Effectiveness of the use of internet search by third year medical students to establish a clinical diagnosis

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ABSTRACT

Introduction: Internet search has been the main source for information and data mining in medical research. Its use by medical students has immensely contributed to learning activities. The main aim of the study was to determine the effectiveness of internet use by medical students during their initial years of clinical instruction in order to establish a diagnosis after being provided with the history and physical findings of a clinical problem.

Methods: A total of 47 cases derived from the New England Journal of Medicine (NEJM) were utilised. The Google search engine was utilised to establish a reasonable diagnosis.

Results: A congruency rate of 44.7% was obtained. This was considered commendable in view of the complexities of the cases published in the NEJM and the fact that the medical students were only in the third year of their Bachelor of Medicine and Bachelor of Surgery program.

Conclusion: The study illustrates that common search engines could complement the traditionally used medical education methods.

Keywords: congruency, Google search, medical diagnosis

Singapore Med J 2010;51(4):332-338

INTRODUCTION

The internet has become an integral part of daily life in information and data sourcing as well as in medical education. Both patients and care providers utilise several well-established sources to derive information and update themselves on information related to medical practice and care. Blended learning has become a common means of providing medical education, as distributed learning is currently in vogue in many medical schools, and media tools for teaching and learning are readily available across the internet.[1,2]

Medical students are encouraged to use the internet to assist them in teaching-learning activities, both in sourcing for information through self-directed learning and in performing tasks to enhance the learning processes. With the traditional curriculum, medical students who enter the third year of medical school would already have a grasp of the rudiments of the medical sciences during the 24–30 months of their pre-clinical years. The current method of integrated problem-based and task-based learning exposes medical students to clinical skills early in the education program. This equips the students with the necessary skills to understand and apply basic scientific knowledge to clinical problems.[1-3]

The International Medical University, Malaysia runs a spiralling outcome-based curriculum, with students completing the first phase of a five-year program in two-and-a-half years.[4,5] When students enter their third year, they consolidate the basic skills accrued by undergoing a rotation over the course of the next six months (in Semester 6), which consists of Internal Medicine, Surgery and Family Medicine. During their third year of study, students are expected to conduct a research project to complement their knowledge of developing a hypothesis, writing up a research proposal and showing elements of professionalism (working as a team, meeting timelines and being accountable) in the process of conducting the research during their Semesters 6 and 7 training. No dedicated time is assigned for conducting the research; both the supervisor and the students are expected to work on the project at any available time that is convenient to them.

Following the publication of the study by Tang et al[6] and based on the groups' experiences with the internet, it was agreed upon to use a similar methodology to conduct this study. The aim of this study was to determine the effectiveness of establishing a clinical diagnosis using internet searches, given that the students had a fundamental grasp of medicine at this stage in their training (first clinical year), when they were challenged with clinical scenarios or problems that require higher cognitive skills in analysis and problem-solving.[7,8]

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The specific aims of the study were to determine the reliability of using an internet search engine (www.google.com) to arrive at a correct diagnosis and if substantial medical knowledge and skills are required in order to fully appreciate the relevant research results to enable third year medical students to arrive at the most accurate diagnosis.

METHODS

The study was conducted from January 2008 to July 2008. It was based on the pioneering work if Tang et at in using Google as a diagnostic tool, given some clinical history and physical findings. In that study, the authors were successful at establishing a diagnosis of the cases they set out to search for through the Google search engine in 15 out of 27 cases (58.0%, confidence interval [CI] 38%–77%).[6] In this study, five medical students in Year 3 of the five-year MBBS program (first clinical year), who were in their sixth semester and who had been assigned to the lead author, were tasked to conduct the research. After some preliminary discussions on the development of the objectives and research hypothesis, the students were left to discuss the methodology among themselves. After a two-week period, they were recalled, and the hypothesis was fine-tuned and the methodology established with the assistance of the lead author.

The students were then divided into two groups: Group A, comprising one student and the lead author, and Group B, which included the remaining four students. The students were assigned to work in pairs so that they could complete their task within a reasonable amount of time without major disruptions to their own study time.

Convenient sampling method was used by the student from Group A, who downloaded all the case reports from the New England Journal of Medicine (NEJM). Out of 54 case reports, cases in which the diagnosis was apparent in the early part of the write-up or management were excluded after discussion with the lead author. 47 cases (out of the 54) were deemed to be suitable for internet search without consideration of the complexity of the presentation. The history and physical findings were then extracted for each case and printed out for Group B to conduct the internet search. Group A was tasked to read the complete cases (all 47 selected), and these were summarised and tabulated according to the definite diagnosis. Provisional diagnoses from prior investigations by the discussants were given due consideration and excluded (i.e. Cases 1, 3, 22, 26, 29, 40).

Group B was blinded to the source and the year of publication of the journal in order to eliminate bias. They did not have access to the differential diagnoses, definitive diagnoses (if applicable), investigations, pathology or necropsy findings and any other relevant information that may influence them to derive the clinical diagnosis without using the Google search engine.

As mentioned earlier, the Group B members, who worked in pairs to ensure teamwork and consultation, used their fundamental knowledge and clinical skills in Medicine (i.e. two-and-a-half years of pre-clinical exposure and approximately 3–4 months of first clinical year training). They analysed and evaluated each of the assigned cases (approximately 24 cases for each pair). The focus group discussion technique was used among the members of Group B (the sole student in Group A did not participate in this part of the study) to derive two to five search terms (keywords) from each of the case reports assigned. They were left to use their existing knowledge and clinical skills for this part of the study. With the keywords, the Google search engine was then used to obtain the best diagnosis and/or differential diagnosis that was deemed to be reasonably appropriate. The results were then categorised into C = correct, A = acceptable and R = rejected (Table I). Group B members were clearly instructed not to access advanced search engines such as PubMed and Embase, which may produce closer matches to the diagnosis.

At the end of the study, under the guidance of the lead author, both groups met to determine the degree of congruence (Table I) between the established diagnosis and that derived by the members of Group B. After initial matching of the results by the two groups, the acceptable congruency was further reviewed and revised by an independent academic expert in Internal Medicine, who evaluated the results and benchmarked them with those befitting medical students. The study design is shown in Fig.1.

Due to the complexity of the cases discussed in the NEJM and the discrepancies in the definitive diagnosis in some cases by the discussants of the medical journal, the lead author played an initial determining role in decision-making on congruency. Members of Group B classified the results under 'Diagnosis' and 'Differential Diagnosis' (Table I). However, only one diagnosis was provided in Cases 5, 7, 9, 17, 23, 36, 37, 42 and 44. For the purpose of obtaining a final assessment of congruence, the suggested diagnosis was classified as 'Correct', 'Acceptable' or 'Rejected'. If any of the diagnoses and/or differential diagnoses were assigned as 'Correct' or 'Acceptable', the final result was classified as 'Yes' for congruency, as it indicated that the students were close to approaching the diagnosis, thus indicating the ability

Table I. Congruence between established and derived diagnosis (n = 47).

NJEM actual diagnosis (Group A)	Google search (Group B)				Congruence
	Provisional diagnosis		Differential diagnosis		
1. Urticaria pigmentosa (before investigations); Acute myeloid leukaemia (after investigations)	Miliaria rubra	R	Allergic reaction to food	R	No
2. Multifocal motor neuropathy syndrome	Guillain-Barré	A	Poliomyelitis	R	Yes
3. Rheumatoid arthritis/Polymyagia Rheumatica (before investigations); Parvovirus-associated arthritis (after investigations)	Complicated rheumatoid arthritis	C	Systemic lupus erythematosus	A	Yes
4. Acute bacterial meningoencephalitis	Subdural haematoma	R	Intracerebral haemorrhage	R	No
5. Epidermotropic cytotoxic cutaneous lymphoma	Squamous cell carcinoma of the skin	R	NS	-	No
6. Acute cytomegalovirus	Schistosomiasis haematobium	R	Disseminated tuberculosis/ Chagas disease	R R	No
7. Bordetella pertussis infection	Subacute bacterial endocarditis	R	NS	-	No
8. Acute tubular necrosis	Yersinia enterocolitica septicaemia	R	Unstable angina	R	No
9. Hodgkin's lymphoma	Disseminated Mycobacteriosis	R	NS	-	No
10. Endovascular infection	Rheumatic fever	R	Myocardial infarction	R	No
11. Acute necrotising eosinophilic myocarditis	Infection with allergic reaction	R	Lymphoma	R	No
12. Mild acute cellular rejection; Pericardial amyloid deposition	Restrictive cardiomyopathy due to amyloidosis	A	Primary amyloidosis	A	Yes
13. Graft-associated endovascular infection	Myocardial abscess	A	Infective endocarditis	A	Yes
14. Left atrial cardiac myxoma with systemic embolisation	Left-sided coronary vascular accident	R	Metastases to brain	R	No
15. Respiratory bronchiolitis; adenocarcinoma of the distal stomach	Lung adenocarcinoma	A	Metastases from stomach cancer	A	Yes
16. Cutaneous Langerhans' cell histiocytosis	Erythema infectiosum by Parvovirus B19	R	Congenital rubella syndrome	R	No
17. Echinococcal cysts	Gastroesophageal reflux disease	R	NS	-	No
18. Subacute sclerosing panencephalitis	Wernicke-Korsakoff syndrome	R	*Streptococcus pneumoniae*	R	No
19. Systemic lupus erythematosus	Cytomegalovirus infection	R	Hodgkin's lymphoma	A	Yes
20. B-cell lymphoma	Autoimmune hepatitis	R	Bronchiolitis obliterans	R	No
21. Stillbirth due to congenital group B streptococcal infection	Stillbirth due to reinfection of tuberculosis	A	Stillbirth due to group B streptococcal infection	C	Yes
22. Deep vein thrombosis (before investigations); May-Thurner syndrome (after investigations)	Deep vein thrombosis	A	Lymphoedema	R	Yes
23. Severe microangiopathy	Multiple sclerosis	R	NS	-	No
24. Gastric cancer	Anxiety disorder	R	Irritable bowel syndrome	R	No
25. Scurvy	Haemarthrosis due to haemophilia	R	Thrombocytopenic purpura	R	No
26. Viral hepatitis (before investigations); Syphilitic hepatitis (after investigations)	Hepatitis B	A	Hepatitis C	A	Yes
27. Meningococcal arthritis; infectious mononucleosis	Dengue fever	R	SLE	R	No

28. Olfactory neuroblastoma	Growing skull fracture	R	Brain tumour	A	Yes
29. *Coccidioides immitis* (before investigations); bronchoesophageal fistula (after investigations)	Reactivation of tuberculosis	A	*Coccidioides immitis*	A	Yes
30. Relapsing polychondritis	Nasopharyngeal cancer	R	Nasopharyngeal infection	R	No
31. Recurrent, fulminant babesiosis in an asplenic patient	Relapsing babesiosis due to asplenia	C	Secondary Lyme disease	A	Yes
32. Status asthmaticus	Status asthmaticus	C	Acute exacerbation COPD	R	Yes
33. Blastomycosis dermatitidis	Bacteraemia (eg gonococcaemia)	R	NS	-	No
34. Lyme disease (neuroborreliosis)	Myasthenia gravis	R	Multiple sclerosis	R	No
35. Collapsing glomerulopathy	Multiple organ failure syndrome	R	Systemic sclerosis	R	No
36. Nocardiosis	Small cell lung carcinoma	R	NS	-	No
37. Atherosclerotic vascular disease with ischaemic ulcer on the heel and osteomyelitis	Atherosclerosis obliterans causing ischaemic ulcer	A	NS	-	Yes
38. *Helicobacter cinaedi* myopericarditis	Pericarditis	A	NS	-	Yes
39. Axonal neuropathy due to lymphoplasmacytic small-vessel vasculitis	Cutaneous vasculitis	C	NS	-	Yes
40. Sarcoidosis (before investigations); Lymphomatoid granulomatosis (after investigations)	Sarcoidosis manifestations	A	Mediastinal tumour	R	Yes
41. Paraneoplastic cerebellar degeneration	Multiple sclerosis	R	Gerstmann syndrome	R	No
42. *Coxiella burnetii* (Q fever) endocarditis	Libman-Sachs endocarditis	A	NS	-	Yes
43. Mixed germ-cell tumour	Testicular carcinoma	C	Spermatocoele	R	Yes
44. Whipple's disease	Whipple's disease	C	NS	-	Yes
45. Multiple vitamin K-dependent coagulation-factor	Haemophilia	R	Cervical paragangliomas	R	No
46. Idiopathic pulmonary haemosiderosis	Gastroesophageal reflux	R	Congenital lung anomalies	R	No
47. Good's syndrome	Lung carcinoma secondary to thymoma	A	Bronchiectasis	A	Yes

Total congruence: 21; Total non-congruence: 26; % of congruence: 44.7%; Confidence interval: 29.7%–59.7%
C: correct diagnosis; A: accepted; R: rejected; NS: not submitted; SLE: systemic lupus erythematosus; COPD: chronic obstructive pulmonary disease

to apply their knowledge of clinical manifestation and reasoning capability to complicated clinical cases. If the diagnosis was rejected, it was classified as 'No' for congruence. A second review of the results of congruency was conducted by a consultant physician before the percentage of congruence was established. A final analysis was done to determine the percentage of congruency.

Timeliness and the degree of enthusiasm and teamwork observed in students as well as adherence to the work schedule drawn up by the students were subjectively evaluated by the lead author at regular discussions. The study was approved by the Research and Ethics Committee of the University.

RESULTS

The study was conducted over a six-month period from January 2008 to July 2008. Out of 54 case reports published in the NEJM in the year 2007, seven cases were excluded because the diagnosis was apparent in the history and physical findings portions of the case report.

Table I shows the summary of results derived by both Group A and B. Congruence between the two groups is shown as 'Yes' or 'No'. 21 out of 47 cases (44.7%, CI 29.7%–59.7%) were accepted as 'Congruent' and the remaining as 'Incongruent' after the final review by the independent consultant physician. None of the cases were unclassified.

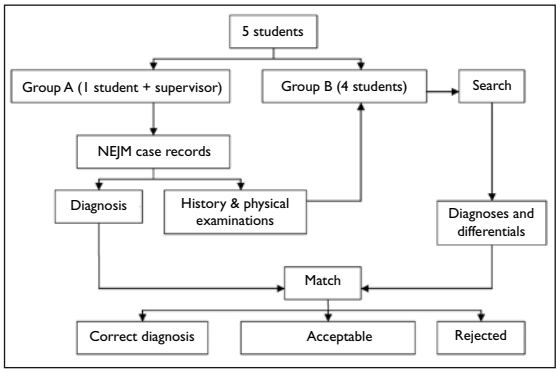

Fig. 1 Study design for internet search.

DISCUSSION

The internet has had an immense impact on the lives of individuals, and it has clearly become a useful and effective tool for sending and deriving information. Seeking health information through various online sources has contributed to patients and clients being better informed, and seeking out second opinions for medical treatment is not uncommon. The general public desires a simple approach of entering a few symptoms they experience to obtaining a diagnosis with a single click. However, such an approach using current methods of internet searches may best be applicable for a single symptom or sign, and yet result in a medical diagnosis that may not be accurate.[9] Some clinical knowledge or training could improve the probability of obtaining an accurate diagnosis, as it would facilitate the analysing and prioritising of clinical problems before applying search engines. Fundamental knowledge of basic medical science and clinical instructions are essential for the useful application of such searches.

The International Medical University has made tremendous advances in utilising information technology and teaching-learning resources in its delivery of the spiralling medical curriculum.[4,5] The computer-aided laboratories are an integral part of the learning process during the pre-clinical years, and this early exposure has helped students feel comfortable with using search engines for enhancing learning in the clinical years. The clinical skills unit in the university adopts learning methods for developing the correct approach to clinical examination, and early exposure to clinical practice has been in vogue in the university since its inception.

This study was conducted as part of the research methodology that students are expected to learn during their first clinical year. Although the participants in this study were apprehensive about advanced searches in medicine due to their level of knowledge and skills at their stage of the MBBS program, they became more comfortable when it was agreed that a Google search would be used as it would be by the layman. The ordinary client is now better informed due to media and access to information. In a paediatric orthopaedic outpatient survey conducted in the United Kingdom, 84% of the respondents had access to the internet and 71% were aware of the internet as a source of information.[12] However, medical students are probably better placed to conduct internet searches, as they can check the reliability of facts obtained from the internet because of their exposure to the fundamental medical sciences and clinical skills.

This study derived a congruency rate with a correct diagnosis of 44.7%. This compares favourably with the study conducted by Tang et al (58%, CI 38%–77%), who had a sample size of 26 cases.[6] The sample size used in the present study was larger (47 cases). Overall, the results highlighted several learning points. Blinding students to the actual diagnosis by only presenting them with the history and physical findings compels them to use their basic skills to derive a diagnosis, which indicates a higher level of cognitive skills.[10] Where it was difficult to understand the case assigned in view of complexity, the students were able to utilise the focus group discussions to improve the probability of demonstrating not only their knowledge and clinical skills, but also elements of softer skills that have been less often examined in the education process, such as teamwork, meeting timelines and appropriate time management. This was well illustrated in our study groups, as the students were going through a stressful change in adapting to the first clinical year of study in a new environment in a Seremban hospital, 60 km from their pre-clinical campus in Kuala Lumpur. They had adhered to the timelines agreed upon and completed the study well within the scheduled time. Although no attempts were made to evaluate the softer skills of the students such as the level of scholarship and teamwork, these were indirectly evaluated based on the work progress and work output.

The level of congruence of 44.7% in this study is lower than that demonstrated by Tang et al.[6] Group B found the initial period of organisation and the search process exceedingly difficult, as they found the case reports from the NEJM complex and unfamiliar. However, the innovative teaching methods used in the university, especially problem-based and task-based learning using clinical triggers, had equipped the students to analyse the presenting problems and assisted them in developing a diagnosis. Farmer et al has published a practical guide that utilised key features for clinical decision-making using single clinical problems to initiate discussion.[13]

Although students in the study group had used problem-based learning during their pre-clinical years,

the case reports in NEJM, which contained several complications arising from, or co-existing with the primary disease, were found to be formidable. The students' enthusiasm had to be sustained by regular encouragement, as all five students had only completed less than six months of formal clinical training, and the case reports derived from the NEJM were often complex in nature with multiple issues in each case, often masking the underlying disease. This complexity is further demonstrated by the differing views among the discussants who had been invited by the NEJM editorial board. Another factor that disadvantaged the students of group B was the nature of disease.[16] As all the disease states were derived from American patients (e.g. Schistosomiasis, case 15 and Q-fever, case 42), the disease patterns were largely different from those occurring in the local population. Hence, many of the students had not seen or heard of such disorders during their formative years in Malaysia. Perhaps using local scenarios would have produced higher congruence rates. In view of these considerations, the lead author suggested that any diagnosis close to the established diagnosis (as in NEJM), whether a diagnosis or a differential diagnosis, was assigned to being congruent. This lower level of acceptance was to pitch the level of understanding and analysis of such complex cases at the standard of medical students. The expert in Internal Medicine who assigned the final grade agreed to this as well. This final review process resulted in the reassignment of seven cases to the 'No' category, resulting in the final acceptance of 21 out of the 47 cases. This approach was different from the method used by Tang et al[6] (both researchers were consultant physicians who were directly involved in the search). The easier approach of utilising clinical cases from the local population with one or two complications would not have been able to meet the objectives of the study, as the purpose was to determine how common search engines could complement the derivation of a diagnosis early in medical education.

The pioneering paper 'Googling for a diagnosis' has been pivotal in considering the possibility of using common search engines to derive a diagnosis, although there are severe limitations involved in using them for clinical practice.[6] Our third year MBBS students were able to obtain a reasonable success rate (44.7%) using basic tools in Google, in spite of a lack of substantial knowledge of medicine and the stress involved in adapting to their new clinical environment. The students demonstrated effective skills in using the internet to obtain a correct diagnosis in more than 40% of the cases. This exercise would perhaps assist them, to some extent, in overcoming diagnostic difficulties in their subsequent clinical practice. With greater emphasis being placed on evidence-based medicine and the need to be well-versed in the use of advanced internet searches to seek good evidence, a change in practice is expected to occur, and this study is indeed encouraging in this regard. It has created awareness and would perhaps play a permissive role for independent learning. The students were left to their capabilities to read, understand and derive search terms, without input from the senior authors. The ability to work through focus group discussions and derive search terms was, at best, a good learning experience through effective teamwork, which is an intangible yet vital aspect of professionalism that the senior author was interested in assessing.

One must be cognizant of Gardner's argument that computer systems targeted at medical diagnosis in the past 50 years have had relatively little impact on clinical practice.[9] Medical students will continue to harness more advanced internet search engines, especially with the development of semantic webs, to assist in medical practice, although the clinching of a diagnosis, especially in complex cases, will require clinical reasoning and integrative skills. The limitations of this study in lowering the acceptance of the diagnosis for congruence have been highlighted. The complexity of the cases used influenced the final result to some extent.

In conclusion, while the web search engine cannot replace the basic tenets of the clinical approach to diagnosis and management, especially in complex cases, it could have some value for medical students during their initial years of training, as one of the many resources to assist in the learning process.

ACKNOWLEDGEMENT

The project was funded by the University Research and Ethical Committee of the International Medical University (Grant IMU 167/08).

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