

**Readability and Quality of Online Information Regarding Dental Treatment for Patients
with Ischaemic Heart Disease**

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ABSTRACT

Background: Healthcare information is increasingly being sought on the Internet. Ischaemic Heart Disease (IHD) poses a significant health burden. Concern often arises for patients with IHD when undergoing dental treatment leading to online searching for relevant healthcare information.

Objective: To evaluate the readability and quality of webpages regarding IHD and dental treatment.

Materials and methods: Three searches were performed on the Google search engine. The first 100 results of each search were collated, and exclusion criteria applied. The remaining 66 webpages were categorised. Readability was assessed using the FRES and SMOG readability tools. Quality was assessed using the PEMAT questionnaire, the JAMA benchmarks and the Health on the Net (HON) seal.

Results: Most examined webpages were commercial. Readability of 90.1% of webpages was deemed fairly to very difficult. Understandability and actionability scores were generally below the comprehension level of the general population. Less than 50% of websites achieved the authorship, attribution and disclosure JAMA benchmarks. Only 12.1% of websites displayed the HON seal.

Conclusions: Online health information related to IHD and dental treatment is generally too difficult for the average individual to read, understand, or act upon; and may be of questionable quality. Given the low health literacy rates amongst the general population, future revisions of educational materials by non-commercial sources regarding IHD and dental treatment are warranted to ensure online health information is understandable and of genuine benefit to patients and/or their carers.

IN BRIEF:

- Presents an analysis of the readability and quality of online information regarding dental treatment for patients with ischaemic heart disease
- Details the impact of low readability scores and poor health literacy levels in the general population
- Explores the need for health education materials by non-commercial sources regarding ischaemic heart disease and dental treatment
- Recommends further research into accuracy or comprehensiveness of online health information

INTRODUCTION

Ischaemic heart disease (IHD), otherwise known as coronary heart disease, is a group of related syndromes resulting from myocardial ischemia – an imbalance between myocardial perfusion and oxygen demand.⁽¹⁾ It includes stable and unstable angina pectoris, and ST-elevation and non-ST-elevation myocardial infarction.^(2, 3) IHD is common across the globe.⁽⁴⁾ Many affected individuals will also have dental needs and it is likely that those patients will seek information from the Internet prior to undergoing dental treatment. The online information regarding the dental implications of IHD includes topics such as: appropriate healthcare, timing of dental treatment, risk of vascular events, adrenaline use, drug therapy, emergency management, and association with periodontitis and endodontic disease.

The Internet is increasingly being used as a source of health-related information by the global population. In Europe, 71% of Internet-users searched for health information online,⁽⁵⁾ and up to 86% of those living with chronic illness in the US.⁽⁶⁾ One study found that over a third of patients presenting for dental treatment had researched their oral condition online.⁽⁷⁾ Significantly, patients have reported that health information searched for online has affected their treatment decisions, led them to ask a doctor new questions or seek a second opinion, and changed the way they cope with a chronic condition.⁽⁶⁾

However health literacy is relatively low in the general population.^(8, 9) One in five adults in England have difficulties with basic literacy and numeracy (i.e. the level expected of an 11-year-old).⁽¹⁰⁾ Since the average reading age in the UK is 9 years, this reading age has been suggested as the level at which to pitch UK patient information leaflets.⁽¹¹⁾ The Organisation for Economic Cooperation and Development (OECD) ranks the UK and US as comparable for literacy and numeracy. Only 12% of US adults demonstrate proficient health literacy skills.⁽¹²⁾

¹³⁾ Because the average general literacy of American adults is 8th grade level, the American

Medical Association (AMA) recommends that materials should be written at 5th or 6th grade level.⁽¹⁴⁾

Dentists do not commonly refer patients to online information due to their uncertainty as to where to direct patients for high quality, reliable information.⁽¹⁵⁾ Since patients often forget or fail to fully comprehend information provided chair-side, websites could empower patients to further appreciate their condition,⁽¹⁶⁾ ultimately leading to improved compliance and eventual clinical outcome.

As such, a need exists to evaluate the appropriateness of online content. Only one study was sourced regarding the readability and quality of web information relating to IHD (coronary angioplasty).⁽¹⁷⁾ Studies assessing online information relating to specific head and neck conditions, such as head and neck oncology,^(18, 19) oral leukoplakia,⁽²⁰⁾ oral ulcers,⁽²¹⁾ and laryngectomy,⁽²²⁾ conclude that online health information performs poorly for quality and readability. However, no studies were found that investigate the implication of any systemic diseases on dental management. Given that ischaemic heart disease is common and the leading cause of death globally,⁴ the aim of this study was to assess the readability and quality of online information regarding IHD and dental treatment.

MATERIALS AND METHODS

Data collection

Three web searches were performed via Google.co.uk on February 12th 2018 at the UCL Eastman Dental Institute using the following search terms:

- “ischaemic heart disease dental treatment”
- “heart attack dental treatment”
- “angina dental treatment”

The internet browser search history was cleared prior to each search. The first 100 sites for each search were independently examined by two reviewers (J.L. and R.N.). The 300 sites were firstly screened for duplicate sites or non-functioning links, following which exclusion criteria were applied as per Table 1.

INSERT TABLE 1

Webpages were categorised based on affiliation (commercial, government, non-profit organisation), specialisation (exclusively related to IHD and dental treatment, part of webpage related to IHD and dental treatment), content type (medical facts, clinical trials, human interest stories, question and answer), and content presentation (image, video, audio).⁽¹⁸⁾

Readability Analysis

Readability of online health information was assessed by calculating the Flesch Reading Ease Score (FRES) and the Simple Measure of Gobbledygook (SMOG) of the textual content. These instruments have been thoroughly validated, are considered highly reliable, and have been highlighted as good choices of tests in the biomedical context, as not all instruments are

equally useful for the analysis of online health information.⁽²³⁾ Two instruments were used in order to enhance reliability, which increases by approximately 0.20 when more than one formula is used.⁽²⁴⁾ Textual content was formatted to remove references, bullets and hyperlinks prior to pasting into the online calculator programme to increase reliability and accuracy of the computerised analysis.⁽²³⁾

The FRES indicates the comprehension difficulty of a text using the formula: $206.835 - (1.015 \times \text{average sentence length}) - (84.6 \times \text{average number of syllables per word})$. The higher the score, the easier the passage is to read, and the scores are mapped to education level.⁽²⁵⁾

The SMOG readability formula outputs a US school grade level, indicating that the average student in that grade level can read the text. It is a tool particularly well adapted to health related content, and the only readability tool that assumes 100% comprehension,⁽²⁶⁾ an important factor in understanding health information.⁽²³⁾

Quality Assessment

Three instruments were applied to determine the quality of information: the Patient Education Materials Assessment Tool (PEMAT),⁽²⁷⁾ the Journal of the American Medical Association (JAMA) benchmarks for webpage analysis,⁽²⁸⁾ and the HON code seal.⁽²⁹⁾

PEMAT is a tool used to assess the understandability and actionability of both print and audio-visual patient education materials. It acts as a guide to determine whether patients will be able to understand and act on health-related information. The tool has shown strong internal consistency (with only minimal training required of raters), reliability, and evidence of construct validity.⁽²³⁾ The creators of PEMAT recommend that the minimum score to achieve adequate reader comprehension is 70%.⁽²⁷⁾

JAMA benchmarks demand that websites must clearly display: Authorship of medical content (authors and contributors, their affiliations and relevant credentials), Attribution (sources of

information or lists of references), Disclosure (website ownership, conflicts of interest), and Currency (dates content posted and updated).⁽²⁸⁾

Health on the Net is a Swiss-based non-profit foundation founded in 1995, and is one of the first URLs to guide both lay people and those in the medical profession to reliable sources of healthcare information on the Internet. In order to be awarded HON code certification, a website must comply with the eight principles of the HON code of ethical conduct.⁽²⁹⁾

Ethical approval was not necessary for this study.

RESULTS

Search Results

The search strategy generated 6,130,000 webpages on the Google search engine:

- “ischaemic heart disease dental treatment”: 3,130,000
- “heart attack dental treatment”: 2,600,000
- “angina dental treatment”: 401,000

For the first 100 sites for each search, 53 were duplicated links, and none were non-functional. Of the remaining 247 webpages, 181 webpages met the exclusion criteria. Sixty-six webpages were reviewed in total. The summary of the search protocol and results is shown in Figure 1.

INSERT FIGURE 1

Categorisation

The majority of included webpages (83.3%) were commercial, and 26 (39.4%) exclusively dedicated their contents to the implications of IHD on dental management.

Readability of Online Information

The Flesch Reading Ease rating of the 66 webpages varied from 13.8 to 62.7, with a mean total readability score (\pm SD) of 44.2 (\pm 11.8). The readability levels ranged from fairly difficult to very difficult in 90.1% (60/66) of the webpages (Figure 2).

INSERT FIGURE 2

The SMOG index of the 66 webpages varied from 7.5 to 14.3, with a mean total readability score (\pm SD) of 10.8 (\pm 1.8) (Figure 3). Readability levels were above 8th grade level (the

average US literacy level) in 80.3% (53/66) of the webpages, and 100% (66/66) of the webpages had readability levels above 6th grade level (that recommended by the AMA for written health education materials).⁽¹⁴⁾

INSERT FIGURE 3

Quality of Online Information

Figure 4 summarises the PEMAT understandability scores distribution. The mean understandability (\pm SD) for all 66 webpages was 55.9% (\pm 17.5%), with a range between 16.7% and 90%. Only 16 achieved the \geq 70% required for adequate understandability.

Figure 5 summarises the actionability scores distribution. The mean actionability score (\pm SD) for all 66 webpages was 37.4% (\pm 28.3%), with a range between 0% and 100%. Overall 49 webpages (74.2%) provided instructions to the reader. The mean actionability score among these 49 webpages that provided instructions to the reader was 50.0% (\pm 20.6%), ranging between 20% and 100%.

INSERT FIGURE 4

INSERT FIGURE 5

Table 2 summarises the JAMA benchmarks of the 66 webpages. The mean number of JAMA benchmarks met was 1.8 (SD \pm 1.29). Overall, 11% of webpages achieved all four benchmarks, 24% achieved three benchmarks, 26% achieved two benchmarks, 18% achieved one benchmark, and 21% achieved no benchmarks.

INSERT TABLE 2

Only 8 of the 66 webpages (12.1%) displayed the HON code seal.

DISCUSSION

Medical-orientated information is increasingly being sourced from the Internet, and has revolutionised patients' access to healthcare information. In the traditional model, scientific information is obtained via direct contact with reliable information sources such as teachers,

professionals or printed materials. However, there has been a shift to a digital model, whereby information retrieval is characterised by indirect connections, multiplicity of sources, and low levels of reliability.^(23, 30) Since information is often poorly moderated, there is a risk of spreading potentially harmful information via the Internet.⁽³¹⁾ Coupled with the wide use of the Internet as an initial or only primary source of health-related information, there is a great risk for patients and carers. Furthermore, given that health literacy is relatively low in the general population,^(8, 9) patients (or their carers) may: fail to recognise that important information is missing, fail to acknowledge biased content, misinterpret some medical information, and/or be unable to recognise non-evidence-based material.^(32, 33) In light of this, multiple organisations have produced guidelines regarding how to produce readable and actionable health education materials. The NHS (UK) has developed a toolkit that discusses the design of good-quality written information for patients.⁽³⁴⁾ The PEMAT describes an inventory of desirable and undesirable characteristics of patient education materials.⁽³⁵⁾ The US Office of Disease Prevention and Health Promotion's *Health Literacy Online* guide discusses how to design user-friendly health websites for all users, including those without strong health literacy skills or much time to process complex health information.⁽³⁶⁾

IHD is the leading cause of death worldwide, and it is likely many patients and their carers will seek information regarding the implications of this condition on dental treatment from the Internet. It is therefore important to evaluate the readability and quality of available webpages regarding IHD and dental treatment.

The high rate of hits using the present search terms reveals that there is a plethora of sources of information on dentistry and IHD. However, analysing the 66 included webpages reveals that 83.3% were commercial. This is more than previous studies regarding oral leukoplakia (55% of webpages) and head and neck cancer (43%).^(18, 20) The majority of education material

was published by dental practices, news media, dental product sales and insurance companies. As such, there exists the potential hidden agenda of promoting commercial interests. Concerningly, few of the webpages were affiliated to government or non-profit organisations, who assumedly are more likely to publish accurate information and advice. This lack of information from publicly funded health systems could suggest that they consider oral health, even in relation to IHD, to be a low priority.

The vast majority of webpages included in this study had readability levels well above the average US literacy level, and were more appropriate for those with at least UK A-level or US senior high school education. Given the poor health literacy in the general populations of the UK and US, this is problematic when it comes to the level of readability of online health education material. Those with low health literacy levels may be excluded from understanding information that may help guide their treatment choices and indeed prevention strategies; have poorer utilisation of health services and health outcomes; and a reliance on online sources (e.g. discussion forums, Wikipedia) that are understandable but not necessarily endorsed by public health authorities.^(23, 37-40) A limitation of readability tools is that they do not consider the role of visual aids in enhancing user's understanding. Additionally, words with fewer syllables (e.g. "ablate") may still be more difficult to read than longer polysyllabic words (e.g. "watermelon"), and familiar words added together can result in more complex meaning (e.g. "white", "blood", "cell", "count").^(22, 23)

The present study found a high variability in both understandability and actionability of online material as assessed with the PEMAT. Though the mean actionability score (74%) met the 70% cut-off for adequate reader comprehension, the mean understandability score (55.9%) indicates that the majority of online information is too difficult for the average person to understand. Unsurprisingly, advertisements embedded within the text were the main cause of

distraction. In this study, PEMAT analysis was performed by health researchers, which introduced a potential source of unintentional bias, and may limit the generalisability of the results due to increased health literacy. Nevertheless, the use of PEMAT requires no special training to use and minimal health literacy.

The presence of the HON code seal guides health information consumers about the reliability of the material, but not the accuracy or quality. Though only 12.1% of websites displayed the HON seal, this does not necessarily indicate poor reliability of the remaining sites. Many website publishers may be unaware of the existence of the HON seal to apply for certification, or unwilling to pay the annual re-evaluation membership fee.⁽⁴¹⁾ Additionally, many individuals searching the web are likely to be unaware of its relevance.

Overall the reviewed webpages scored poorly with respect to the JAMA benchmarks. Less than half met the authorship, attribution and disclosure benchmarks. This is concerning since: acknowledged authorship may reassure readers that the information they have read is provided by an expert in the field; attribution allows the reader to discern the evidence base behind the information; disclosure allows the reader to estimate the potential for bias; and currency informs the reader whether the health education material is current in what is a constantly evolving field.

A limitation of the JAMA benchmarks is that they do not assess accuracy. A webpage may meet the benchmarks for authorship, attribution, disclosure, currency - but convey information that is not scientifically sound. Though not formally assessed in this study, one of the apparent issues with unregulated online health information was the scientific accuracy and commercial bias of some of the webpages. Some commercial webpages indicated that the biological mechanisms proposed for periodontal disease's effect on CVD are a certainty (rather than a

yet-to-be-defined association), and combined emotive language to conclude that the reader should attend their clinic for an examination. Additionally, news media websites tended to report on scientific studies with controversial findings (e.g. that certain dental procedures increase the risk of a heart attack). Though these early studies may self-report limitations, critiques, and require further research, the reader may only register the sensationalised news article title due to the difficult readability level of the article itself. Another example was one webpage that drew an association between undergoing root canal treatment and an increased risk of IHD, by quoting a scientific article that actually investigated the association between endodontic disease and IHD.

Educational material may be readable and understandable, but still contain biased or incorrect information. As such, future research into the accuracy or comprehensiveness of online information is recommended. Additionally, search engine results are customised based on individual search history and the location the search is conducted, thereby somewhat limiting generalisability of this study's findings. However the results in this study are consistent with those of similar studies examining other disease of relevance to oral health or oral health care.^{16,17,18,19,20}

CONCLUSIONS

The present study has found that online health education material related to IHD and dental treatment may be too difficult for the average person (e.g. patient or carers) to read, understand, or act upon. When searching for IHD and dental treatment on the Internet, the vast majority of the websites were commercial, failed to meet the JAMA benchmarks, and did

not display the HON code seal, placing the reliability of the available online information into question. Though this study only assessed the readability and quality of online information formally, it was clear that inaccurate information did exist on the websites. Given the poor health literacy rates amongst the general population, future revisions of education materials by non-commercial sources relating to IHD and dental treatment are warranted in order to ensure online health information concerning oral health and IHD is more accessible and likely to benefit the lives of those with, or at risk of, IHD.

Conflict of Interest Statement

None declared.

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