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The Internet and the oral healthcare professionals: potential and challenges of a new era

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Abstract: The Internet is increasingly used as a means of continuous education for healthcare practitioners. At the same time, a rapidly growing number of patients rely on the Internet for the search and acquisition of healthcare-related information and services. This fact has introduced new challenges for the oral healthcare personnel, which must not only often face the misperceptions of ill-informed patients but also be able to redirect them to quality sources of healthcare-related information.Consequently, there is a great need for the whole oral healthcare team to further understand the potential and dangers of Internet-based information.The present paper aimed to briefly discuss the major implications of Internet use from two distinct points of view:

(a) potential and risks of Internet use for lifelong learning and quality assessment of the oral healthcare team and
(b) potential and dangers from the Internet as a means of patients' education.

In particular this paper will review strategies of

(1) generic Internet search;
(2) search within healthcare-related databases; and
(3) principles quality assessment of information and resources.

Key words: computers; databases; education; Internet; quality assessment

Introduction

The expansion of the use of the Internet has greatly affected many aspects of our everyday professional practice. Internet-based databases have become the resource of choice when it comes to

up-to-date evidence-based healthcare-related information. Database use as a means of continuous education of healthcare practitioners is steadily rising. At the same time, a rapidly increasing number of patients currently rely on the Internet for search and acquisition of healthcare-related information and services.

The majority of the oral healthcare practitioners currently in service are neither educated nor prepared to use the Internet for the benefit of professional practice and educational activities. Therefore, as the use of the Internet affects our daily professional lives more and more, there is a great need for the oral healthcare team to further understand the potential and dangers of the Internet Era.

The present paper aimed to briefly discuss the major implications of Internet use from two distinct points of view:

(a) potential and risks of Internet use for lifelong learning and quality assessment of the oral healthcare team and
(b) potential and dangers from the Internet as a means of patients' education.

This paper will attempt to comprehensively address the most important issues in this field, through discussing some frequently asked questions.

Continuous education of the oral healthcare team

One of the key professional skills for the oral healthcare practitioners today is the ability to stay up-to-date in the middle of a rapidly increasing knowledge base and guarantee a treatment always based on the best available evidence for their patients. Rather than simple attendance of congresses and occasional courses, lifelong learning is today perceived as a continuous process, implemented in everyday clinical practice (1). The dentist or hygienist must be able to evaluate the process and outcome of every treatment performed, identify weaknesses and areas of improvement and consequently search available evidence and resources in a continuous strive for excellence. In this process, the Internet is an invaluable resource, providing a compilation of the latest evidence and information. Yet the rapid increase in published scientific reports in medicine has made it hard for healthcare professionals to keep up with medical progress (2). This means that to navigate through the vast information alleys, professionals need training and strategies for access, evaluation and prioritizing of information.

Educating the patients

The growth of the Internet has enabled a whole new approach to patient empowerment, in terms of assisting people to undertake a more active and well-informed role in health-related decision making (3). The Internet has opened public access to medical information previously restricted only to healthcare professionals. In 2003, more than 40% of the Americans (4) and 25% of Europeans (5) turned to the Internet for healthcare-related information. A recent PhD thesis in Sweden showed a rapidly increasing use of Internet-based 'Ask the doctor' services (6). In another study in the USA 60% of the Internet users felt that the healthcare-related information on the Internet was the 'same as' or 'better than' information from their doctors (7).

However, the quality of healthcare information available on the Internet may vary broadly (8). Not all resources are free of bias and information sites and services serve commercial, political or personal interests without a clear disclaimer. It has been shown that healthcare-related information on the Internet is often of questionable quality and can even be hazardous to health (9, 10). Furthermore, many clinics are now placing treatment options and even prices on the Internet. In several countries Internet services have appeared which actually compare prices between dentists, suggesting the cheapest dentist for a given geographical area and a given treatment.

It is obvious that the patients of the Internet Era will often reach the dental practice with a self-perceived awareness of their problems and even with expectations already shaped by the information they have found. A well-informed patient is a necessary step for the success of every dental treatment. The Internet certainly opens up a great possibility for effective patient education and support. The patients, however, are not able to fully evaluate all dimensions of the information they find on the Internet. The danger lies in the misinformed patient, the patient who is unaware of his actual problem and has expectations not relevant to the potential and limitations of the available treatment options.

Therefore, the oral healthcare personnel are currently faced with two new challenges:

- First, we must be prepared to face the misperceptions of patients who have relied on inappropriate information.
- Second, we must be able to direct interested patients to quality resources and also help them understand some essential quality assurance principles, when it comes to healthcare-related information.

Comprehension of information search, retrieval as well as quality assessment on the resources becomes therefore an important skill for the oral healthcare team, in particular for those involved in patients' instruction and education. The following text discusses some aspects of information search and retrieval in relation to the oral healthcare team. It is organized in three units:

(A) Generic Internet Search
(B) Search for the oral health professional and
(C) Quality assessment of Internet resources.

Generic Internet search – databases

Search portals

What is a search portal on the Internet?

A search portal is a web page specially designed to allow users conduct *keyword* or *categoric* searches of material on the World Wide Web. The search facility and the respective database reside on a server and they allow users to access all information through their web browser. Today, the most popular search portals rely on a search engine, a directory or a combination of both.

What is the difference between a directory and a search engine?

A directory is a human-made organization of information in different categories. The web pages appearing in directories are reviewed, selected and classified in groups according to their content, origin or other characteristics. A directory can be perceived as the principle of the Yellow Pages, transferred on the Internet environment.

On the contrary, a search engine relies on a fully automated process. Certain programmes called Webbots (from Robots!), webcrawlers or spiders search the Internet on a 24-h basis and register in databases all the material they find in the different pages. The process is fully automatic and the crawler will typically follow all links in a given web page. As the World Wide Web is just a network of hyperlinks, a crawler will soon be able to register practically all material that is freely available on the 'visible Web' (not password-protected pages, not content of databases). This way, when a user submits a keyword search to a search engine, the engine responds with a list of the web pages where the particular keyword was found by its web crawler, during its last visit.

So which is preferable, search engines or directories?

Well, it depends! Both ways have advantages and disadvantages. Directories present certainly a better possibility to find relevant information, as the web pages are picked and classified by humans. This way, when looking for information about Acquired Immuno-Deficiency Syndrome (AIDS) at http://www.yahoo.com, for example, one can follow the categories Health > Diseases and Conditions Index > HIV & AIDS. The information found under this category will be specifically related to AIDS. On the contrary, a search with the keyword 'AIDS' in a search engine will result in a large list of web pages which somehow include the word AIDS. Some of these pages will refer to the disease AIDS, but many will simply refer to hearing *aids*, the English verb *aids* or other irrelevant information. The information presented in directories is therefore much more specific, but that is done at the expense of 'sensitivity'. The amount of information currently on the Internet is such that no directory could possibly cover it and keep it updated. Therefore, the information presented in directories is only a small fraction of what is actually available on the Internet. Furthermore, as this information is selected and categorized by humans, the danger of a bias exists, favouring certain pieces of information over other. In general, a directory might be useful when you want to browse various web pages on a specific topic, but when the search of particular information or page is the aim, then a search engine could be a better option. The latest search engines have introduced sophisticated algorithms and filters for ordering the information, which brings their function closer to that of the directories.

Discussing an example of a search engine

Google is without doubt one of the most popular search portals today. It essentially combines most of the important features that define a search engine; therefore, we have chosen this as an example to discuss in this chapter. Many of the principles and tools found in Google are also available in other search engines.

How is Google structured?

Google is based on a powerful search engine called PageRank™. According to Google, the search engine is completely automated and search results returned are not influenced by man at any stage. The search engine finds all web pages connected to the selected keywords and automatically ranks them for the user.

What kind of information can I find in Google?

Google is a generic search portal, which means that it can access all kinds of material available on the Web. Special features in the search options can define if the search is for web

pages or specific type of documents, such as photos, Powerpoint presentations and text documents (see advanced search).

How does Google rank the search results in order?

The search engine evaluates a given page A according to the amount of 'links' that other pages have made to it. The more pages include links to page A, the higher 'importance' this page will acquire for Google classification system. Also Google analyses the pages that link to page A as well. Links which appear in pages that are themselves 'important' are of higher value for the calculation of the final calculation of the 'importance' of page A. This calculation of links together with the relevance (how much the particular page connects to the keywords) of the content, determine how high a page will be positioned in the search results.

Is this system a quality assurance mechanism?

No. This practically means that pages which are widely linked or popular (and consequently acknowledged) will appear before less popular pages. This does not examine the quality, reliability of nature of the page content. For example, a search with the keyword 'dentistry' will return http://dentistry.com (a commercial site) in the first place, much higher than, for example, the British Dental Association. That only reflects the facts that thousands of private practitioners and companies have included links to http://dentistry.com in their web pages. This search mechanism is not a quality assurance mechanism, but rather a transparent, well-defined way to filter and prioritize search results for the user.

Discussing an example of a directory

http://www.yahoo.com: initially started as a directory, this search portal today combines both a webcrawler (Yahoo search) and a directory (Yahoo Directory) service. The main portal gives the option to do a keyword search either in the search engine (web search) or in the directory content (directory search). The directory service is otherwise accessed at the URL: http://search.yahoo.com/dir.

How is material organized in the Yahoo directory

The directory has organized the material of the WWW in several main categories with many subcategories in each. So we see for example the Category 'Health' with more than 50 subcategories varying from 'Dental Health' to 'alternative medicine', 'law' and more. Following the category and subcategories will eventually link to a number of web pages with the respective content. These web pages are manually submitted or recommended through the free 'Submit your site' function of the portal. Then the pages are reviewed and listed by Yahoo staff. Sponsored results and sites are separated from the main search results into a special frame at the right. Although Yahoo claims to use objective criteria for classification and ranking of the sites, one cannot neglect the fact that this is a human-controlled process; therefore, by definition, liable to bias or error. On the other hand, this is still a good way to find some reasonable amount of relevant information, for someone who does not want to scan endless pages returned from a search engine.

Health science databases

(1) MEDLINE and PubMed

MEDLINE (freely available on the Web through PubMed) is without doubt the largest scientific database within health sciences and it has been established as a golden standard within evidence-based healthcare practice. MEDLINE was introduced electronically in the 1980s by the National Library of Medicine, USA (NLM). It is currently the premier bibliographic database covering the fields of medicine, nursing, dentistry, veterinary medicine, the healthcare system and the preclinical sciences. It contains bibliographic citations and author abstracts from more than 4800 biomedical journals published in the USA and 70 other countries. The database contains over 14 million citations dating back to the mid-1960s. Coverage is worldwide, but most records are from English-language sources or have English abstracts. An additional database is the OLDMEDLINE, which currently contains approximately two million citations to articles from 1950 to 1965. MEDLINE was initially accessible through CD-ROMs, but is currently available on the Internet through PubMed.

What is the difference between MEDLINE and PubMed?

Entrez/PubMed, is a web-based service developed under the auspices of the US National Institutes of Health (NIH). It is a text-based search and retrieval system used at NCBI for databases including MEDLINE, OLDMEDLINE, Nucleotide and Protein Sequence databases, Protein Structures, Complete Genomes and other life science journals that receive a qualitative review by NLM. In that sense, PubMed is not a database, but

a web-based interface that carries our searches in multiple databases, of which MEDLINE is the largest and most frequently used.

What kind of information can I find in PubMed?

PubMed mainly provides citation information to published articles, which means bibliographic reference and abstracts. Originally, one had to search himself for the original articles or with the help of a library. However, lately, an increasing number of journals allow full digital access to their articles for free or for a certain charge. When a full-text article is available, PubMed also provides a link to this.

A recent interesting development in this direction is the PubMed Central (PMC) (http://www.pubmedcentral.nih.gov/) introduced by NIH in 2000. PMC is a web-based search service similar to PubMed with the difference that it includes full-text scientific articles which are freely available in html or pdf format. The journals that contribute articles to PMC do so on a voluntary basis, but still have to fulfil certain publishing and editorial criteria and guarantee a peer review process. Most of the PMC journals are also cited in MEDLINE/PubMed. PMC currently contains over half a million articles, most of which have a corresponding entry in PubMed.

Is the information found in MEDLINE quality assured?

The great emphasis placed lately on evidence-based medicine and the establishment of MEDLINE/PubMed as standard electronic resource for research or treatments has led (or misled) many to believe that information retrieved from MEDLINE is of secured validity or accuracy. The truth is that MEDLINE has no quality control mechanisms of the reported research. MEDLINE has introduced certain filters, to secure that the journals enlisted fulfil certain requirements. These criteria describe the publishing process as well as the editorial process (peer review system, editorial board, etc.). Therefore, responsibility for validity relies solely with the authors and the journals publishing the article. One must always be critical; the fact that a study is appearing in MEDLINE does not guarantee a sound scientific methodology or the validity of the results.

How can I effectively access the information I need in PubMed?

Despite the amazing effort to structure and organize the available information, the amount of information and the rate of update is such that one need to develop search strategies to not get lost in a sea of articles. PubMed in principle is one such search portal and it can be approached as a *search engine* or a *directory*.

- The *search engine* approach is the most popular and it simply requires the submission of one or more keywords in the search space. Depending of the search strategy, these keywords can be pathological entities or structures, parts of the title or abstract, author names. The search engine will search full text including titles, abstract and fields such as authors and return matching results. As such a search is likely to produce many findings, it is usually important to limit down the results by using the fields in the 'limits' selections. This way one can, for example, limit the results to only 'randomized controlled trials', 'human' or 'animal' studies or articles published within a specific time frame. The use of the most common Booleans is also encouraged to refine the search. The *search engine* approach will most likely access a wide range of publications, but will be less specific often ending with too many results.
- The *directory approach* involves search through the MeSH database.

What is the MeSH database?

The MeSH (Medical Subject Headings) is a controlled taxonomy produced by the National Library of Medicine and used for indexing, cataloguing and searching for biomedical and health-related information. In this sense it is essentially a set of descriptors or keywords under which biomedical information could be classified. The first edition was prepared in the 1960s, used to organize published articles in the Index Medicus, a thick printed volume of sorted scientific references. Today these set of keywords is used to describe every article available in MEDLINE and is also used by many major scientific journals. Direct access to MeSH data is provided on the Web at http://www.nlm.nih.gov/mesh.

Is information found on PubMed suitable for patients' education?

Certainly not. The information accessed in PubMed is intended for the use of healthcare professionals with adequate training and experience in scientific methodology. The Internet era has of course opened up such databases to a wider public and access to information *per se* is never harmful. However, the way scientific data is presented in scientific journals and PubMed might be misleading for an untrained audience. An appropriate database to direct your patients would be the

MEDLINEPLUS (11), a service also created and supervised by the NLM. MEDLINEPLUS can be useful to healthcare professionals and patients alike and has extensive information on over 700 diseases and conditions. It also includes a medical encyclopaedia and a medical dictionary, extensive information on prescription and non-prescription drugs, health information from the media, and links to thousands of clinical trials. Similar services are available through public authorities in most European countries, such as the NHS Direct (12) in the UK, http://www.sundhed.dk (13) in Denmark and http://www.sjukvardsragivningen.se (14) in Sweden.

(2) The Cochrane database of systematic reviews (http://www.cochrane.org/)

What is the Cochrane Collaboration?

The Cochrane Collaboration was founded in 1993, named after the British epidemiologist, Archie Cochrane. It is operated as an independent, non-profit organization. Developed for promoting evidence-based medicine, the Cochrane Collaboration aims to produce up-to-date, scientifically sound information on healthcare interventions and provide them freely to healthcare practitioners worldwide. The major product of the Collaboration is the Cochrane Database of Systematic Reviews which is published quarterly as part of the Cochrane Library.

What kind of information is available in the Cochrane Library?

A large number of systematic reviews are available in many disciplines of heath care, including a significant amount of documents for Oral Health. Excessive abstracts are available for free in the library, which is searchable by topic as well as free search. However, the full articles are available under subscription for countries in the developed world. The review articles are sometimes also published fully or partly by peer reviewed journal and can then appear also in MEDLINE. However, most of the information is only accessible through the Cochrane Libraries.

Who produces the reviews?

The reviews are produced by healthcare professionals who volunteer to work in one of the many Cochrane Review Groups. Editorial teams oversee the process of the reviews and well-defined strict criteria and standards are applied in every step of the process.

Quality assurance – evaluation of information

One could roughly divide material from the Internet in two categories: evidence and other information. Evidence is the information coming from structured observations and research. Other information includes, for example, descriptions of products, materials and services as they originate from producers or users. Initially, evidence was accessible only in specific databases such as MEDLINE. Yet with the increasing expansion of search engines into scientific databases through special deals and with the spread of online journals there is, of late, a lot of scientific research content accessible through engines such as Google. This introduces great possibilities, but at the same time makes a quality assessment of information an imperative skill.

How do we evaluate research evidence?

The value of specific evidence is depending on the methodology of the research. Therefore, a meta-analysis based on the randomized controlled clinical trials has a better chance to reach valid conclusions than a single trial. A controlled trial on the other hand is more reliable than a case report. Another factor of assessing quality of research results is the process of dissemination. Research published on a peer-reviewed journal is the only accepted way to disseminate research results.

Do peer-reviewed journals guarantee the validity of research published?

No. The peer review system secures only that the information has been critically assessed from independent experts. In addition, different journals have different degrees of selectiveness. More prestigious journals might appear more selective and strict in what they choose to publish, enforcing stricter review process.

What about journals with high impact factor?

The impact factor is a system introduced by the Institute for Scientific Knowledge (ISI) as a means to classify research articles and scientific journals in terms of their usage by the scientific community. Selected journals from many scientific disciplines are included in a large database. In principle, ISI calculates every year how many times an original article has been cited in other scientific works. Articles that are cited frequently appear to be more used by the researchers. Consequently, journals that are cited more often acquire a higher

impact factor in this system. The actual impact factor of a journal is calculated by dividing the number of times this journal was cited in research articles in a given time by the number of articles this journal published in the same time. Therefore, a journal with an impact factor of two gets two citations, on average, for each article it publishes.

Does a high impact factor guarantee validity of the research published?

No. There is a tendency to use the impact factor as a means of judging quality of research, especially from people outside the academic world. The impact factor is a purely quantitative measurement, reflecting how often specific research is found and used by other researchers. The system relies on objective measurements, yet many factors other than the quality of research affect how easily a study is found and cited or not.

How about non-peer-reviewed information?

The majority of the information accessed through the Web is non-peer reviewed. In this field the ability to assess the quality of the information is even more critical. There is a series of questions one should always pose when evaluating such information:

- *Is the information signed and the author accessible?* Authors or sources should always provide their contact details and affiliations. Information not signed by a physical person or a consortium of authors should be considered with skepticism. On top of that, the author must provide verifiable contact details (e.g. e-mail address) where the readers can send comments, questions or objections.
- *Does the author have position or interests that can interfere with the information?* The authors must be presenting their conflicts of interest when relevant. The readers should be, for example, able to know if the author who writes about a medicine is partly or fully employed by a pharmaceutical company.
- *Is the information up-to-date?* A date of publication must always be available.
- *Is the information based on existing research or other controllable sources?* The author must be providing his resources in a way that the readers can verify.

Conclusions

Internet-based databases and search engines have already acquired a significant importance as sources of up-to-date healthcare information, for both healthcare professionals and patients. The oral healthcare team must be trained in search strategies and evaluation of Internet-based information services. In addition, healthcare professionals must be prepared to face misinformed patients and be able to direct them to reliable sources of quality-assured healthcare information.

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