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REVIEW

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Info-pollution: a word of caution for the neurosurgical community

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Abstract

The medical-patient relationship is facing pollution of information all over the internet, for physician and patients is becoming tougher to keep updated with the highest quality of information. During the last 20 years multiple evaluation tools have been developed trying to find the best tool to assess high-quality information, to date DISCERN tool represents the most widely spread. Information can be found on the surface internet and in the deep web, constituting the biggest chunk of the internet, informing and controlling the quality of information is a formidable task. PubMed and Google Scholar are the most important tools for a physician to find information, although multiple others are available; awareness must be raised over improving current strategies for data mining high-quality information for the patients and the healthcare community.

Keywords: PubMed, Google Scholar, Medical information

Background

Providing a piece of adequate and correct information to patients is a fundamental practice in medicine and neurosurgery. Among the sources of information used by patients are asking the acquaintances, relatives and health workers. With the advent of new technologies, patients are increasingly exposed to thousands of web pages evidence by the increase in web with more than 3.8 billion users as of 2017 [1], this issue has already been of concern as a new consumer health informatics framework [2] and particularly in neurosurgery and general medicine [3–7].

Atci et al. [8] report that 66% of the patients who underwent lumbar disk surgery had searched internet for related information on the lumbar spine surgeries; in the same study; the group that carried out more search on their condition were university graduates (100%), while secondary school graduates (88.2%) and primary school was (18.7%). When it comes to medical information, patients mostly use patient information leaflets, followed by doctors, pharmacists, television, newspapers, magazines, drug advertisements, nurses, and the internet [9].

The Internet contains a lot of inaccurate information [5, 10–16], it is widespread, easy to use and offers a load of information, Google being the most popular search engine focuses in the amount of information, rather than in the quality of information. The quality of information is rather assessed by scientific journals; each one of them is directed to a specific community, scientists, and clinicians, in the matter of basic science research, translational research or clinical practice. Web blogs are also available without any kind of quality regulations, all this due to globalization and free speech we joy nowadays, although powerful, this leads to the question, How to manage all this information and digested into what we practice? Subtracting high-quality information is a delicate process for professionals and not an easy one for patients.

Multiple sources of information are available and many ways to assess the quality of information are already standardized, we present an overview into what

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information pollution represents and what can we do about it to develop better research and clinical care. In that way, we shed light on the wrong concepts as well as information that may mislead our patients and their legal guardians.

Available tools to discern the quality of information

DISCERN tool

Nuffield Department of Population Health in Oxford University in 2004 in the UK funded by National Health Service developed DISCERN, a tool designed to help individual consumers about treatment choices, health information providers, authors and producers of written health information and a training tool for health professionals to judge the quality of health information [17]. DISCERN was originally developed by asking an expert panel to analyze consumer health information about treatment options in myocardial infarction, endometriosis, and chronic fatigue syndrome and after a pilot study with their drafted instrument using a national sample was performed. This tool covers a wide range of the population from patients to researchers, by applying a brief questionnaire made of 16 questions classified into three sections, using a Likert scale.

Since it was created, multiple articles have been published on the matter of assessment of the quality of information by using DISCERN tool in regard to vestibular schwannoma [18], pituitary adenoma [19], vagus nerve stimulation [20], perianal surgery for Chron's fistula [21], swallowing disorders [22], radiological related information [23], renal diet information [24], patient information [25], maxillofacial trauma [26], sickle cell disease [27], male infertility [28], Human Immunodeficiency Virus [29], ontological information [30], chest pain [31], craniosynostosis [32], heart failure [33], robotic prostatectomy [34], breast cancer [35–37], thumb sucking habit [38], prostate cancer [39, 40], cochlear implantation [41], Down syndrome screening [42], congenital heart defects [43], pelvic organ prolapse [44], childhood epilepsy [45], autism [46], bariatric surgery [47], diabetes mellitus [48, 49], clubfoot [50], attention-deficit/hyperactivity disorder (ADHD) [49], idiopathic scoliosis [51], chronic pain [52, 53], colorectal cancer [54], metabolic syndrome [55], cervical spine surgery [56], osteosarcoma [57], dengue [58], chemotherapy [59], aromatase inhibitors [60], alcohol dependence [61], juvenile idiopathic arthritis [62], head and neck oncology [63], neuro-oncology [4, 64, 65], familial adenomatous polyposis [66], obsessive convulsive disorder [67], osteoarthritis [68]. As evident very few have been evaluated in the Neurosurgery related areas. See Table 1.

JAMA benchmark criteria

The JAMA benchmark criteria were developed in 1977 to aid in the discrimination of information on the internet [7, 69], more specifically for the American Medical Association (AMA) websites and visitors to these sites, but these criteria can be used for other providers. These criteria have been used for otitis media [70], breast cancer [71], overactive bladder [72], preoperative fasting information [73], scaphoid fractures [74], oral leukoplakia [75], adult kidney cancer [76], robotic prostatectomy [34], prostate cancer [39], gynecologic cancer [77], discectomy [78], rotator cuff tears [79], head and neck cancer [80], oral ulcers [81], Perthes disease [82], temporomandibular disorders [83], hydrocele [84], scoliosis [85], post-herpetic neuralgia [86], among other disorders.

Health on the Net (HONcode)

Health on the Net Foundation located in Geneva, Switzerland, is the oldest code for medical and health information on the Internet, used by 7300 certified websites and more than 10 million pages in 102 countries, it is a not-for-profit organization, funded by the Geneva Ministry of Health and the State of Geneva launched in 1996 [16, 87], targeting the general public, the health professionals, and the web publisher, by actively involving the site owner in the process of certification, it defines a set of rules only intended to hold Web site developers to basic ethical standards in the presentation of information and help make sure readers always know the source and the purpose of the data they are reading.

This certification is accomplished by the following eight principles: giving qualifications of authors, information is for support not replacement, sources and dates are cited, justification of claims, providing contact details, financial disclosure, and clearly distinguishing advertising from editorial content.

Other initiatives

Most other initiatives have been intended as a code of conduct, the three formerly mentioned are the most widely used for evaluation of quality of information on the internet, while a lot of initiatives like: eHealth Code of Ethics, Health Internet Ethics (Hi-Ethics), URAC Health Web Site Accreditation Program, MedPICS Certification and Rating of Trustworthy and Assessed Health Information on the Net (MedCERTAIN), TNO Quality Medical Information and Communication (QMIC), EC (European Community) Quality Criteria for Health-related Websites, Organizing Medical Networked Information (OMNI), British Healthcare Internet Association (BHIA): Quality Standards for Medical Publishing on the Web, The Health Summit Working Group-Criteria for

Table 1 Neurosurgery related-evaluated websites

Tool	Subject	Findings	Author
DISCERN	Vestibular schwanoma	Highly variable in quality Information written at a difficult level	[18]
DISCERN and Ensuring Quality Information for Patients tool	Pituitary adenoma	Highly variable in quality Correlation between different assessors was poor different in how healthcare professionals and patients view healthcare information	[19]
DISCERN	Vagus Nerve Stimulation	Highly variable in quality-Fair to border line quality	[20]
DISCERN	Craniosynostosis	Top quality information available but not appearing of an internet search	[32]
DISCERN, accessibility and comprehensibility	Cervical spine surgery	Mostly low quality High quality were affiliated with a professional society	[56]
DISCERN	Pediatric neuro-oncology	Web sites were found deficient in topics covering etiology, late effects, prognosis, and treatment choices	[4]
DISCERN	Pediatric neuro-oncology	Most sites rated from poor to very poor Difficult readability	[65]
DISCERN	Pediatric neuro-oncology	Time-consuming Few French speaking website	[64]
DISCERN, JAMA Benchmark, Discectomy-specific content score	Discectomy	Poor and variable 20–30% good quality compared to 2005	[78]
DISCERN, JAMA Benchmark, Discectomy-specific content score	Scoliosis	Significant differences noted between the DISCERN score, JAMA benchmark criteria, and scoliosis-specific content quality score	[85]
HON code	Low back pain	Average quality was satisfactory	[99]
Rating as "excellent," "high," "moderate," "low," or "unacceptable"	Vertebroplasty	Inadequate information Misleading information HON code could not be used	[100]

Assessing the Quality of Health Information on the Internet: IQ Tool (HSWG IQ Tool), The International Federation of Pharmaceutical Manufacturers Associations (IFPMA) Code of Marketing have been founded, none is extensively used, discectomy-specific content score [78, 88]

Information load

A limitation for a successful choice of information is that anyone can create a website and post information that the website owner believes is relevant and no regulations are available to keep track of information quality. It is probably a herculean task to try to count every single non-scientific article published in a neurosurgery related area. We will spread our analysis in two: Surface web and deep web.

Surface web

The surface web is the part of the internet we can easily search with common metadata engines, it is also called the indexed web and contains at least 4.5 billion pages as of November 2017 [89], as estimated by Van Den Bosch at al. methods [90], through a 9-year longitudinal study based on what is indexed in Google and Bing.

Deep web

Since it is impossible to index every single content on the web into a search engine it leaves us with an important amount of information that is not easily available except for people with experience in navigating through non-conventional ways. Very few research is written in this context, Bergman in 2001 revealed that public information on the deep Web was 400–550 times larger than World Wide Web (WWW), with 7500 terabytes of information compared to 19 terabytes on the surface Web with quality content 1000–2000 greater [91]. Explaining how to use the deep web would require a completely different article due to the extent of tools involved, therefore we are concentrating on the surface web [92].

Web tools in the surface web

Medical trainees use multiple medical resources to fasten their learning, frequently used for clinical decision and medication queries. A study published by Egle et al. found that when entering a set of clinical queries into these resources, the highest percentage of correct answers were found in Up-to-date and Epocrates with Google having the lowest percentage of wrong answers.

PubMed

The amount of index articles is growing unprecedentedly, during the last years at a double-exponential pace. Each year there is an increase of ~3.1 new entries in MEDLINE [93], with 26,759,399 citations found up to November 2017 including data from Index Medicus with citations since 1946. Pubmed is a comprehensive, up-to-date and open-access search engine, but finding a relevant citation to our personal needs is becoming more and more challenging due to the increase in the literature. PubMed has developed throughout the year's search strategies that empower users to get the most accurate information based on their queries, in 2009, when 8 million fewer citations were available, one-third of queries returned from 1 to 20 citations and 6% were > 10,000 citations [94].

Google Scholar

Google Scholar is growing at an impressive rate and nowadays it could be probably the most important option when looking for information somewhere besides PubMed [95, 96], when contrasted with PubMed, they both use Boolean terms, search limits, spell checking for search terms, linking to institutions, citation managing, track the number of times articles are cited by other publications, email alerts for prespecified searches and allow users to view related articles. Google Scholar does have the advantage of when searching, it automatically searches for the full-text of the publication, but does not have search filters, truncation, controlled vocabulary or search history storing [97]. Google Scholar does provide access to free-full test articles to a higher extent than PubMed and this is especially relevant for a physician who works independently and does not have access to institutions that pay the fees to grant access to these articles, limiting the usability of information and consequent research mainly in developing countries.

Other tools

Additional 28 tools are comparable to the PubMed system as published by Lu [98]. RefMed, Quertle, MedLineRanker, MiSearch, Hakia, SemanticMEDLINE, MScanner, eTBLAST, PubFocus, Twease, Anne O' Tate, McSyBi, GoPubMed, ClusterMed, XplorMed, MedEvi, EBIMED, CiteXplore, MEDIE, PubNet, PubMed, PubGet, BabelMeSH, HubMed, askMEDLINE, SLIM, PICO and PubCrawler with novel proposals for searching, results analysis and interface/usability.

Limitation

Given the review nature of our article, there is missing comparison between the different common internet and other search tools including progress all over the years, rules, degree of accuracy, and percentage of inaccurate information. We are planning to conduct primary research to include such data.

Conclusion

Finally, the info-pollution is here and it comes to stay. Neurosurgeons should be alert to the fact that disinformation is affecting the doctor–patient relationship and our efforts must be doubled to ensure that our patients receive the maximum reasonable information about their illness. Neurosurgeons must inform their patients in detail everything about their illness including surgical approaches, results, complications and prognosis in accordance to law, ethics, and patients' rights.

We must keep in constant evolution in the way we obtain our information.

Abbreviations

BHIA: British Healthcare Internet Association; Hi-Ethics: Health Internet Ethics; IFPMA: International Federation of Pharmaceutical Manufacturers Associations; MedCERTAIN: Certification and Rating of Trustworthy and Assessed Health Information on the Net; OMNI: Organizing Medical Networked Information; QMIC: Quality Medical Information and Communication; WWW: World Wide Web.

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Competing interests

The authors declare that they have no competing interests.

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References

1. Internet World Stats. World Internet Users Statistics and 2017 World Population Stats n.d. http://www.internetworldstats.com/stats.htm. Accessed 23 Nov 2017
2. Reid P, Borycki EM. Emergence of a new consumer health informatics framework: introducing the healthcare organization. Stud Health Technol Inform. 2011;164:353–7.
3. Eysenbach G, Diepgen TL. Patients looking for information on the Internet and seeking teleadvice: motivation, expectations, and misconceptions as expressed in e-mails sent to physicians. Arch Dermatol. 1999;135:151–6.
4. Hargrave DR, Hargrave UA, Bouffet E. Quality of health information on the Internet in pediatric neuro-oncology. Neuro Oncol. 2006;8:175–82. https://doi.org/10.1215/15228517-2005-008.
5. Jadad AR, Gagliardi A. Rating health information on the Internet: navigating to knowledge or to Babel? JAMA. 1998;279:611–4.
6. Diaz JA, Griffith RA, Ng JJ, Reinert SE, Friedmann PD, Moulton AW. Patients' use of the Internet for medical information. J Gen Intern Med. 2002;17:180–5. https://doi.org/10.1046/J.1525-1497.2002.10603.X.
7. Silberg WM, Lundberg GD, Musacchio RA. Assessing, controlling, and assuring the quality of medical information on the Internet: Caveant lector et viewor—let the reader and viewer beware. JAMA. 1997;277:1244–5.
8. Atci IB, Yilmaz H, Kocaman U, Samanci MY. An evaluation of internet use by neurosurgery patients prior to lumbar disc surgery and of information available on internet. Clin Neurol Neurosurg. 2017;158:56–9. https://doi.org/10.1016/j.clineuro.2017.04.019.
9. Närhi U. Sources of medicine information and their reliability evaluated by medicine users. Pharm World Sci. 2007;29:688–94. https://doi.org/10.1007/s11096-007-9131-1.
10. Akuoko CP. Quality of breast cancer information on the internet by African Organizations: an appraisal. Int J Breast Cancer. 2017;2017:2026979. https://doi.org/10.1155/2017/2026979.
11. Meric F, Bernstam EV, Mirza NQ, Hunt KK, Ames FC, Ross MI, et al. Breast cancer on the world wide web: cross sectional survey of quality of information and popularity of websites. BMJ. 2002;324:577–81.
12. Kuenzel U, Monga Sindeu T, Schroth S, Huebner J, Herth N. Evaluation of the quality of online information for patients with rare cancers: thyroid cancer. J Cancer Educ. 2017. https://doi.org/10.1007/s13187-017-1173-z.
13. Berg GM, Hervey AM, Atterbury D, Cook R, Mosley M, Grundmeyer R, et al. Evaluating the quality of online information about concussions. J Am Acad Physician Assist. 2014;27:1–8. https://doi.org/10.1097/01.JAA.0000442712.05009.b1.
14. Gray NJ, Klein JD. Adolescents and the Internet: health and sexuality information. Curr Opin Obstet Gynecol. 2006;18:519–24. https://doi.org/10.1097/01.gco.0000242954.32867.76.
15. Laversin S, Baujard V, Gaudinat A, Simonet M-A, Boyer C. Improving the transparency of health information found on the internet through the honcode: a comparative study. Stud Health Technol Inform. 2011;169:654–8.
16. Boyer C, Baujard V, Geissbuhler A. Evolution of health web certification through the HONcode experience. Stud Health Technol Inform. 2011;169:53–7.
17. Charnock D, Shepperd S. Learning to DISCERN online: applying an appraisal tool to health websites in a workshop setting. Health Educ Res. 2004;19:440–6. https://doi.org/10.1093/her/cyg046.
18. Spiers H, Amin N, Lakhani R, Martin AJ, Patel PM. Assessing readability and reliability of online patient information regarding vestibular schwannoma. Otol Neurotol. 2017;38:e470–5. https://doi.org/10.1097/MAO.0000000000001565.
19. Druce I, Williams C, Baggoo C, Keely E, Malcolm J. A comparison of patient and healthcare professional views when assessing quality of information on pituitary adenoma available on the internet. Endocr Pract. 2017;23:1217–22. https://doi.org/10.4158/EP171892.OR.
20. Ved R, Cobbold N, Igbagiri K, Willis M, Leach P, Zaben M. Online patient information on Vagus Nerve Stimulation: how reliable is it for facilitating shared decision making? Seizure. 2017;50:125–9. https://doi.org/10.1016/j.seizure.2017.06.009.
21. Marshall JH, Baker DM, Lee MJ, Jones GL, Lobo AJ, Brown SR. Assessing internet-based information used to aid patient decision-making about surgery for perianal Crohn's fistula. Tech Coloproctol. 2017;21:461–9. https://doi.org/10.1007/s10151-017-1648-2.
22. O'Connell Ferster AP, Hu A. Evaluating the quality and readability of Internet information sources regarding the treatment of swallowing disorders. Ear Nose Throat J. 2017;96:128–38.
23. Bowden DJ, Yap L-C, Sheppard DG. Is the internet a suitable patient resource for information on common radiological investigations? Acad Radiol. 2017;24:826–30. https://doi.org/10.1016/j.acra.2017.01.012.
24. Lambert K, Mullan J, Mansfield K, Koukomous A, Mesiti L. Evaluation of the quality and health literacy demand of online renal diet information. J Hum Nutr Diet. 2017;30:634–45. https://doi.org/10.1111/jhn.12466.
25. Carlsson T, Axelsson O. Patient information websites about medically induced second-trimester abortions: a descriptive study of quality, suitability, and issues. J Med Internet Res. 2017;19:e8. https://doi.org/10.2196/jmir.6380.
26. McGoldrick DM, Kielty P, Cotter C. Quality of information about maxillofacial trauma on the Internet. Br J Oral Maxillofac Surg. 2017;55:141–4. https://doi.org/10.1016/j.bjoms.2016.09.020.
27. Breakey VR, Harris L, Davis O, Agarwal A, Ouellette C, Akinnawo E, et al. The quality of information about sickle cell disease on the Internet for youth. Pediatr Blood Cancer. 2017;64:e26309. https://doi.org/10.1002/pbc.26309.
28. Robins S, Barr HJ, Idelson R, Lambert S, Zelkowitz P. Online health information regarding male infertility: an evaluation of readability, suitability, and quality. Interact J Med Res. 2016;5:e25. https://doi.org/10.2196/ijmr.6440.
29. Niu L, Luo D, Liu Y, Xiao S. The accessibility, usability, and reliability of Chinese web-based information on HIV/AIDS. Int J Environ Res Public Health. 2016;13:834. https://doi.org/10.3390/ijerph13080834.
30. Danino J, Muzaffar J, Mitchell-Innes A, Howard J, Coulson C. Quality of information available via the internet for patients with otological conditions. Otol Neurotol. 2016;37:1063–5. https://doi.org/10.1097/MAO.0000000000001151.
31. Joury AU, Alshathri M, Alkhunaizi M, Jaleesah N, Pines JM. Internet websites for chest pain symptoms demonstrate highly variable content and quality. Acad Emerg Med. 2016;23:1146–52. https://doi.org/10.1111/acem.13039.
32. Lloyd MS, Lafferty K, Horton J, Noons P, Dover S, Evans M. Empowerment of parents of children with craniosynostosis by objective scoring of patient information websites. J Craniofac Surg. 2016;27:874–5. https://doi.org/10.1097/SCS.0000000000002623.
33. Cajita MI, Rodney T, Xu J, Hladek M, Han H-R. Quality and health literacy demand of online heart failure information. J Cardiovasc Nurs. 2017;32:156–64. https://doi.org/10.1097/JCN.0000000000000324.
34. Borgmann H, Mager R, Salem J, Bründl J, Kunath F, Thomas C, et al. Robotic prostatectomy on the web: a cross-sectional qualitative assessment. Clin Genitourin Cancer. 2016;14:e355–62. https://doi.org/10.1016/j.clgc.2015.12.020.
35. Nghiem AZ, Mahmoud Y, Som R. Evaluating the quality of internet information for breast cancer. The Breast. 2016;25:34–7. https://doi.org/10.1016/j.breast.2015.10.001.
36. Peterson CK, Bolton J, Hsu W, Wood A. A cross-sectional study comparing pain and disability levels in patients with low back pain with and without transitional lumbosacral vertebrae. J Manip Physiol Ther. 2005;28:570–4. https://doi.org/10.1016/j.jmpt.2005.08.011.
37. Hsu W-C, Bath PA. Development of a patient-oriented tool for evaluating the quality of breast cancer information on the internet. Stud Health Technol Inform. 2008;136:297–302.
38. Shital Kiran D, Bargale S, Pandya P, Bhatt K, Barad N, Shah N, et al. Evaluation of Health on the Net seal label and DISCERN as content quality indicators for patients seeking information about thumb sucking habit. J Pharm Bioallied Sci. 2015;7:481. https://doi.org/10.4103/0975-7406.163509.
39. Borgmann H, Wölm J-H, Vallo S, Mager R, Huber J, Breyer J, et al. Prostate cancer on the web—expedient tool for patients'

decision-making? J Cancer Educ. 2017;32:135–40. https://doi.org/10.1007/s13187-015-0891-3.
40. Sadowski DJ, Ellimoottil CS, Tejwani A, Gorbonos A. Proton therapy for prostate cancer online: patient education or marketing? Can J Urol. 2013;20:7015–20.
41. Seymour N, Lakhani R, Hartley B, Cochrane L, Jephson C. Cochlear implantation: an assessment of quality and readability of web-based information aimed at patients. Cochlear Implants Int. 2015;16:321–5. https://doi.org/10.1179/1754762815Y.0000000015.
42. Saiklang P, Skirton H. Quality of patient information leaflets for Down syndrome screening: a comparison between the UK and Thailand. Nurs Health Sci. 2015;17:313–22. https://doi.org/10.1111/nhs.12190.
43. Carlsson T, Bergman G, Karlsson A-M, Mattsson E. Content and quality of information websites about congenital heart defects following a prenatal diagnosis. Interact J Med Res. 2015;4:e4. https://doi.org/10.2196/ijmr.3819.
44. Solomon ER, Janssen K, Krajewski CM, Barber MD. The quality of health information available on the internet for patients with pelvic organ prolapse. Female Pelvic Med Reconstr Surg. 2015;21:225–30. https://doi.org/10.1097/SPV.0000000000000156.
45. Cerminara C, Santarone ME, Casarelli L, Curatolo P, El Malhany N. Use of the DISCERN tool for evaluating web searches in childhood epilepsy. Epilepsy Behav. 2014;41:119–21. https://doi.org/10.1016/j.yebeh.2014.09.053.
46. Grant N, Rodger S, Hoffmann T. Evaluation of autism-related health information on the web. J Appl Res Intellect Disabil. 2015;28:276–82. https://doi.org/10.1111/jar.12127.
47. Akbari K, Som R. Evaluating the quality of internet information for bariatric surgery. Obes Surg. 2014;24:2003–6. https://doi.org/10.1007/s11695-014-1403-y.
48. Talati K, Upadhyay V, Gupta P, Joshi A. Quality of diabetes related health information on internet: an Indian context. Int J Electron Healthc. 2013;7:205. https://doi.org/10.1504/IJEH.2013.057408.
49. Montoya A, Hernández S, Massana M, Herreros O, Garcia-Giral M, Cardo E, et al. Evaluating internet information on attention-deficit/hyperactivity disorder (ADHD) treatment: parent and expert perspectives. Educ Health. 2013;26:48. https://doi.org/10.4103/1357-6283.112801.
50. Kumar VS, Subramani S, Veerapan S, Khan SA. Evaluation of online health information on clubfoot using the DISCERN tool. J Pediatr Orthop B. 2014;23:135–8. https://doi.org/10.1097/BPB.0000000000000000.
51. Wellburn S, Bettany-Saltikov J, van Schaik P. An evaluation of web sites recommended by UK NHS consultants to patients with adolescent idiopathic scoliosis at the first point of diagnosis. Spine (Phila Pa 1976). 2013;38:1590–4. https://doi.org/10.1097/BRS.0b013e31829965bc.
52. Bailey SJ, LaChapelle DL, LeFort SM, Gordon A, Hadjistavropoulos T. Evaluation of chronic pain-related information available to consumers on the internet. Pain Med. 2013;14:855–64. https://doi.org/10.1111/pme.12087.
53. Kaicker J, Debono VB, Dang W, Buckley N, Thabane L. Assessment of the quality and variability of health information on chronic pain websites using the DISCERN instrument. BMC Med. 2010;8:59. https://doi.org/10.1186/1741-7015-8-59.
54. Grewal P, Alagaratnam S. The quality and readability of colorectal cancer information on the internet. Int J Surg. 2013;11:410–3. https://doi.org/10.1016/j.ijsu.2013.03.006.
55. Joshi A, Mehta S, Talati K, Malhotra B, Grover A. Evaluation of metabolic syndrome related health information on internet in Indian context. Technol Health Care. 2013;21:19–30. https://doi.org/10.3233/THC-120706.
56. Weil AG, Bojanowski MW, Jamart J, Gustin T, Lévêque M. Evaluation of the quality of information on the internet available to patients undergoing cervical spine surgery. World Neurosurg. 2014;82:e31–9. https://doi.org/10.1016/j.wneu.2012.11.003.
57. Lam CG, Roter DL, Cohen KJ. Survey of quality, readability, and social reach of websites on osteosarcoma in adolescents. Patient Educ Couns. 2013;90:82–7. https://doi.org/10.1016/j.pec.2012.08.006.
58. Rao NR, Mohapatra M, Mishra S, Joshi A. Evaluation of dengue-related health information on the internet. Perspect Health Inf Manag. 2012;9:1c.
59. Som R, Gunawardana NP. Internet chemotherapy information is of good quality: assessment with the DISCERN tool. Br J Cancer. 2012;107:403–403. https://doi.org/10.1038/bjc.2012.223.
60. McDermott CL, Hsieh AA, Sweet ES, Tippens KM, McCune JS. A pilot study of website information regarding aromatase inhibitors: dietary supplement interactions. J Altern Complement Med. 2011;17:1043–9. https://doi.org/10.1089/acm.2010.0471.
61. Coquard O, Fernandez S, Zullino D, Khazaal Y. A follow-up study on the quality of alcohol dependence-related information on the web. Subst Abuse Treat Prev Policy. 2011;6:13. https://doi.org/10.1186/1747-597X-6-13.
62. Stinson JN, Tucker L, Huber A, Harris H, Lin C, Cohen L, et al. Surfing for juvenile idiopathic arthritis: perspectives on quality and content of information on the internet. J Rheumatol. 2009;36:1755–62. https://doi.org/10.3899/jrheum.081010.
63. Evrard A-S, Guertin L, Remacle M, Jamart J, Lévêque M. Information Internet en langue française en oncologie ORL. Ann d'Otolaryngol Chir Cervico-Faciale. 2009;126:99–111. https://doi.org/10.1016/j.aorl.2009.05.001.
64. Lévêque M, Dimitriu C, Gustin T, Jamart J, Gilliard C, Bojanowski MW. Évaluation de l'information sur Internet destinée aux patients francophones en neuro-oncologie. Neurochirurgie. 2007;53:343–55. https://doi.org/10.1016/j.neuchi.2007.07.033.
65. Bartels U, Hargrave D, Lau L, Esquembre C, Humpl T, Bouffet E. Analyse pädiatrisch neuro-onkologischer Informationen in deutschsprachigen Internetseiten. Klin Pädiatrie. 2003;215:352–7. https://doi.org/10.1055/s-2003-45491.
66. Neuman HB, Cabral C, Charlson ME, Temple LK. Is internet information adequate to facilitate surgical decision-making in familial adenomatous polyposis? Dis Colon Rectum. 2007;50:2135–41. https://doi.org/10.1007/s10350-007-9036-z.
67. Serdobbel Y, Pieters G, Joos S. Obsessive compulsive disorder and the internet. An evaluation of Dutch-language websites and quality indicators. Tijdschr Psychiatr. 2006;48:763–73.
68. Maloney S, Ilic D, Green S. Accessibility, nature and quality of health information on the Internet: a survey on osteoarthritis. Rheumatology. 2005;44:382–5. https://doi.org/10.1093/rheumatology/keh498.
69. Winker MA, Flanagin A, Chi-Lum B, White J, Andrews K, Kennett RL, et al. Guidelines for medical and health information sites on the internet: principles governing AMA web sites. JAMA. 2000;283:1600–6.
70. Joury A, Joraid A, Alqahtani F, Alghamdi A, Batwa A, Pines JM. The variation in quality and content of patient-focused health information on the Internet for otitis media. Child Care Health Dev. 2017. https://doi.org/10.1111/cch.12524.
71. Janssen S, Käsmann L, Fahlbusch FB, Rades D, Vordermark D. Side effects of radiotherapy in breast cancer patients. Strahlenther Und Onkol. 2017. https://doi.org/10.1007/s00066-017-1197-7.
72. Clancy AA, Hickling D, Didomizio L, Sanaee M, Shehata F, Zee R, et al. Patient-targeted websites on overactive bladder: what are our patients reading? Neurourol Urodyn. 2017. https://doi.org/10.1002/nau.23359.
73. Roughead T, Sewell D, Ryerson CJ, Fisher JH, Flexman AM. Internet-based resources frequently provide inaccurate and out-of-date recommendations on preoperative fasting. Anesth Analg. 2016;123:1463–8. https://doi.org/10.1213/ANE.0000000000001590.
74. Nassiri M, Mohamed O, Berzins A, Aljabi Y, Mahmood T, Chenouri S, et al. Surfing behind a boat: quality and reliability of online resources on scaphoid fractures. J Hand Surg Asian-Pacific Vol. 2016;21:374–81. https://doi.org/10.1142/S2424835516500375.
75. Wiriyakijja P, Fedele S, Porter S, Ni RR. Web-based information on the treatment of oral leukoplakia—quality and readability. J Oral Pathol Med. 2016;45:617–20. https://doi.org/10.1111/jop.12459.
76. Alsaiari A, Joury A, Aljuaid M, Wazzan M, Pines JM. The content and quality of health information on the internet for patients and families on adult kidney cancer. J Cancer Educ. 2017;32:878–84. https://doi.org/10.1007/s13187-016-1039-9.
77. Sobota A, Ozakinci G. The quality and readability of online consumer information about gynecologic cancer. Int J Gynecol Cancer. 2015;25:537–41. https://doi.org/10.1097/IGC.0000000000000362.
78. Elhassan Y, Sheridan G, Nassiri M, Osman M, Kiely P, Noel J. Discectomy-related information on the internet. Spine (Phila Pa 1976). 2015;40:121–5. https://doi.org/10.1097/BRS.0000000000000689.

79. Dalton DM, Kelly EG, Molony DC. Availability of accessible and high-quality information on the Internet for patients regarding the diagnosis and management of rotator cuff tears. J Shoulder Elb Surg. 2015;24:e135–40. https://doi.org/10.1016/j.jse.2014.09.036.
80. Best J, Muzaffar J, Mitchell-Innes A. Quality of information available via the internet for patients with head and neck cancer: are we improving? Eur Arch Oto-Rhino-Laryngol. 2015;272:3499–505. https://doi.org/10.1007/s00405-014-3349-z.
81. Riordain RN, Hodgson T. Content and quality of website information on the treatment of oral ulcers. BDJ. 2014;217:E15–E15. https://doi.org/10.1038/sj.bdj.2014.886.
82. Nassiri M, Bruce-Brand RA, O'Neill F, Chenouri S, Curtin P. Perthes disease. J Pediatr Orthop. 2015;35:530–5. https://doi.org/10.1097/BPO.0000000000000312.
83. Park MW, Jo JH, Park JW. Quality and content of internet-based information on temporomandibular disorders. J Orofac Pain. 2012;26:296–306.
84. Nason GJ, Tareen F, Quinn F. Hydrocele on the web: an evaluation of Internet-based information. Scand J Urol. 2013;47:152–7. https://doi.org/10.3109/00365599.2012.719540.
85. Nason GJ, Baker JF, Byrne DP, Noel J, Moore D, Kiely PJ. Scoliosis-specific information on the internet. Spine (Phila Pa 1976). 2012;37:E1364–9. https://doi.org/10.1097/BRS.0b013e31826619b5.
86. Hallingbye T, Serafini M. Assessment of the quality of postherpetic neuralgia treatment information on the internet. J Pain. 2011;12:1149–54. https://doi.org/10.1016/j.jpain.2011.05.005.
87. Health On the Net Foundation n.d. http://www.hon.ch/. Accessed 23 Nov 2017.
88. Risk A, Dzenowagis J. Review of internet health information quality initiatives. J Med Internet Res. 2001;3:E28. https://doi.org/10.2196/jmir.3.4.e28.
89. WorldWideWebSize.com | The size of the World Wide Web (The Internet) 2017. http://www.worldwidewebsize.com/. Accessed 25 Nov 2017.
90. van den Bosch A, Bogers T, de Kunder M. Estimating search engine index size variability: a 9-year longitudinal study. Scientometrics. 2016;107:839–56. https://doi.org/10.1007/s11192-016-1863-z.
91. Bergman MK. White paper: the deep web: surfacing hidden value. J Electron Publ. 2001. https://doi.org/10.3998/3336451.0007.104.
92. Egle JP, Smeenge DM, Kassem KM, Mittal VK. The internet school of medicine: use of electronic resources by medical trainees and the reliability of those resources. J Surg Educ. 2015;72:316–20. https://doi.org/10.1016/j.jsurg.2014.08.005.
93. Hunter L, Cohen KB. Biomedical language processing: what's beyond PubMed? Mol Cell. 2006;21:589–94. https://doi.org/10.1016/j.molcel.2006.02.012.
94. Islamaj Dogan R, Murray GC, Névéol A, Lu Z. Understanding PubMed user search behavior through log analysis. Database (Oxford). 2009;2009:bap018. https://doi.org/10.1093/database/bap018.
95. Younger P. Using Google Scholar to conduct a literature search. Nurs Stand. 2010;24:40–6. https://doi.org/10.7748/ns2010.07.24.45.40.c7906.
96. Nourbakhsh E, Nugent R, Wang H, Cevik C, Nugent K. Medical literature searches: a comparison of PubMed and Google Scholar. Heal Inf Libr J. 2012;29:214–22. https://doi.org/10.1111/j.1471-1842.2012.00992.x.
97. Shariff SZ, Bejaimal SA, Sontrop JM, Iansavichus AV, Haynes RB, Weir MA, et al. Retrieving clinical evidence: a comparison of PubMed and Google Scholar for quick clinical searches. J Med Internet Res. 2013;15:e164. https://doi.org/10.2196/jmir.2624.
98. Lu Z. PubMed and beyond: a survey of web tools for searching biomedical literature. Database (Oxford). 2011;2011:baq036. https://doi.org/10.1093/database/baq036.
99. Galbusera F, Brayda-Bruno M, Freutel M, Seitz A, Steiner M, Wehrle E, et al. What do patients know about their low back pain? An analysis of the quality of information available on the Internet. Technol Health Care. 2012;20:447–55. https://doi.org/10.3233/THC-2012-0682.
100. Sullivan TB, Anderson JT, Ahn UM, Ahn NU. Can Internet information on vertebroplasty be a reliable means of patient self-education? Clin Orthop Relat Res. 2014;472:1597–604. https://doi.org/10.1007/s11999-013-3425-5.

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