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Readability, content, quality and accuracy assessment of internet-based patient education materials relating to labor analgesia

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ABSTRACT

Background: With over 90% of parturients searching the internet for health information, the quality of information is important. Web-based patient education materials (PEMs) related to labor analgesia are frequently of low readability. This study compares the readability, content, quality and accuracy of labor analgesia-related PEMs from relevant healthcare society websites and the top internet search results.

Methods: The first ten PEMs from Google searches for "labor epidural" and "labor pain relief" were compared with PEMs from North American and United Kingdom anesthesiology, obstetric and medical society websites. Readability was assessed utilizing five validated readability indices. Quality was assessed using Patient Education Materials Assessment Tool for Print (PEMAT). The PEMs were graded for accuracy by four obstetric anesthesiologists. Readability, quality and accuracy scores were compared using the independent t-test and content using Chi-square analysis.

Results: Society PEMs were significantly more readable than non-society PEMs for three of five readability indices, though the mean of both groups was at or above an eighth-grade (average age 13–14 years-old) reading level. The PEMAT understandability and accuracy scores were significantly higher for society websites. The most frequently mentioned topics were benefits, effects of epidural analgesia on labor and delivery, definitions, post-dural puncture headache and alternative analgesics.

Conclusions: Google search results for labor analgesia lead to PEMs of variable quality and readability. For readers to be better informed, web-based PEMs should be improved or women directed to society PEMs. Inaccurate information may lead to incorrect expectations and conflict during labor, with potentially lower maternal satisfaction.
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Introduction

Over 90% of pregnant women in the United States of America (USA) and Western Europe search the Internet for health information.[1–4] Yet two thirds of parturients reported they visited a website that contained information they thought was wrong or misleading[1] and that they felt worried after reading pregnancy-related information on the internet.[4] A 2018 USA survey of over 900 pregnant or recently pregnant women found that 74% had misconceptions regarding labor epidural analgesia.[5] As patients are increasingly relying on the internet to obtain health information in pregnancy and to aid in shared decision making, the imperative becomes to evaluate the quality and accuracy of this information.

Previous studies have examined the readability and quality of patient education materials (PEMs) relevant to labor analgesia obtained from popular search engines and from academic medical center websites.[6,7] However, a search of the literature revealed a lack of analysis of national and international obstetric and anesthesiology society PEMs related to neuraxial anesthesia and labor pain relief. This study compared society websites to the top search engine results, based on readability, content analysis, quality, and accuracy.

Methods

Data collection and selection of search terms

After receiving exemption from the Institutional Review Board at Cedars-Sinai Medical Center, this study was performed from December 2017 to February 2018.

A search for PEMs on the Internet was performed using the most popular search engine www.google.com[8] and the following terms: "labor epidural" and "labor pain relief". These terms were selected based on Google Trends and relevance, similar to the methods previously described by Sutton et al.[9] Non-medical society websites containing text articles with information on labor pain relief or epidural analgesia for labor, directed towards the public, were included. Exclusion criteria included websites not in English, those not freely available to the public, those directed towards healthcare providers, links to video-sharing websites and websites of professional medical societies. The search was limited to the first 10 Google results based on previous data suggesting that over 90% of traffic generated from a query is limited to the first results page.[10]

Patient education materials from medical society websites based in North America and the United Kingdom (UK) were reviewed, including anesthesiology, obstetric, general and primary care medicine organizations. Materials related to neuraxial anesthesia for non-obstetric procedures and links to external websites were excluded. Website traffic ranking was determined using www.alexa.com.[11] The Alexa Rank is a commonly used method for measuring website popularity, based on unique visitor traffic and webpage views over the prior three months.[12] Website URLs, website names, author information, dates, references, advertisements, disclaimers, copyright and contact information were omitted to allow for blinded assessment.

Content analysis

The content of PEMs was independently reviewed by two investigators for inclusion of 26 labor epidural-related topics adapted from Patel et al.[7] (see Table 1). The frequency that each topic was mentioned in the society and non-society groups is reported as a percentage.

Readability assessment

Readability was assessed utilizing the Flesch-Kincaid Grade Level (FKGL), Gunning Frequency of Gobbledygook (FOG), Simple Measure of Gobbledygook (SMOG), Flesch Reading Ease Score (FRES) and Coleman-Liau indices, using the website www.readabilityformulas.com.[13] These indices are objective, commonly utilized tools[14] that measure the complexity of text and ease of comprehension, based on the number of words per sentence, sentence length, word difficulty and

Table 1 Content analysis of web-based patient education materials related to labor epidural analgesia

	Non-society websites (n=10) Frequency	Society websites (n=13) Frequency	P-value
Topic			
Definition of epidural	70%	76.9%	0.708
Description of procedure	70%	69.2%	1
Benefits (≥1 benefit mentioned)	90%	100%	0.165
Alternative analgesic options	30%	76.9%	0.024[†]
Timing of epidural placement	30%	30.8%	1
Effect of epidural on labor or delivery	100%	76.9%	0.047[†]
Effect of epidural on neonate	70%	76.9%	0.708
Effect of epidural on breastfeeding	40%	30.8%	0.645
Contraindications	30%	15.4%	0.4
Incomplete or failed block	50%	69.2%	0.349
Post-dural puncture headache	70%	84.6%	0.4
Hypotension	80%	69.2%	0.56
Dizziness	10%	0%	0.165
Fever	80%	46.2%	0.099
Shivering	20%	0%	0.046[†]
Pruritus	40%	46.2%	0.768
Nausea	40%	7.7%	0.063
Urinary difficulty or need for catheter	60%	30.8%	0.161
Back pain	40%	69.2%	0.161
Bleeding	10%	15.4%	0.704
Infection	30%	23.1%	0.708
Nerve damage	50%	53.9%	0.855
Paralysis	0%[†]	23.1%[†]	0.047[†]
Symptoms of local anesthetic toxicity	30%	23.1%	0.708
Allergic reaction	0%	15.4%	0.11
Breathing difficulty or other symptoms of high spinal block	10%	7.7%	0.846

[†]P <0.05 significant.

syllables per word. Five of the most frequently used indices were included, as used in previous studies evaluating the readability of PEMs.[6,7] Only text from the body of the PEMs was used for readability assessment; text accompanying visual aids and references was omitted.

Accuracy grading

Accuracy of website material was assessed independently by two obstetric anesthesiologists and two obstetric anesthesiology fellows (authors JM, JV, AG and MZ). Accuracy was calculated as the number of accurate statements divided by the total number of statements. A fifth obstetric anesthesiologist (KG) graded the materials to resolve any lack of agreement.

Quality assessment

Quality was evaluated by three investigators (JM, JV, MZ) using the Patient Education Materials Assessment Tool for Print (PEMAT), a validated tool designed for assessing the understandability and actionability of PEMs.[15] Actionability measures whether the reader can identify at least one action they can do, which is an important component following comprehension.[15] The PEMAT topics "layout and design" and "use of visual aids" were graded including article titles, tables, graphs, photographs and illustrations. Any discrepancy identified in quality scoring was resolved by consensus with two additional independent researchers (AG, KG).

Statistical analysis

Readability, accuracy, PEMAT understandability and actionability scores were reported as mean and standard deviation (SD) and compared between non-society and society websites using the independent t-test, with a P-value of <0.05 considered significant. Content was compared between the non-society and society websites using Pearson's Chi-square test with a P-value of <0.05 considered significant. Inter-rater agreement for quality and accuracy grading was determined using Krippendorff's alpha.

Results

Internet search

A systematic search of society websites yielded 13 written PEMs from six societies, including one obstetric, two obstetric anesthesiology, one general anesthesiology, one family practice, and one general medical organization. Of the 13 PEMS, three contained pictures, two contained an embedded video, and two included a reference list. Twelve of the 13 society websites generated a global Alexa rank, ranging from 3338 to 4 206 262 (mean 1 548 399).

Among the top ten Google search results for the term "labor epidural" meeting inclusion criteria, eight were commercial websites (.com or .co.uk), one was a not-for-profit organization (.org), and one was a government website (.gov). Seven of the websites contained pictures, two contained an embedded video, and five websites included references. The top 10 Google search results for "labor pain relief" meeting inclusion criteria contained seven commercial websites (.com), two not-for-profit organization websites (.org) and one government website (.gov.au). Seven of the websites contained pictures, two contained embedded videos, and four included a reference list. The mean global Alexa rank of all non-society websites was 22 556 with a range 137 to 75 038.

Content

In a content analysis of 26 topics related to 'labor epidural', the most frequently mentioned topics among all society (n=13) and non-society (n=20) PEMs were: benefits (87.9%), effect on labor or delivery (75.6%), definition of the neuraxial procedure, alternative analgesia options, and post-dural puncture headache (69.7% each). The least frequently mentioned topics among all PEMs were bleeding, paralysis, breathing difficulty or symptoms of high neuraxial block (9.1% each) and allergic reaction (6.1%). Compared to non-society websites (n=20), society websites (n=13) more frequently mentioned back pain (69.2% society vs. 30% non-society, P=0.027) and paralysis (23.1% society vs. 0% non-society, P=0.024).

All society PEMs included a discussion of epidurals for labor analgesia. Among the 10 non-society results for the term "labor pain relief", three did not include a discussion of epidurals in their description of labor pain relief options. These articles focused on either opioid analgesia or non-pharmacological alternatives. Thus separate statistical comparisons between the society and non-society results for the term "labor epidural" (n=10) were performed (Table 1). Society websites more frequently mentioned alternative analgesic options (76.9% society vs. 30% non-society, P=0.024) and paralysis (23.1% society vs. 0% non-society, P=0.047). Non-society websites more frequently mentioned the effects of epidural on labor or delivery (100% non-society vs. 76.9% society, P=0.047) and shivering (20% non-society vs. 0% society, P=0.046).

Readability

The mean readability scores of both society and non-society PEMs were at or above an 8th grade (average age 13–14 years-old) reading level, utilizing all readability indices (Table 2). The mean scores for the society PEMs were significantly lower using the FOG, FKGL and SMOG indices, indicating a lower grade level (i.e. easier readability) required to read the society PEMs (Table 2).

Table 2 Readability, accuracy and PEMAT scores of web-based patient education materials related to labor analgesia

	Non-society websites (n=20) Mean ± SD[†]	Society websites (n=13) Mean ± SD[†]	P-value
Readability			
FRES	54.02 ± 8.29	59.22 ± 11.13	0.13
FOG	12.75 ± 1.8	11.22 ± 2.3	0.04[‡]
FKGL	10.27 ± 1.68	8.78 ± 2.23	0.036[‡]
Coleman-Liau	9.85 ± 1.18	9.23 ± 1.54	0.2
SMOG	9.46 ± 1.34	8.32 ± 1.67	0.038[‡]
Accuracy	75.8% ± 20.2%	94.6% ± 3.4%	<0.001[‡]
PEMAT			
Understandability	61.4% ± 10.9%	76.9% ± 8%	<0.001[‡]
Actionability	20% ± 21.5%	23.1% ± 24.3%	0.49

PEMAT: Patient Educational Materials Assessment Tool.
[†]FOG, FKGL, Coleman-Liau and SMOG scores represent grade level. In the FRES test, higher scores indicate greater readability, corresponding to a lower grade level (e.g., 50–60 = 10th–12th grade/fairly difficult, 60–70 = 8th–9th grade/standard, 70–80 = 7th grade/fairly easy, 80–90 = 6th grade/easy).
[‡]P <0.05 significant.

Accuracy

The mean accuracy of society PEMs was significantly higher than that of non-society PEMs (94.6% ± 3.4 vs 75.8% ± 20.2%, P <0.001) (Table 2), with a notably larger variation among the non-society PEMs. Inter-rater reliability for accuracy grading, using Krippendorff's alpha, was 0.923. Of the inaccurate statements in non-society "labor epidural" PEMs, 25.7% were on the effect of epidural on labor or delivery; 14.3% were claims about the effects on the neonate or breastfeeding; and 11.4% were in relation to side effects or complications. Among the inaccurate statements in society PEMs, 16.7% were regarding the effect of epidural on labor or delivery, 14.8% were in relation to the effects of epidural on the neonate or breastfeeding, and 11.1% were regarding the frequency of complications.

Quality

The mean PEMAT understandability score was significantly higher (i.e. easier to understand) for society PEMs (76.9% ± 8%) compared to non-society PEMs (61.4% ± 10.9%, P <0.001). Mean actionability scores were low for both society and non-society PEMs (23.1% ± 24.3% and 20% ± 21.5%, respectively). Krippendorff's alpha was 0.971 for the PEMAT grading.

Discussion

Society PEMs were significantly more readable compared to non-society PEMs, utilizing three of five readability indices. Society websites were significantly more accurate and understandable, as measured using the PEMAT.

With over 90% of parturients seeking medical information online,[1–3] it is imperative to ensure the quality and accuracy of the education materials being accessed. A survey of over 500 pregnant or recently pregnant women revealed that after Internet use, their confidence levels significantly increased with respect to making decisions about their pregnancy.[2] In that same survey, 97% of women reported using a search engine to obtain information, compared to fewer than 62% accessing a site run by health care professionals. Moreover, 40% of the women expressed dissatisfaction with the information provided by health professionals, while over 96% reported that they considered the information they obtained online to be "useful". Thus, Internet usage may increase patient confidence about making decisions regarding their care. However, reliance on inaccurate information obtained online has the potential to impede informed shared decision-making. Preconceived notions regarding different medical options may lead to delays in important medical interventions. Parturients who refuse medical treatment have a higher risk of adverse perinatal outcomes, including lower Apgar scores and perinatal mortality.[16,17]

In our study, the mean readability of both the society and non-society websites was above the seventh to eighth grade (average age 13–14 years old) reading level recommended by the National Institute of Health (NIH),[18] the sixth grade level recommended by American Medical Association,[19] and 11–14 year age group recommended by National Health Services in the UK.[20] This finding is consistent with previous studies on the readability of PEMs for labor analgesia.[6,7] Among female Internet users, those with a university or higher education were 3.5 times more likely to search for health information online compared with those with a high school education or less.[21] Pregnant Latina women with a high school education or higher were three times more likely to seek out pregnancy advice

than women with less than a high school education,[22] suggesting that the recommended NIH seventh to eighth grade reading level may not be as relevant in this segment of readers. However, poor readability of educational content could discourage women with less than a high school education from seeking medical educational advice online. If PEMs continue to be above the seventh to eighth grade reading level, many patients eager to improve their understanding of labor epidurals may be accessing online resources that are difficult to read, regardless of accuracy. Authors of PEMs should employ readability tools before publishing, to ensure they have the potential to impact a wider audience.

Differences in education and socio-economic status influence whether a patient elects to have epidural analgesia.[23] While cost may be a factor for some women, cultural views including fears of epidural complications could potentially play an even larger role. In a survey of 50 predominantly Hispanic women, only 28% planned on labor epidural analgesia prior to anesthetic counseling.[24] Over half the women surveyed cited fears of paralysis and chronic back pain, as well as a belief that women should cope with labor pain as a natural part of childbirth. When over 500 parturients were interviewed prior to requesting a labor epidural, over 75% of Hispanic women voiced concerns regarding fear of back pain.[25] Disparities in labor epidural analgesia utilization by ethnic minorities in Europe have also been reported. In a study of over 21 000 vaginal deliveries in Spain, 61% of Spanish women received labor epidural analgesia compared to 51.5% of immigrant women, with women from Africa and Asia having the lowest rates of epidural analgesia use.[26] Improving access to quality information may help dispel the inaccurate beliefs that contribute to differences in neuraxial utilization rates, thereby helping to close the racial healthcare disparity gap.[27]

Our study has a number of limitations. Google search results may vary depending on multiple factors including geographic location. We avoided medical terms that patients would be unlikely to use (e.g., "neuraxial", "analgesia") and selected the most popular associated terms. However, other search terms may be used when querying to obtain information. The readability indices factor in sentence length and syllables, but this does not account for medical jargon, which may be of low syllable count (e.g., Foley, forceps). Conversely, most readability tools tally the frequency of three-syllable words; thus if the word 'epidural' is used more frequently in a PEM, it may make the text less readable. For this reason, we also used the PEMAT which grades materials in understandability, their use and definition of medical terms, and their use of common, everyday language.[28]

In our study, we found significantly higher understandability in the society PEMs using the PEMAT, though scores for actionability were low in both groups.

Examples of graded actionability items include that the material "provides a tangible tool (e.g., menu planners, checklists) whenever it could help the user take action" and "uses visual aids whenever they could make it easier to act on the instructions". Many websites did not include a checklist or visual aid which could help the reader not only understand the information, but also take action. However, actionability items may not be as relevant for PEMs explaining procedures (e.g., neuraxial analgesia) compared to PEMs that describe disease management and lifestyle changes (e.g., weight loss, diabetes management).

In our Google queries, the top search results were commercial websites. Websites with financial interest in obtaining "hits" may pay for search engine optimization to increase their query rank. The mean global Alexa rank of society websites was 68 times lower than that of the non-society sites, indicating far less traffic and viewing. Though we have demonstrated the superior readability, understandability and accuracy of society PEMs, the problem remains that patients are less likely to find and access society sites unless directed to do so. There are different approaches available with improve Google search term rankings, and these should be considered by medical societies and health care providers in order to promote patient access to high quality, readable materials.

Search engine results for labor epidural analgesia led to PEMs of variable quality, variable accuracy, and lower then recommended readability. Society websites demonstrated superior accuracy and quality, although the readability and actionability remained low. While actionability may be less applicable to PEMs regarding labor analgesia, improving understandability, including the use of everyday language, will help to increase the PEMs ease of use and consumption. Both top-ranked Google-searched websites and society websites have a responsibility to improve understandability of their material, to help inform and guide patients to make more informed decisions. Patients should be directed to society websites by healthcare providers and societies for access to higher quality, more accurate information regarding labor analgesia. Provision of high quality, accurate information should enable patients to make better decisions and may improve the patient's perception of quality of care as well as outcomes.

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