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Assessing the quality of online information for patients with carotid disease

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ABSTRACT

Introduction: Controversy exists relating to carotid endarterectomy (CEA) versus carotid artery stenting (CAS). We aimed to assess the quality of online patient information relating to both.

Methods: The Google search engine was searched for “carotid endarterectomy” and “carotid stenting”. The first 50 webpages returned were assessed. The Gunning Fog Index (GFI) and Flesch Reading Ease Score (FRES) were calculated to assess readability. The LIDA tool (Minervation Ltd., Oxford, U.K.) was used to assess accessibility, usability and reliability.

Results: 20% ($n = 10$) of the webpages returned for CEA were from peer reviewed sources with 34% ($n = 17$) posted by hospitals or health services. Comparatively, for CAS, 40% ($n = 20$) were peer reviewed with 16% ($n = 8$) posted by hospitals or health services. GFI and FRES scores indicated webpages for both CEA and CAS had poor general readability. Webpages for CEA were easier to read than those for CAS (mean FRES difference of 6.7 (95% CI 0.51 to 12.93, $p = 0.03$). Median LIDA scores demonstrated acceptable reliability, accessibility and usability of information for both CEA and CAS webpages. The more readable webpages were not associated with higher LIDA scores for either CEA or CAS webpages.

Conclusion: Webpages providing information on carotid disease management must be made more readable. Online information currently available to patients regarding CAS is more difficult to read and comprehend than CEA.

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1. Introduction

Over the past two decades there has been a dramatic increase in access to and usage of the Internet by the world's population. It is estimated that today 2405 million people use the internet, representing approximately 34.3% of the world's population.¹ Surveys report that 55% of users with Internet access have searched for health or medical information.² There is evidence that 6.75 million health-related searches are performed each day on Google© alone.³ Several studies have shown that one of the most frequently searched topics on the Internet is the treatment of a disease or condition.⁴

The common starting point for patients researching online health information is search engines rather than medical portals, the websites of medical societies or libraries.⁵ The Net Market Share

website shows that the most used search engine is Google, controlling 83.85% of the global market share.⁶

The internet is however unregulated and the reliability and readability of information on many websites is questionable. Although the internet is becoming increasingly popular as a source of health information, a recent study reported that amongst the general population, 86% of Internet users expressed concern as to the reliability of the information obtained.² A recent publication by Grewal P et al., assessed online information relating to a number of vascular procedures. The study raised concerns relating to the readability and reliability of online vascular surgery information.⁷

Carotid endarterectomy (CEA) has long been the standard treatment for symptomatic carotid artery stenosis. The introduction of carotid artery stenting (CAS) in recent years has provided another option but for the majority of patients open surgery remains the standard of care. A comparative study of online procedural information between CEA and CAS has not yet been undertaken. As such we sought to assess the reliability, usability, accessibility and readability of online information relating to CEA

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and CAS for patients researching information regarding treatment options for carotid stenosis.

2. Methods

Using the Google© search engine the keywords “carotid endarterectomy” and “carotid stenting” were searched for. We analysed the top 50 search results on Google as per the keywords. Webpages were excluded from the analysis if they contained irrelevant information, repetition, or were inaccessible.⁷ The content of individual webpages was assessed for readability as the subjects searched for may only be a segment of a certain website i.e. a webpage of that website. However the website in entirety was assessed for accessibility, usability and reliability.

3. Readability scores

The Flesch Reading Ease Score (FRES) rates English text on a 100-point scale and is designed to indicate comprehension level. Higher scores indicate material that is easier to read, for example scores of 90–100 are easily understood by an average 11 year old. The Reader's digest has a readability index of 65, while the Harvard Law Review has a general readability score in the low 30 s. Scores between 60 and 70 represent a standard readability level, easily understood by 13–15 year old students. The FRES can be calculated using the formula: $206.835 - 1.015 (\text{total words}/\text{total sentences}) - 84.6 (\text{total syllables}/\text{total words})$.

The Gunning Fog Index (GFI) also measures the readability of English writing. The index estimates the years of formal education needed to understand the text on a first reading. Lower scores in the GFI indicate material that is easier to read. For Example, a GFI of 6 represents television guides, 10 represents Time magazine and >15 represents academic papers. Texts requiring near-universal understanding need an index less than 8. The GFI can be calculated using the following formula: $0.4 [(\text{words}/\text{sentences}) + 100 (\text{complex words}/\text{words})]$.

To prevent human error during calculations and for ease of use, both readability tests were performed using an online readability calculator.⁸ Some websites also contained multiple webpages about the topic, if these multiple webpages were all relevant to the patient's search, then all webpages were analysed together to give a final result.

4. The LIDA tool

The LIDA tool (Minervation Ltd., Oxford, U.K.) is an online application used to measure the accessibility, usability and reliability of healthcare websites.⁹ Scores greater than 90% represent good results and less than 50% represent poor results. Accessibility answers four questions: Can your audience access your website? Does your website conform to legal accessibility standards? Are your competitors ahead of you? Does your website reflect “best practice” in coding and relevant metadata? Usability is assessed with questions such as: Can your users find what they need to know? Can they use your website effectively? What does it cost people to use your website? Do your website visitors return to use the website again and again? Reliability questions include: does your website keep up to date with the latest research? Does your website reflect best current knowledge? Do your users trust you to provide them with unbiased information? Does your website conform to the highest information quality standards throughout? Is your website harmful or dangerous?

5 Statistical analysis

Descriptive statistics were calculated for readability and LIDA scores, and are presented as mean (SD) for normally distributed variables or median (range) for skewed distributions. Spearman's correlation coefficient was used to measure the association between readability and LIDA scores and between ranking of webpages, readability and LIDA scores. Independent samples *t*-test was used to compare mean FRES readability scores for CEA and CAS webpages. Non-parametric tests were used to compare median GFI and LIDA scores for CEA and CAS webpages. A 5% level of significance was used for all statistical tests and SPSS Version 20 for Windows was used to carry out the analysis.

6. Results

The searches which were performed using the keywords returned 1,959,000 results. Of these 1.16 million were related to CEA and 799,000 related to CAS. We analysed 50 webpages per topic, 100 webpages in total. The 100 webpages which we assessed for carotid endarterectomy (CEA) and carotid artery stenting (CAS) are listed in Table 1.

20% ($n = 10$) of the webpages returned for CEA were from peer reviewed sources, 34% ($n = 17$) were from hospitals or health services while 46% ($n = 23$) were other websites. Comparatively, for CAS, 40% ($n = 20$) were peer reviewed, 16% ($n = 8$) were from hospitals or health services, leaving 44% ($n = 22$) from other websites.

The mean readability scores for FRES for both CEA and CAS indicated poor readability, below a standard readability level [Table 2]. Median GFI scores indicated readability levels required for academic papers for both CEA and CAS [Table 2]. Webpages for CEA were easier to read than those for CAS with a mean FRES difference of 6.7 (95% CI 0.51 to 12.93, $p = 0.03$) and a median GFI difference of 1.5 ($p = 0.045$).

Median accessibility, usability and reliability indicated acceptable levels for both CEA and CAS websites [Table 2] though three websites had reliability scores below 50%.

Association between readability, components of LIDA and total LIDA scores was weak indicating that the more readable webpages were not associated with higher LIDA scores.

The webpages most likely to be accessed are in the first page of search results.⁵ There was a moderate correlation between ranking of the webpages on the first page of results and readability (Spearman's correlation = -0.31) for CEA webpages, this indicated that the higher ranked webpages tended to be more readable. The correlation between ranking of the webpages and readability for CAS webpages was weak. Similarly, top ranked webpages for both CAS and CEA were not associated with higher LIDA scores.

7. Discussion

In 2012 the Pew Research Centre's Internet & American Life Project completed a national survey which showed that one in three American adults have gone online to investigate a medical condition¹⁰ reporting that 59% of U.S. adults have looked online for health information in preceding 12 months. Furthermore 53% of patients self-diagnosing online spoke with their clinician about the online information they had reviewed, and that 41% had their condition confirmed by a clinician. Much of the healthcare related information on the Internet is unreliable¹¹ and this may negatively impact patient decision making when faced with potential treatment options offered by their physicians or surgeons.¹²

The webpages that we analysed had poor readability. Interestingly, the results from CAS and CEA differed in that information

Table 1

List of websites returned after using the search terms “carotid endarterectomy” and “carotid stenting” in the Google search engine.

Google search for “carotid endarterectomy”	
1	http://en.wikipedia.org/wiki/Carotid_endarterectomy
2	http://www.vascularweb.org/vascularhealth/Pages/carotid-endarterectomy.aspx
3	http://www.ninds.nih.gov/disorders/stroke/carotid_endarterectomy_backgroundunder.htm
4	http://www.nhs.uk/conditions/CarotidEndarterectomy/Pages/introduction.aspx
5	http://www.webmd.com/stroke/carotid-endarterectomy-for-tia-and-stroke
6	http://circ.ahajournals.org/content/97/5/501.full
7	http://emedicine.medscape.com/article/1895291-overview
8	http://www.surgeryencyclopedia.com/A-Ce/Carotid-Endarterectomy.html#b
9	http://www.strokecenter.org/patients/stroke-treatment/carotid-endarterectomy/
10	http://www.uptodate.com/contents/carotid-endarterectomy
11	http://www.texheart surgeons.com/CarotidEndarter.htm
12	http://guidelines.gov/content.aspx?id=8129
13	http://www.mayoclinic.org/carotid-endarterectomy/
14	http://www.aan.com/professionals/practice/guidelines/pda/Carotid_Endarterectomy.pdf
15	http://www.nhlbi.nih.gov/health/health-topics/topics/caend/
16	http://neurosurgery.mgh.harvard.edu/neurovascular/cea.htm
17	http://neurosurgery.mgh.harvard.edu/neurovascular/v-f-93-1.htm
18	http://www.facs.org/public_info/operation/brochures/carotid.pdf
19	http://www.aan.com/professionals/practice/guideline/pdf/patient_guideline.pdf
20	http://www.texasheartinstitute.org/HIC/Topics/Proced/carotidendar.cfm
21	http://www.heart.org/idc/groups/heart-public/@wcm/@hcm/documents/downloadable/ucm_300432.pdf
22	http://www.rcplondon.ac.uk/projects/uk-carotid-interventions-audit
23	http://www.hopkinsmedicine.org/healthlibrary/test_procedures/cardiovascular/carotid_endarterectomy_carotid_angioplasty_with_stenting_92_P08293/
24	http://www.aans.org/Patient%20Information/Conditions%20and%20Treatments/Cartoid%20Endarterectomy%20and%20Stenosis.aspx
25	http://www.nlm.nih.gov/medlineplus/tutorials/carotidendarterectomy/ns059108.pdf
26	http://www.healthlinkbc.ca/kb/content/surgicaldetail/hw224563.html
27	http://vascular.surgery.ucsf.edu/conditions-procedures/carotid-endarterectomy.aspx
28	http://www.upmc.com/services/heart-vascular/treatments/vascular-surgery/pages/carotid-artery-stenosis.aspx
29	http://www.rsfh.com/categories/departments_and_services/centers_of_excellence/heart_and_vascular_center/documents/carotidbooklet.pdf
30	http://www.oxfordradcliffe.nhs.uk/forpatients/090427patientinfoleaflets/100709carotid.pdf
31	http://pathways.nice.org.uk/pathways/stroke/carotid-imaging-and-carotid-endarterectomy-for-people-with-tia-or-non-disabling-stroke
32	http://www.metrohealth.org/body.cfm?id=1449
33	http://www.rcplondon.ac.uk/sites/default/files/documents/uk-carotid-endarterectomy-audit-round-3-public-report.pdf
34	http://www.cmaj.ca/content/157/6/653.full.pdf
35	http://bja.oxfordjournals.org/content/99/1/119.full.pdf
36	http://www.circulationfoundation.org.uk/help-advice/carotid/carotid-endarterectomy/
37	http://cvi.med.nyu.edu/patients/treatments-technologies-surgeries/carotid-endarterectomy
38	http://www.nhsdirect.wales.nhs.uk/encyclopaedia/c/article/carotidendarterectomy/
39	http://www.hopkinsmedicine.org/neurology_neurosurgery/specialty_areas/cerebrovascular/treatment/carotid-endarterectomy.html
40	http://www.nhs.uk/Conditions/Carotidendarterectomy/Pages/Recovery.aspx
41	http://www.thirdage.com/hc/p/14785/carotid-endarterectomy-what-to-expect
42	http://cholesterol.about.com/od/treatments/a/carotidendarter.htm
43	http://www.specialistvascularclinic.com.au/carotid-interventions.html
44	http://stroke.ahajournals.org/content/29/11/2435.full
45	http://www.mmc.org/workfiles/mmc_media/carotidinstructions.pdf
46	http://www.strokeaudit.scot.nhs.uk/Downloads/files/UK_Audit_of_Vascular_Surgical_Services%20Carotid_Endarterectomy_v1_1.pdf

Table 1 (continued)

47	http://www.vascularurgical.co.uk/carotidendarterectomy.pdf
48	http://www.nlm.nih.gov/medlineplus/ency/article/002951.htm
49	http://www.mayoclinic.com/health/carotid-artery-disease/DS01030/DSECTION=treatments-and-drugs
50	http://en.wikipedia.org/wiki/Endarterectomy
Google search for “carotid stenting”	
1	http://www.vascularweb.org/vascularhealth/Pages/carotid-stenting.aspx
2	http://en.wikipedia.org/wiki/Carotid_stenting
3	http://my.clevelandclinic.org/heart/services/tests/procedures/carotidstent.aspx
4	http://www.mayoclinic.com/health/carotid-angioplasty/MY00656
5	http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(10)60239-5/abstract
6	http://circ.ahajournals.org/content/97/1/121.full
7	http://www.nejm.org/doi/full/10.1056/NEJMoa061752#t=article
8	http://www.nlm.nih.gov/medlineplus/ency/article/002953.htm
9	http://www.nlm.nih.gov/medlineplus/carotidarterydisease.html
10	http://www.ohsu.edu/dotter/carotid_stenting.htm
11	http://www.cordis.com/products/precise-pro-rx-carotid-stent-system/epi
12	http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/DeviceApprovalsandClearances/Recently-ApprovedDevices/ucm255200.htm
13	http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3058352/
14	http://www.hopkinsmedicine.org/healthlibrary/test_procedures/cardiovascular/carotid_endarterectomy_carotid_angioplasty_with_stenting_92_P08293
15	http://guidance.nice.org.uk/IPG389
16	http://www.abbottvascular.com/us/acculink.html
17	http://www.ccmj.org/content/77/12/892.full
18	http://www.jerseyshoreuniversitymedicalcenter.com/JSUMC/services/interventionalradiology/CarotidStenting.cfm
19	http://www.webmd.com/heart-disease/carotid-artery-stenting
20	http://content.onlinejacc.org/article.aspx?articleid=1136222
21	http://clinicaltrials.gov/ct2/show/NCT00004732
22	http://www.cirse.org/index.php?pid=255
23	http://www.hearthealthywomen.org/treatment-and-recovery/treatment-and-recovery/carotid-stenting-page-1.html
24	http://www.mmc.org/vc_body.cfm?id=6413
25	http://www.froedtert.com/HealthResources/ReadingRoom/EveryDay/May-July2006Issue/CarotidStentingAlternative.htm
26	http://content.onlinejacc.org/article.aspx?articleID=1358364
27	http://neurosurgery.mgh.harvard.edu/Interventional/CarotidAngioplasty.htm
28	http://www.radiologyinfo.org/en/info.cfm?pg=angioplasty
29	http://www.nytimes.com/2010/02/27/health/27stroke.html?_r=0
30	http://stroke.ahajournals.org/content/38/2/715.full
31	http://www.medpagetoday.com/Cardiology/Atherosclerosis/33827
32	http://www.nhs.uk/conditions/carotidendarterectomy/pages/alternatives.aspx
33	http://bmartinmd.com/2010/03/conflicting-carotid-stent-trials.html
34	http://videos.nyp.org/videos/innovations-in-stroke-prevention-carotid-stenting
35	http://bja.oxfordjournals.org/content/105/suppl_1/i34.full
36	http://www.froedtert.com/HealthResources/ReadingRoom/EveryDay/May-July2006Issue/CarotidStentingTechnologyEvolvesQuickly.htm
37	http://www.bmj.com/content/340/bmj.c467
38	http://www.sciencedaily.com/releases/2008/04/080410140459.htm
39	http://www.ajnr.org/content/21/9/1736.full.pdf
40	http://www.ajnr.org/content/27/7/1508.full
41	http://www.cns.org/publications/clinical/53/pdf/cnb00106000217.PDF
42	http://emedicine.medscape.com/article/1839544-overview#aw2aab6b2b1aa
43	http://www.medicine.virginia.edu/clinical/departments/radiology/divisions/Neuroradiology/expertise/stent
44	http://www.medpagetoday.com/Cardiology/PCI/22105
45	http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(10)61009-4/abstract
46	http://circinterventions.ahajournals.org/content/1/2/93.full
47	http://www.tcaway.com/tc-cardo_stenting.htm
48	http://www.yourpracticeonline.com.au/carotid-artery-stenting-surgery-3dvideo.html
49	http://interventions.onlinejacc.org/article.aspx?articleid=1207423
50	http://www.emoryjohnscreek.com/about-us/news/carotid-stenting.html

regarding CAS was more difficult to comprehend than CEA. Two-thirds of the webpages analysed for CAS showed readability scores higher than academic papers, which would be difficult for the general population to comprehend. Carotid artery stenting is a

Table 2

Readability, accessibility, usability, reliability and total LIDA scores for carotid endarterectomy webpages ($n = 50$) and carotid artery stenting webpages ($n = 50$).

	Carotid endarterectomy	Carotid artery stenting
Mean FRES (SD)	42.8 (17.5)	36.1 (13.6)
Median GFI (range)	14.8 (8–21)	16.3 (11–24)
Median accessibility (range)	83% (57–98%)	83% (57–98%)
Median usability (range)	75% (50–100%)	83% (58–100%)
Median reliability (range)	87% (33–100%)	84% (47–100%)
Median total LIDA (range)	82% (62–94%)	83% (61–97%)

relatively new technique and CEA has long been the standard technique of treatment. This suggests that more information and certainly more readable information needs to be made available with regards to CAS, particularly for patients unsuitable for CEA who may be scheduled for CAS by their physician.

It's also interesting to note that the numbers of peer reviewed sources relating to CAS are over twice the number of resources available from hospitals or health services, whereas the converse is true for CEA. The information available from hospitals and health services tends to be aimed towards the patient, and this is reflected in our results of higher readability of CEA rather than CAS. However given that overall readability remains poor the onus is on health-care institutions to provide more accessible information for their patients online.

The LIDA tool assessed the accessibility, usability and reliability of the webpages searched during our study. The results showed that accessibility, usability and reliability of the webpages studied was relatively good on average. There were some websites that had very poor reliability which is of great concern. Some of these unreliable websites ranked within the first 10 webpages returned when searched on google. These websites can be potentially harmful to patients.

We acknowledge a number of limitations in our study. There are some weaknesses to using the FRES and the GFI to assess the readability of health-related articles. They rely on the number of words in a sentence and the numbers of syllables in a word, which may not in some circumstances reflect the reading level. The comprehension of material can be enhanced by the use of diagrams, illustrations, improved layout and appropriate use of font size and colour.¹³ The readability tools that we used do not assess these features. The LIDA tool has clear criteria for assessing websites but it is subjective and there is potential for observer bias.

8. Conclusions

Our study concluded that the majority of information available online for the treatment of carotid artery disease is very difficult for the general population to comprehend. Also the information available for both CEA and CAS differs in level of comprehension, with information relating to CEA more easily understood by patients than that for CAS.

The onus is on health services to publish information online that is easy for patients with carotid disease to comprehend, especially

in respect to CAS. As health care professionals we need to be aware of usable, reliable, accessible and most importantly readable websites for our patients. We need to be able to direct our patients towards these websites in order to keep them informed.

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Author contribution

Keogh CJ – Data collection, data analysis, paper writing.

McHugh SM – Study design, paper writing.

Clarke Moloney M – Study design, paper writing.

Hannigan A – Data analysis, paper writing.

Healy DA – Paper writing.

Burke PE – Paper writing.

Kavanagh EG – Paper writing.

Grace PA – Study design, paper writing.

Walsh SR – Study design.

Conflict of interest

None.

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