



ORIGINAL ARTICLE

Search engine as a diagnostic tool in difficult immunological and allergologic cases: is Google useful?

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Google, search engine, difficult case, allergy, immunology.

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Abstract

Background: Web search engines are an important tool in communication and diffusion of knowledge. Among these, Google appears to be the most popular one: in August 2008, it accounted for 87% of all web searches in the UK, compared with Yahoo's 3.3%. Google's value as a diagnostic guide in general medicine was recently reported. The aim of this comparative cross-sectional study was to evaluate whether searching Google with disease-related terms was effective in the identification and diagnosis of complex immunological and allergic cases.

Methods: Forty-five case reports were randomly selected by an independent observer from peer-reviewed medical journals. Clinical data were presented separately to three investigators, blinded to the final diagnoses. Investigator A was a Consultant with an expert knowledge in Internal Medicine and Allergy (IM&A) and basic computing skills. Investigator B was a Registrar in IM&A. Investigator C was a Research Nurse. Both Investigators B and C were familiar with computers and search engines. For every clinical case presented, each investigator independently carried out an Internet search using Google to provide a final diagnosis. Their results were then compared with the published diagnoses.

Results: Correct diagnoses were provided in 30/45 (66%) cases, 39/45 (86%) cases, and in 29/45 (64%) cases by investigator A, B, and C, respectively. All of the three investigators achieved the correct diagnosis in 19 cases (42%), and all of them failed in two cases.

Conclusion: This Google-based search was useful to identify an appropriate diagnosis in complex immunological and allergic cases. Computing skills may help to get better results.

Introduction

The World Wide Web has become an important resource in communication and diffusion of knowledge. Approximately 20% of the world's population accesses the Web using Internet search engines to find information. The first search engines became available approximately 15 years ago; currently, they are indexing tens of billions of web

pages and serving hundreds of millions of web searches per day. Furthermore, the quality of search results shows an upward trend.^{1,2}

In daily practice physicians need to find solutions to the clinical problems they come across. Search engines enable them to gather multiple evidence promptly, saving time and obtaining up-to-date information.³ The vast majority of physicians using the Internet for clinical purposes access targeted sites; only 8% of them use a search engine.⁴

Among extensively used search engines, Google is the most popular one. According to a recent report, 73.13% of

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all web searches carried out in the UK during August 2008 were through www.google.co.uk; www.google.com accounted for 14.2%; uk.search.yahoo.com 3.37%, www.uk.ask.com 2.69% and others 6.61%.⁵ Tang and Kwoon recently showed that the use of web-based searching might help make the correct diagnosis in difficult clinical cases.⁶

During the last decades there have been substantial advances in the knowledge of allergic and immunological diseases; and this, paralleled by the availability of new therapeutic resources, has made the diagnosis and management of such conditions more complex.

Clinicians surf the Internet to retrieve clinically relevant and readily available information. A recent analysis from a specialized website showed that among 620 735 searches carried out in 1 year by physicians, the most frequently entered term was 'asthma', which accounted for just more than 1% of all search terms.³ We carried out this study to evaluate whether searching the Web by Google, using disease-related terms might improve diagnostic accuracy in complex immune and allergic diseases.

Methods

Forty-five clinical cases were selected, through a PubMed search, by an independent observer (case details listed in Table 1). Each corresponding diagnosis was entered into the PubMed search box and the first listed paper from a peer-reviewed journal was selected. Clinical data from each case were then transferred from the original paper to a word processing programme, modified to hide some details (including diagnosis, management plan and journal title) and subsequently printed on a plain sheet. Copies of those sheets were handed to each investigator (Fig. 1). Investigator A was a Consultant in Internal medicine and Allergy with basic computing skills. Investigator B was a Registrar in Internal medicine and Allergy. Investigator C was a Research Nurse. Both investigators B and C were familiar with the Internet and search engines.

The investigators were required to carry out an Internet search through Google. For each of the 45 clinical cases provided, each investigator was asked to select five terms (freely chosen from the text: symptoms, signs or

Table 1 List of the 45 clinical cases submitted to the three investigators

Disease group (WHO ICD-10)	WHO ICD-10 code and references	No. correct diagnoses			No. cases (total)
		Investigator A	Investigator B	Investigator C	
Systemic connective tissue disorders	M30.7; M30.1 ⁸ ; M30.1 ⁹ ; M30.1 ¹⁰ ; M30.3 ¹¹ ; M35.0 ¹²	5	4	4	6
Primary immunodeficiency diseases	D81.2 ¹³ ; D82.8 ¹⁴ ; D82 ¹⁵ ; D80.5 ¹⁶ ; D80.0 ¹⁷	3	4	3	5
Lung diseases due to external agents	J67.9 ¹⁸ ; J67.9 ¹⁹ ; J67.9 ²⁰ ; J67.9 ²¹	3	4	4	4
Inflammatory diseases of the nervous system	G03 ²² ; G04.0 ²³ ; G61.8 ²⁴	2	3	2	3
Chronic lower respiratory diseases	J44.8 ²⁵ ; J45 ²⁶ ; J44.8 ²⁷	1	2	2	3
Urticaria or erythema related with other diseases	L51.2 ²⁸ ; E85.0 ²⁹ ; T78.3; ³⁰	2	3	1	3
Disorders of red or white blood cells	D60.8 ³¹ ; D72.1 ³² ; D72.1 ³³	3	3	3	3
Malignant neoplasms	C46 ³⁴ ; C96.2 ³⁵	2	2	2	2
Diseases of vocal cords and larynx	D14.1 ³⁶ ; J38.3 ³⁷	2	2	0	2
Coagulation defects, purpura and other haemorrhagic conditions	D68.8 ³⁸ ; D69.0 ³⁹	1	2	2	2
Necrotizing vasculopathies	M31.4 ⁴⁰ ; M31.3 ⁴¹	1	1	1	2
Invasive mycoses	B44.8 ⁴² ; B39.0 ⁴³	2	2	0	2
Adverse effects, not elsewhere classified	T78.0 ⁴⁴	1	1	1	1
Disorders of adrenal gland	E27 ⁴⁵	1	1	1	1
Glomerular diseases	N07 ⁴⁶	1	1	1	1
Certain infectious and parasitic diseases (rickettsioses)	A79.8 ⁴⁷	0	1	1	1
Sarcoidosis	D86 ⁴⁸	0	1	0	1
Diseases of myoneural junction and muscle	G72.8 ⁴⁹	0	1	0	1
Fetus and newborn affected by other maternal conditions	P00.820 ⁵⁰	0	1	1	1
Malabsorption due to intolerance, not elsewhere classified	K90.4 ⁵¹	0	0	1	1

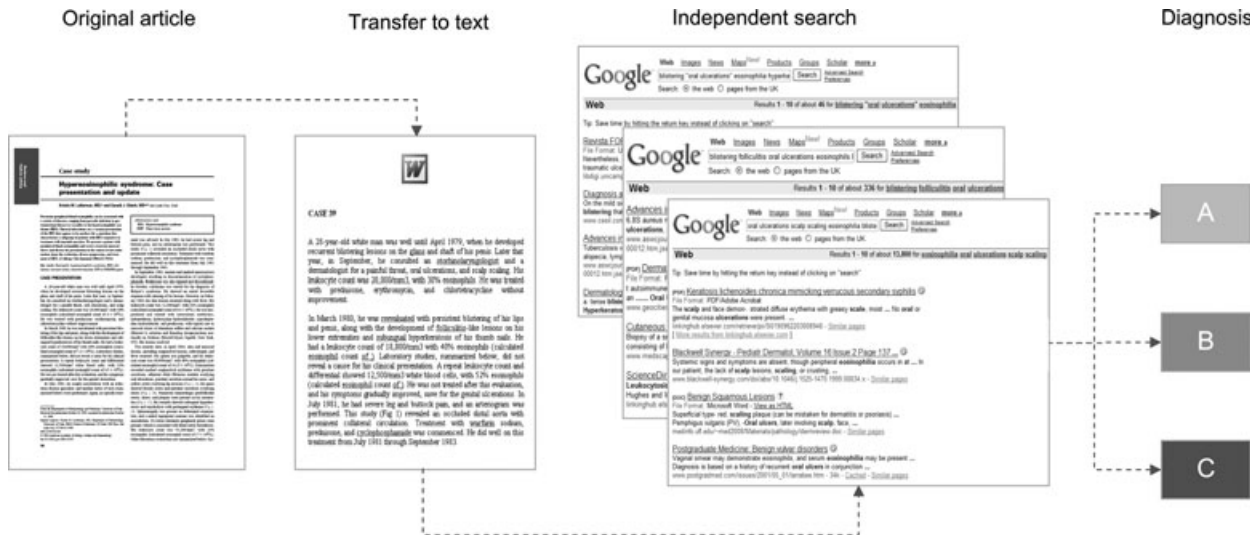


Figure 1 Steps leading to Google search. Step 1: original paper from a journal, selected by the independent observer. Step 2: transfer of clinical data on a plain sheet, hiding some details (see text). Step 3: Google search, carried out by the three investigators. Step 4: proposed diagnoses.

any other inherent feature) and enter them into the 'standard' Google search engine. For any given clinical case the investigators selected the diagnosis that more frequently appeared in the first three pages of Google's search results and eventually submitted their work to the independent observer.

The diagnoses made by each investigator were then compared, by the independent observer, with the correct ones reported in the original papers, and subsequently categorized, according to the World Health Organization International Classification of Diseases 10.⁵²

The main outcome measure of this study was the percentage of correctly obtained diagnoses achieved by each investigator.

Results

Searches were carried out independently by the three investigators in a 10-day period using personal computers connected to the Imperial College of London network.

The correct diagnosis was made in 30 of 45 (66.67%) cases by Investigator A, in 39 of 45 (86.67%) cases by investigator B and in 29 of 45 (64.44%) cases by Investigator C.

Details about the clinical cases and the number of correct diagnoses provided for each disease group by the three investigators are shown in Table 1.

In 19 cases (42.22%), all the three investigators made a correct diagnosis. None of them, however, made a correct diagnosis in the clinical case of pneumonitis in a patient affected by Wegener's granulomatosis and in the

clinical case of a patient affected by X-linked hyperimmunoglobulin M syndrome.¹⁶

Discussion

Research output published in journals is defined as primary literature. Systematic reviews with meta-analysis, critically appraised topics, reviews that use evidence-based medicine (EBM) methodology and synopses are considered secondary sources. Clinicians can obtain information from the Internet using primary or secondary sources. Accessing detailed information, available through these websites, generally requires a subscription.⁵³

Information can also be obtained by search engines like PubMed, Embase and others. PubMed is widely used: through it more than 70 million searches were carried out during 2005. Appealing features of PubMed are free availability, regular updating and the 'Clinical queries' option, which provides an easy approach to evidence-based searching within the Medline database. Nonetheless, Medline's successful use requires some skills. A possible initial data overabundance can be easily overcome by defining limits to the search.⁵⁴ Moreover, not all journals are included in the database and only 16% of papers are available in a free, full-text version.^{55,56}

Physicians approach the Internet, for clinical purposes, in different ways, as shown by a recent online survey that totalled 381 valid responses.⁴ Overall, this survey reported that most doctors access a targeted site; only 8% of them use a search engine (Google, Yahoo, Ask.com,

Altavista etc.); 32% also use secondary data sources (UpToDate 10.8%, Medscape 8.4%, WebMD 5.5%, MdConsult 4.7% and eMedicine 2.9%); 27.3% prefer using research databases to consult medical journals (PubMed 19.7%, Ovid 3.9% and Medline 3.7%); 3.1% use medical website portals like Merckmedicus; a minority among them use sites dedicated to their specialized area (2.9%).⁴

The use of search engines, as far as medical information is concerned, has already been assessed.^{57,58} Tang and Kwoon showed Google's usefulness in providing an accurate diagnosis in more than 50% of a series of medical case reports published by *The New England Journal of Medicine*.⁶

Clinical decision support programmes have been reported to be valuable aids in making the correct diagnosis in clinical cases of particular difficulty. However, there are still many limitations in the use of the Internet for medical purposes.

Despite the progress made in recent years, medical information is still scattered in the Internet. Moreover, a proportion of it is poorly organized, modified for profit, locked in commercial databases or hidden in the 'deep web'. Some of medicine's best evidence is inaccessible to most physicians except for the lucky few affiliated with universities or large medical centres. If this invisible information was made available it would probably contribute to better overall clinical decision-making.

Google will probably become a useful and widespread tool in the medical profession, having the advantages of easy and free use. Some possible operational limits in its use must, however, be taken into account.

First, more information could be achieved by using more appropriate search terms. In this study, investigators chose a combination of search terms they felt would be relevant and would provide the most specific result. Each investigator selected five search terms per clinical case, chosen among symptoms and signs. It is evident, and we recognize it as a drawback of our study that differences in the investigators' clinical experience and background may significantly affect the search results.

Second, as Google does not 'suggest' a diagnosis, these were arbitrarily selected from the first three pages of Google's search results, each containing 12 files, according to their overall correspondence to the case record. Google's usefulness in supporting the diagnostic process could be enhanced by clinically more adequate associations of symptoms and/or signs. Here, again, cultural and professional peculiarities of each investigator might prove crucial in determining the success (or the, at least partial, failure) of a search.

Other recognized biases of our study, aside from those related to the investigators' clinical experience and

background, are possibly attributable to the following variables:

1 *Internet skills*. Familiarity with either dedicated or lay literature retrieval systems could have influenced the search results. Any comparison between primary and secondary sources was not the purpose of our study, but the importance of the subject is very clear and will be addressed in future studies.

2 *Computer skills*. Even if differences could have been controlled by unique search-engine utilization, this aspect could be taken into account in future research, where more homogeneity among investigators could be one of the desired criteria. In future studies, preliminary basic computer skills of the investigators should be assessed. According to the study design, no instructions regarding the use of Boolean operators were given to the investigators to achieve results that represented current practice.

3 *Clinical scenarios*. General practitioners, registrars and consultants have different information needs in their practice to solve clinical problems; therefore, this could influence both the search approach and the search strategies.

Conclusions

Access to the Internet is becoming more readily available in outpatient clinics, ambulatory settings and hospital wards. The Internet use is rapidly becoming an important clinical tool for doctors. In allergy and immunology there are many rare and complex diseases/syndromes and the use of web-based searching may help doctors to identify a diagnosis for difficult cases. In the future, the Internet may reduce the use of traditional textbooks and the official medical journals that we have always considered fundamental and irreplaceable. Before this happens, further steps are vital to validate the benefit of these electronic tools. It will be necessary to test search engines with real-life cases, comparing traditional resource methods with the results from search engines. Future studies need to look at how the Internet resource is used by non-specialists.

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