Non-physicians may reach correct diagnoses by using Google: a pilot study

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Summary

Objective: We endeavoured to determine whether individuals who are not physicians are likely to arrive at correct diagnoses by using Internet resources.

Methods: In this prospective study four non-physicians used Google to search for diagnoses. They reviewed the 26 diagnostic cases presented in the case records of the *New England Journal of Medicine* during 2005; they were blind to the correct diagnoses. The main measurement was the percentage of correct diagnoses arrived at by non-physicians by using Google. The diagnostic success of the four non-physicians was compared to that of four young physicians.

Results: The average diagnostic success of non-physicians was 22.1% (95% confidence interval [CI] 4.5–39.7%). There was no statistically significant difference between the non-physicians regarding this outcome (*p* = 0.11).

They took 8.9 ± 6.7 (mean ± standard deviation) minutes for case record reading and 17.4 ± 7.9 minutes for Google searching per case. Non-physicians performed worse than physicians (50.9% [95% CI 37.4–64.5%]) in regard to diagnostic success (*p* <0.001).

Conclusion: Non-physicians, at least those who have similar characteristics to the participants in the present study, may occasionally reach correct diagnoses by performing a brief web-based search. Doctors should realise that patients may assume a more active role in their health decision-making process and take this development into consideration in physician-patient interaction.

Key words: world wide web; diagnostic test; sensitivity; public; differential diagnosis

Introduction

The advent and popularisation of the Internet are changing the way in which physicians search for and retrieve medical information [1]. Web-based engines are becoming a powerful tool in the hands of clinicians; thus, it has been suggested that doctors, especially those in training, should become proficient in their use [2]. In a recent study using one year's diagnostic cases presented in the case records of the *New England Journal of Medicine*, Google searches by physicians revealed the correct diagnosis in 15 (58%) out of the 26 cases examined [3]. The authors of the above study inferred that web-based searching may help physicians to diagnose difficult cases [3].

Internet is available not only for healthcare providers but also for healthcare users [4]. Surveys investigating the kind of topics that are assessed online showed that up to 80% of World Wide Web users have logged-in to assess health information, particularly regarding diet, drugs and experimental treatments [5]. Healthcare seekers are going online to gather information addressing a specific medical problem [6]. During this process it seems not unlikely that at least a small proportion of them will try to identify diagnostic possibilities by entering symptoms or signs as search key terms into an Internet search engine.

It has been postulated that a non-medical public conducting Web-based searches will be less effective in arriving at the correct diagnosis because of their inadequate knowledge base [3]. Hence in this study we investigated whether non-physicians are likely to arrive at correct diagnoses by exploiting Internet resources.

Methods

Four non-physicians (two males and two females) conducted the Internet searches. All of them were young (22–24 years old), experienced in using the Internet and without health-related problems. They were university undergraduate students (two in the field of applied mathematics and the other two in physics); none of them had studied medicine.

One of the authors (IIS) collected the 26 diagnostic cases presented in the case records of the *New England Journal of Medicine* during 2005; these cases were also used in the study by Tang and Ng [3]. Copies of each case record were made, without including the differential diagnosis and conclusion sections.

The four non-physician searchers independently read the presentations of the above 26 cases. Then they independently selected the search key terms they considered most appropriate for each case record. There was no limit on the number of search terms employed; use of a dictionary was allowed. The investigators independently entered the selected keywords into Google and read up to the first 30 results provided by the search engine. Making decisions on the appropriate keywords at once was not compulsory; the investigators were free to determine the set of keywords they regarded as most appropriate (i.e., the final set of keywords) after performing several trials. Reading websites derived from the Massachusetts General Hospital and the *New England Journal of Medicine* was not permitted. Three potential diagnoses (which seemed to fit the symptoms and signs) were identified for each case following this process, the total time of which (i.e., from starting to read the case record until selection of the three diagnostic possibilities) should not have exceeded one hour. The time required for reading and the time for the Web search were recorded.

The above process was repeated by physicians instead of non-physicians. In detail, four young (25–27 years old) physicians (two males and two females) independently read the same 26 cases and independently selected three potential diagnoses for each case.

One physician (IIS) compared the results of each study participant with the correct diagnoses as published in the case records. If one of the three diagnoses provided by the study participant was correct, her/his search was regarded as successful. The diagnostic success of the four non-physicians (i.e., the percentage of correct diagnoses they arrived at by using Google compared to the diagnoses as published in the medical journal) served as the primary outcome for this study. The diagnostic success of the non-physicians was then compared with that of the four physicians who also participated in the study.

Statistical analysis was performed using Statistica 6.0 (StatSoft Inc, Tulsa, OK, USA). Data were presented as means ± standard deviation. One way analysis of variance was used to determine the statistical significance of between-group differences. If statistical significance was revealed it was further examined by *post hoc* analysis (Tukey's modification). A p value below 0.05 was considered statistically significant.

Results

In table 1 we depict the correct diagnosis as published in the *New England Journal of Medicine*, the number of the case record evaluated by the study participants, and the time intervals required to read each case record and search Google. Detailed information on the diagnostic success in each case and for each study participant (either non-physician or physician) is also given in table 1.

The average diagnostic success of the non-physicians was 22.1% (95% confidence interval [CI] 4.5–39.7%). In detail, one non-physician found the correct diagnosis in 10 (38.5%) out of the 26 evaluated cases, while the remaining three non-physicians were correct in 4 (15.4%), in 4 (15.4%) and in 5 (19.2%) cases respectively. There was no statistically significant difference between the diagnostic success of the four non-physicians (p = 0.11). In contrast, there was a difference in diagnostic success between non-physicians and physicians (50.9% [95% CI 37.4–64.5%]) (p <0.001): non-physicians performed worse than physicians.

Non-physicians took 8.9 ± 6.7 minutes to read each case record and 17.4 ± 7.9 minutes to search Google per case. Non-physicians did not differ from physicians (8.9 ± 4.3 minutes) regarding the time required to read each case record (p = 0.92). However, non-physicians took more time than physicians (13.6 ± 8.5 minutes) to search the Web (p = 0.001).

Discussion

The main finding of the present study was that young, experienced Internet users without any special medical knowledge base arrived at correct diagnoses in one fifth of the cases evaluated, by performing a brief Web-based search.

It may be interesting to view the above finding in the context of the contribution by Tang and Ng [3], in which physicians reached the correct diagnosis in 58% of the same cases. Although comparison of our paper with that by Tang and Ng [3] may be limited by methodological differences between the two studies (i.e., differences in study participants' medical knowledge base), non-physicians apparently did worse than physicians. This is also confirmed by the direct comparison between non-physicians and physicians in our study.

Table 1

Time required and correct diagnoses arrived at by the Google users participating in the present study (non-physicians vs physicians).

Published diagnosis / Case record*	Time to read case record, minutes, mean ± SD	Time to search Web, minutes, mean ± SD	Diagnostic success**¥
Infective endocarditis / 5	10±4 vs 8±4	19±2 vs 19±9	No – No – No – No vs Yes – Yes – Yes – Yes
Linitis plastica with bowel obstruction / 6	13±12 vs 4±1	15±7 vs 9±5	No – No – No – No vs No – Yes – No – No
Cushing's syndrome secondary to adrenal adenoma / 7	8±8 vs 5±1	16±7 vs 11±6	No – No – No – No vs Yes – Yes – Yes – Yes
Osteoid osteoma / 8	8±8 vs 5±3	20±11 vs 10±1	No – No – No – No vs Yes – Yes – Yes – No
Hot tub lung secondary to *Mycobacterium avium* / 9	12±9 vs 8±3	18±11 vs 11±5	No – No – No – No vs No – No – No – No
Ehrlichiosis / 10	11±13 vs 6±2	16±7 vs 14±7	No – No – No – No vs Yes – No – No – No
Lymphoma / 12	13±15 vs 10±5	18±9 vs 9±8	No – Yes – No – No vs Yes – Yes – Yes – Yes
Neurofibromatosis type 1 / 13	15±10 vs 10±4	18±11 vs 11±8	Yes – No – No – No vs Yes – Yes – Yes – Yes
Vasculitis/ 14	10±8 vs 12±9	31±11 vs 14±10	Yes – No – No – No vs No – No – Yes – No
Amyloid light chain / 15	9±8 vs 11±6	24±13 vs 13±6	No – No – No – No vs Yes – Yes – Yes – No
Phaeochromocytoma / 16	8±2 vs 13±8	20±5 vs 16±12	Yes – No – No – No vs Yes – Yes – Yes – Yes
Acute chest syndrome / 17	10±7 vs 11±2	12±3 vs 18±9	Yes – No – No – No vs Yes – Yes – No – No
Endometriosis / 18	6±2 vs 6±2	15±7 vs 10±7	No – No – No – No vs No – Yes – No – No
Aspiration pneumonia, brain abscess / 19	7±2 vs 8±2	15±4 vs 13±6	No – No – No – No vs No – Yes – Yes – Yes
West Nile fever / 22	7±3 vs 10±4	17±6 vs 14±5	No – No – No – No vs No – No – No – No
Pyleophlebitis / 25	7±6 vs 9±2	11±4 vs 17±10	No – No – No – No vs No – No – No – Yes
Hypertrophic obstructive cardiomyopathy / 26	12±8 vs 7±2	12±4 vs 10±7	No – No – No – Yes vs Yes - No – No - Yes
Creutzfeldt-Jakob disease / 27	9±6 vs 12±6	23±8 vs 13±6	No – No – Yes – No vs Yes – No – Yes – No
Churg-Strauss syndrome / 28	7±1 vs 12±3	20±8 vs 16±10	Yes – No – No – No vs No – Yes – No – No
Dermatomyositis secondary to non-Hodgkin's lymphoma / 29	5±3 vs 10±1	19±5 vs 11±6	Yes – Yes – Yes – Yes vs Yes – Yes – Yes – No
Cat scratch disease / 30	9±6 vs 6±2	20±10 vs 11±9	Yes – Yes – Yes – No vs Yes – Yes – No – Yes
Cryoglobulinaemia / 31	8±6 vs 10±4	16±9 vs 12±7	No – No – No – No vs No – Yes – No – No
MADH4 mutation (Hereditary haemorrhagic telangiectasia plus juvenile polyposis) / 33	7±2 vs 10±4	13±9 vs 17±11	Yes – No – No – No vs Yes – No – No – Yes
Toxic epidermal necrolysis syndrome / 34	7±2 vs 13±5	13±5 vs 23±15	Yes – Yes – Yes – Yes vs No – Yes – Yes – Yes
Myoclonus epilepsy lactic acidosis strokelike syndrome / 36	7±3 vs 9±2	17±4 vs 23±18	No – No – No – Yes vs No – No – No – No
Brugada syndrome / 37	7±6 vs 8±3	17±6 vs 12±7	Yes – No – No – Yes vs No – No – No – No

Abbreviations: SD: standard deviation

* These are the published diagnoses of the 26 diagnostic cases presented in the case records of the *New England Journal of Medicine* during 2005.

** If one of the 3 diagnostic possibilities identified by the Google user through the Google search was similar to the published diagnosis, her/his search was regarded as successful.

¥ The diagnostic success for each case and for each of the eight Google users (four non-physicians vs four physicians) who participated in the study is presented.

Several methodological issues affecting our work should be mentioned. Firstly, our choice of Google rather than another popular search engine or even PubMed may be open to criticism. However, it is well known that during 2005 Google led more visitors to the many biomedical journal websites than did the other widely used search tools, such as Yahoo, Google Scholar and PubMed [1, 5]. In addition, studies noted that the non-medical public usually starts its quest for online health information with a general search engine rather than visiting a specific health portal and searching from there [6]. Secondly, the key words used by the non-medical participants as search terms were found during the reading of the case records; the fact that these records were written by specialists may strongly influence the selection of search terms and thereby the success of the search.

Thirdly, the non-physicians in our study presumably had searching skills far above average and were familiar with scientific language; this difference between our non-medical study participants and ordinary Internet users should be taken into consideration when interpreting our findings. Fourthly, it should be noted that a differential diagnosis encompassing three possibilities has a many times greater chance of hitting on the right diagnosis than a single shot. Fifthly, the data collected by the non-medical students' evaluation of the 26 case records were not adequate to investigate whether there is a field in medicine in which (compared to other medical fields) non-physicians are less or more likely to reach correct diagnoses using Google. Finally, it may be argued that people do not visit healthcare sites randomly or for entertainment, but only if they have health-related problems, and thus this study would be more to the purpose if conducted with real patients instead of healthy individuals. However, studies have established that the population of healthcare seekers also includes relatives taking care of a sick family member as well as generally healthy individuals with specific health risks or a specific health interest [6, 7]. Hence our current contribution also appears to be of value.

Interestingly, differences of diagnostic success, albeit statistically non-significant, were detected between the four non-physicians. Differences in Internet-"surfing" experience and capability, in comprehension of the numerous specialised medical terms included in the case records (the mother tongue of the investigator who performed better in identifying the correct diagnosis is English), and in familiarity with health sites may help to explain this finding. It is noteworthy that all the study participants agreed that the total time devoted to a case was greater in the initial cases and diminished as the project went on, as familiarity with the structure of presentations and of the health-related websites increased.

Implications for practice

Physicians increasingly encounter patients who bring Internet printouts to the medical office for discussion [4]. The findings of our study suggest that patients will also be likely to consult their doctor after arriving at a correct diagnosis through Internet search. Thus, our results further heighten the scepticism regarding the potential impact of wide availability of online health information on the physician-patient relationship [8]. Internet appears to alter the balance of knowledge power between practitioners and the public, allowing patients to assume a more active role in the healthcare decision process. However, we believe that few will dispute the need to provide patients with adequate medical information to educate, sensitise and prepare themselves before and after undergoing medical procedures. A physician's opinion remains the cornerstone of health decisions, because patients regard the Web merely as an additional source of health information not as a replacement for him [6]. Finally, the physician continues to be the main source of emotional support for patients diagnosed with severe diseases.

Thus, although the primary role of practitioners in health decisions appears to be beyond doubt for the present, doctors should realise that at least a subgroup of their patients might have a larger say or even a more active decision-making role in diagnosis, a development to be welcomed. Doctors who understand this will institute a higher-quality interaction with their patients and in this way strengthen their bond.

Conclusion

Non-physicians, at least these who have similar characteristics with those who participated in this study, may be able to reach the correct diagnosis by performing a brief Google-based search. Further research using a greater number of patients instead of healthy individuals seems to be warranted to expand the findings of this study as well as to examine whether the patients' potential to locate diagnostic possibilities through Web-based searching alters their relationship with their physician.

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