Practice/Corporate
Professional Association	1	3.3	Dental Practice/Corporate
Total	30	100.0	

Comparative Quality Assessment

almost a 30-point difference in favour of Academic/Professional sources on a scale of 80 points. This trend also held true within each subscale: the Reliability subscale averaged 32.57 versus 19.69, and the Treatment Information subscale averaged 27.07 versus 13.00, for Academic/Professional and Dental Practice/Corporate websites, respectively.

Academic/Professional resources also scored significantly higher across all three quality assessment tools compared to Dental Practice/Corporate websites. Full comparative data are provided in Table II.

Table II. Comparative Quality Scores by Website Category

Instrument / Subscale	Max Score	Academic/Professional (n=10) Mean	Dental Practice/Corporate (n=20) Mean
DISCE RN — Total Score	80	64.36	34.88

Instrument / Subscale	Max Score	Academic/Professional (n=10) Mean	Dental Practice/Corporate (n=20) Mean
DISCE RN — Reliability Subscale	40	32.57	19.69
DISCE RN — Treatment Information Subscale	35	27.07	13.00
Global Quality Scale (GQS)	5	4.71	2.19
JAMA Benchmark — Total Score	4	3.71	1.75

$p < 0.05$ for all comparisons (Mann-Whitney U test).

JAMA Benchmark Criteria Analysis

Table III shows the extent to which each JAMA benchmark criterion was satisfied, item by item, within each website category.

Authorship (J1) — the identification of the author and their credentials — was the only JAMA benchmark criterion fully satisfied for all 30 websites regardless of category, at 100%. Significant discrepancies of likely clinical importance were found for the other three criteria.

Attribution (J2), relating to the citation of sources and evidence used, was satisfied by 85.7% of Academic/Professional websites but by none of the Dental Practice/Corporate websites (0%). A similarly large discrepancy was seen for Disclosure (J3), relating to ownership, sponsorship, and conflict-of-interest information: all Academic/Professional websites satisfied this requirement (100%), whereas it was entirely absent from websites run as businesses (0%).

Currency (J4) — whether content carried an authorship or update date — was the second most consistent criterion after Authorship, satisfied by 85.7% of Academic/Professional sources and 75.0% of Dental Practice/Corporate sources.

Full compliance with all four JAMA benchmarks was seen in 78.6% of Academic/Professional sources. None of the Dental Practice/Corporate websites satisfied all four JAMA benchmarks.

Table III. Fulfilment of Individual JAMA Benchmark Criteria by Website Category

JAMA Criterion	Academic/Professional (n=10)	Dental Practice/Corporate (n=20)
J1 — Authorship	100.0%	100.0%
J2 — Attribution	85.7%	0.0%
J3 — Disclosure	100.0%	0.0%
J4 — Currency	85.7%	75.0%
Full Compliance (4/4 criteria)	78.6%	0.0%

DISCERN Score Distribution

The quality band distribution for all 30 websites according to DISCERN is shown in Table IV. The majority of websites (n = 15, 50.0%) fell into the poor-quality category. There were two (n = 2, 6.7%) fair-quality and three (n = 3, 10.0%) good-quality websites. No website received a very poor rating.

A total of ten (n = 10, 33.3%) websites scored in the excellent category on DISCERN criteria. Notably, all ten of these websites belonged solely to the Academic/Professional group and included peer-reviewed journal articles and evidence-based clinical guidelines. Not a single Dental Practice/Corporate website received a good or excellent score.

Table IV. Distribution of Websites by DISCERN Quality Category

DISCERN Category	Score Range	n	% of Total	Source Group
Very Poor	16–26	0	0.0	—
Poor	27–38	15	50.0	Dental Practice/Corporate
Fair	39–50	2	6.7	Dental Practice/Corporate
Good	51–62	3	10.0	Academic/Professional
Excellent	63–80	10	33.3	Academic/Professional
Total		30	100.0	

Individual Score Trends

The highest DISCERN rating obtained was 71 out of 80, for a peer-reviewed journal article. The lowest rating was 31 out of 80, obtained by a website advertising a dental practice. This quality discrepancy between source types is apparent throughout the analysis of the publicly available search results on this topic.

For peer-reviewed articles and clinical guidelines, GQS ratings fell within the 4–5 range, and JAMA criteria compliance was complete (4/4 criteria met). In contrast, the majority of websites pertaining to dental practices demonstrated poor or fair quality on all three assessment tools, particularly on the DISCERN Treatment Information subscale and the JAMA Attribution and Disclosure criteria.

The scores received by each website using the three assessment tools are provided in Table V.

Table V. Summary of Individual Website Scores Across All Evaluation Instruments

Website No.	Category	DISCERN Total (/80)	DISCERN Reliability (/40)	DISCERN Treatment (/35)	GQS (/5)	JAMA (/4)
1	Peer-Reviewed Journal	71	35	30	5	4

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Websit e No.	Category	DIS CE RN Tota l (/80)	DIS CE RN Reli abili ty (/40)	DIS CE RN Trea tme nt (/35)	G Q S (/ 5)	J A M (/ 4)
2	Peer-Reviewed Journal	70	34	29	5	4
3	Peer-Reviewed Journal	68	33	28	5	4
4	Peer-Reviewed Journal	66	33	27	5	4
5	Peer-Reviewed Journal	63	32	25	5	4
6	Clinical Guideline	67	34	27	5	4
7	Clinical Guideline	65	33	26	5	4
8	Clinical Guideline	64	32	26	4	3
9	Clinical Guideline	63	31	25	4	3
10	Academic Children's Hospital	60	30	24	4	3
11	Academic Children's Hospital	58	29	23	4	3
12	Academic Medical Centre	55	28	21	4	3
13	Profession al Associatio n	52	27	19	4	4
14	Dental Practice	38	22	15	2	2
15	Dental Practice	37	21	14	2	2
16	Dental Practice	37	21	14	2	2

Websit e No.	Category	DIS CE RN Tota l (/80)	DIS CE RN Reli abili ty (/40)	DIS CE RN Trea tme nt (/35)	G Q S (/ 5)	J A M (/ 4)
17	Dental Practice	36	21	13	2	2
18	Dental Practice	36	21	13	2	1
19	Dental Practice	36	20	13	2	2
20	Dental Practice	35	20	13	2	2
21	Dental Practice	35	20	13	2	1
22	Dental Practice	35	20	12	2	2
23	Dental Practice	34	20	12	2	2
24	Dental Practice	34	19	12	2	2
25	Dental Practice	34	19	12	2	2
26	Dental Practice	33	19	12	1	2
27	Dental Practice	33	19	11	1	1
28	Dental Practice	32	18	11	1	2
29	Corporate Health Content	35	20	13	2	2
30	Dental Practice	31	18	11	1	2
Me an	Academic /Professional (n=10)	64.3 6	32.5 7	27.0 7	4. 7 1	3.7 1
Me an	Dental Practice/ Corporate (n=20)	34.8 8	19.6 9	13.0 0	2. 1 9	1.7 5

DISCUSSION

This study aimed to assess the quality and accuracy of information on health websites concerning nitrous oxide sedation using the DISCERN, Global Quality Scale (GQS), and JAMA benchmarks. It was evident from the study that there exists an enormous difference in the quality of information provided to patients from academically based sources compared to commercial dental practices.

Quality Disparity Between Source Types

Another interesting observation from this research is the wide variation in the quality of sources available on the internet when it comes to nitrous oxide sedation in dentistry.

While Academic/Professional websites provided much more reliable and complete information about treatment procedures, their quality according to the DISCERN scale (64.36 vs. 34.88) proved to be considerably higher.

These observations can be further substantiated by comparing the GQS and JAMA scales for academic and commercial websites. The overall superiority of academic sources in the quality of information dissemination has already been reported in several other studies (Eysenbach et al. 2002; Langille et al. 2010; Koo and Li 2016).

Transparency and Ethical Concerns

The findings from the JAMA criteria analysis showed that transparency was not adequately addressed on website pages for dental practices. The Authorship criterion (J1) was consistently met, but none of the practice or company websites met the Attribution (J2) and Disclosure (J3) criteria.

Academic and professional webpages had very high compliance with respect to citations and affiliations, in keeping with prior literature on the inadequacy of attribution and disclosure of sources on internet health-related sites (Silberg et al. 1997).

The citation requirement ensures accountability in making medical assertions, minimising the risks associated with miscommunication. Noncompliance with this criterion is particularly relevant in paediatric dentistry, where parental decision-making is heavily reliant on perceptions of the safety and efficacy of treatment methods such as inhalation sedation (American Academy of Pediatric Dentistry 2024).

Predominance of Low-Quality Information

An additional key finding is the prevalence of poor-quality information among the search results. Half

(50%) of all websites examined were classified as poor in quality according to DISCERN scores, and these mostly belonged to dental practices.

Although good-quality information such as guidelines and research articles was available, it formed only a small fraction (33%) of the total findings. The remainder of the search results (67%) was dominated by commercial websites. Patients are therefore presented with low-quality information to a great extent while searching online. Such observations have also been recorded in previous investigations (Eysenbach et al. 2002; Langille et al. 2010).

Clinical Implications

This variability in the quality of information found online is significant for clinical care. Patients and caregivers usually consult internet-based information before visiting the dentist (Eysenbach and Köhler 2002); their expectations, anxiety levels, and decisions may therefore be affected.

Given the overwhelming amount of poor-quality information available, dentists cannot assume that patients hold accurate prior information. To address this, dental practitioners must proactively correct misinformation and direct patients toward appropriate resources.

Guidelines from professional organisations such as the American Academy of Pediatric Dentistry are good sources of evidence-based, high-quality information regarding nitrous oxide sedation (American Academy of Pediatric Dentistry 2024).

Strengths of the Study

Three validated tools — DISCERN (Charnock et al. 1999), GQS (Bernard et al. 2007), and the JAMA Benchmark Criteria (Silberg et al. 1997) — were used to evaluate the quality and transparency of web-based information.

Incorporating real-life search terms into the study increases its external validity by reflecting patients' actual behaviours when searching for information online (Eysenbach and Köhler 2002).

This research also highlights limitations in commercial sources, adding to the body of knowledge concerning online health information.

Limitations

Several limitations should be acknowledged. The study evaluated only 30 websites, providing a single snapshot of search results; search engine results are dynamic and may differ at another time or location.

In addition, while the study assessed the quality and clarity of information, it did not examine its clinical accuracy.

Future Directions

Future research could explore larger sample sizes, multiple search engines, and content accuracy in addition to content quality. It is also recommended that future studies examine how online information influences patients' knowledge, anxiety levels, and treatment outcomes.

CONCLUSION

Overall, the Internet provides abundant and diverse information about the use of nitrous oxide sedation in dentistry; however, this information is predominantly of poor quality. Academic sources offer information of considerably better quality, even though such sources are less represented in search results.

These results underscore the importance of information dissemination and the role of healthcare providers in directing patients toward reliable references.

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