

Quality and readability of online patient information for abdominal aortic aneurysms

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Objective: We assessed the quality and readability of patient information for abdominal aortic aneurysms (AAAs) on the World Wide Web, as accessed from the United Kingdom.

Methods: Web sites returned by a simple Web search using the three largest search engines by market share were objectively and subjectively assessed for quality and readability. The Internet search engines Google, Yahoo!, and Bing were interrogated for the term “abdominal aortic aneurysm” and the first 50 hits screened. Organization type and Health on the Net status were recorded. Each unique site containing AAA information was scored for quality using the University of Michigan Consumer Health Web site Evaluation Checklist by two authors, and readability was calculated using the Flesch Reading Ease (FRE) score. Subjective content assessment was also undertaken.

Results: Of 150 hits, 112 were relevant, with 55 unique sites for assessment. Overall, the FRE score was 39 (range, 29-47) and the Michigan score was 36 (range, 25-56), with good interobserver agreement ($r_s = 0.83$; $P = .01$). Michigan and FRE scores were poorly correlated ($r_s = 0.064$; $P = .6$). Sites containing discussion on the merits of endovascular/open repair and the concept of an intervention threshold had the highest Michigan scores (58.5 [50-59.75] vs 28 [13-36.5]; $P < .001$). Search engine ranking, Health on the Net status, country of origin, and organization type did not affect quality or readability.

Conclusions: The current quality and readability of online patient information for AAAs is poor and requires significant improvement. Clinicians treating patients with AAAs should be aware of the limitations of the online “lay literature.” (J Vasc Surg 2012;56:21-6.)

During the last decade, the use of the Internet has begun to pervade all aspects of modern life, and consequently, we are experiencing an “e-health revolution” where patients may research health issues online before seeking professional consultation.^{1,2} These patients may have had significant education before they come into contact with the health care profession. Hence, information sought from the World Wide Web (WWW) can inform treatment decisions.^{3,4} Patient choice has an important role in the management of abdominal aortic aneurysms (AAAs),⁵ particularly in choosing between open and endovascular repair (EVAR) in anatomically and medically suitable patients.⁶ Choice of treatment location is also important, especially now that the volume-outcome relationship in aneurysm surgery is established.^{7,8}

However, for online information to be valuable, it must be both accurate and accessible to patients. More than a decade ago in the *Journal of Vascular Surgery*, Soot et al⁹ reported that the quality of Web sites dealing with a number of vascular diseases was poor, with one-third of such sites containing information the authors concluded was misleading, unconventional, or incorrect. Given the increased accessibility and exponential use of the WWW, these data are now historic.

As the United Kingdom’s (U.K.) National Health Service AAA Screening Programme is being rolled out,^{10,11} we concluded that it is pertinent to reassess the online information these screened individuals will have at their disposal. We set out to examine the quality and readability of patient information about AAAs on the WWW.

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METHODS

Patient focus groups. Five patient focus groups were conducted in the U.K., in Leeds, Bristol, Manchester, Aberdeen, and Cardiff, in conjunction with the Vascular Society of Great Britain and Ireland (VSGBI) National AAA Quality Improvement Programme (NAAAQIP; <http://www.aaqip.com/>). We specifically set out to determine patients’ experiences of and preferences for education and counseling about their AAAs in addition to their access to information technology and experience with the Internet using structured questionnaires.

Web site identification. The three most popular U.K. search engines by market share—Google UK (<http://www.google.co.uk>), Yahoo! (<http://www.yahoo.com>),

Table I. The University of Michigan Web site evaluation checklist scoring system

<i>Michigan score (80 possible)</i>	<i>Result</i>
0-25	Poor site
26-50	Weak site
51-60	Fair site
61-70	Good site
71-80	Excellent site

and Bing (<http://www.bing.com>)—were used to perform a search using the term “abdominal aortic aneurysm” undertaken in February 2011 from an Internet Protocol (IP) address in Leeds. The universal resource locator (URL) of the first 50 results returned by each of the three search engines was recorded, and each of these 50 sites were evaluated for relevance to patients with an AAA. Web sites were included for analysis if they contained information about AAAs that patients could feasibly use as a source of disease-specific information, even if they were not designed with patients in mind. Web sites were excluded from analysis if they contained inappropriate content (eg, regarding thoracic aortic aneurysms or other cardiovascular diseases), were advertisements for aneurysm-related products without any specific information, required a paid subscription (eg, articles from medical journals), or had inaccessible links. Those Web sites that were within the first 50 results from more than one of the search engines were only analyzed once.

Web site assessment. Each Web site was assessed independently by two of the authors (M.B. and P.C.) with expertise in AAA disease for quality and readability as directed by the instructions supplied with the tools used. In addition, the country of origin, type of organization producing the site (commercial company, health care provider, academic institution, charitable organization, layperson, government, or news outlet), target audience, and presence of Health on the Net (HoN) Certification status was recorded.

Quality. Web site quality was assessed objectively using the University of Michigan Consumer Health Web site Evaluation Checklist¹² to generate an overall Michigan score of 80 possible points (Table I). The tool produces a profile of 10 domains focusing on the quality of the content (as rated by the expert reviewer in the context of the subject of the site) and the usability and design of the site: authority, currency, information, scope and selection, audience, value, accuracy, advertising, navigation, speed, and access. The scoring tool comprises 43 separate yes/no questions, each associated with a marking scheme.

In addition to this objective assessment, we subjectively interrogated each site for three key content areas we determined were of particular relevance: (1) a clear explanation of the risk–benefit assessment when determining the threshold of AAA intervention (not simply a single threshold value of 5.5 cm),^{13,14} (2) a clear explanation of the

Table II. The Flesch Reading Ease (FRE) score

<i>FRE score (100 possible)</i>	<i>Text difficulty</i>	<i>Level of understanding</i>
90-100	Easy text	Primary school
70-90	Simple text	Below-average reading level
60-70	Standard text	Standard reading level (13 to 15 years old)
30-60	Difficult text	Above-average reading level
0-30	Complex text	Graduates

advantages and disadvantages of open repair and endovascular repair,¹⁵ and (3) inclusion of the volume–outcome relationship in AAA surgery.¹⁶

Readability. The readability of each site was assessed by calculating the Flesch Reading Ease (FRE) score,¹⁷ which uses word syllable content and sentence length to generate a score that relates to the complexity of language within the text corrected for passage length. A standard reading level equates to a FRE score of between 60 and 70, with lower scores indicating increased reading difficulty (Table II).

Statistical analysis. Overall FRE and Michigan scores are presented as median and interquartile range (IQR). Correlation between Michigan score and search engine ranking was performed by Spearman correlation coefficient for each search engine. Subgroup analysis was performed based on HoN certification status, country of origin, and organization type (professional vs commercial and layperson sites) with Mann-Whitney *U* testing. Differences in scores according to the inclusion of the designated key messages was assessed using the Kruskal–Wallis test. Statistical analyses were undertaken with SPSS 16 software (SPSS Inc, Chicago, Ill).

RESULTS

Patient focus groups. We questioned 28 patients from the five NAAAQIP focus groups about their experience of counseling for AAAs and the Internet. Of these, 79% expressed a preference for face-to-face counseling about their AAAs, with only 7% favoring the use of the Internet. However, 75% of patients had direct or indirect access to the Internet and reported competence in its use. Of these, 57% had used the Internet to research health-related queries and reported it to be a useful adjunct to face-to-face counseling.

Included Web sites. Of the 150 Web sites reviewed, 38 were excluded for the following reasons: required paid subscription, 12; policy documents, including but not specifically focused on AAA, 10; advertisements, four; irrelevant sites, 10; and inaccessible links, two. Of the 112 relevant Web sites that remained, 57 were repeats and were excluded from quality analysis, although they were included for analysis of the influence of search-engine ranking. Fifty-five unique Web sites underwent detailed assessment.

Web site quality. Overall, the median FRE score was 39 (IQR, 29–47) and the median Michigan score was 36

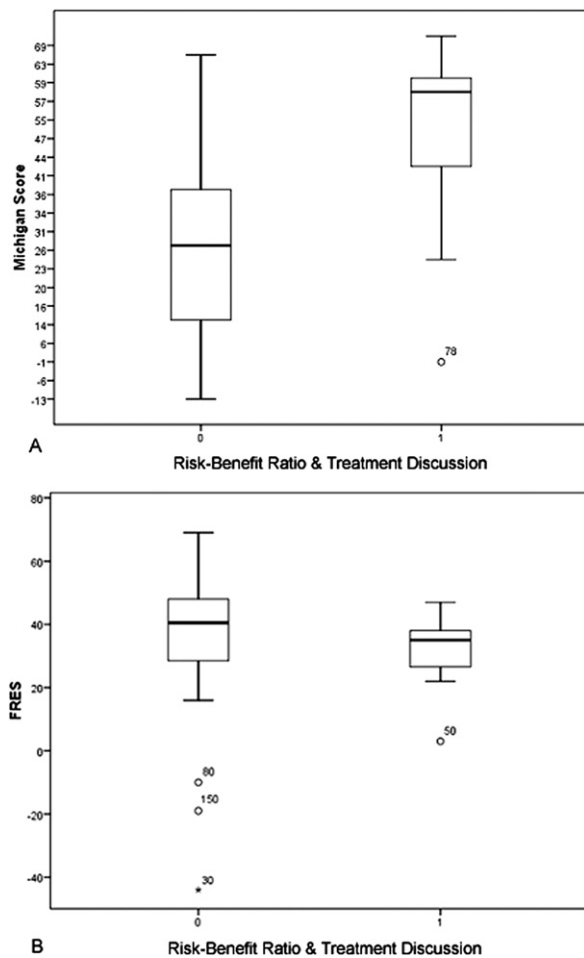


Fig 1. Box and whisker plot demonstrates a comparison of the (A) Michigan score and the (B) Flesch Reading Ease score (*FRES*) in Web sites with (1) a discussion of the risk–benefit ratio and treatment threshold vs those without (0) such a discussion. Median (interquartile range) scores: (A) 58 (41.5–59.5) vs 28 (14.75 to 36.5), $P < .001$; and (B) 35 (26–38) vs 40.5 (29.25–48), $P = .03$. The horizontal line in the middle of each box indicates the median; the top and bottom borders of the box mark the 75th and 25th percentiles, respectively; and the whiskers mark the 90th and 10th percentiles.

(IQR, 25–56), with high interobserver agreement between reviewers ($r_s = 0.83$; $P = .01$). As assessed by the Michigan score, four sites (7.2%) were rated good, eight (14.5%) were fair, 24 (43.6%) were weak, and 19 (34.5%) were poor. The correlation between the Michigan and FRE scores was not significant ($r_s = 0.064$; $P = .6$).

Fifteen (27.3%) Web sites included a coherent discussion on the individual risk–benefit balance determining the treatment threshold for AAAs. These Web sites had a significantly higher median (IQR) Michigan score (58 [41.5–59.5] vs 28 [14.75–36.5]; $P < .001$) but a significantly lower FRE score (35 [26–38] vs 40.5 [29.25–48]; $P = .03$; Fig 1).

Fourteen (25%) Web sites included a well-reasoned explanation of the advantages and disadvantages of open

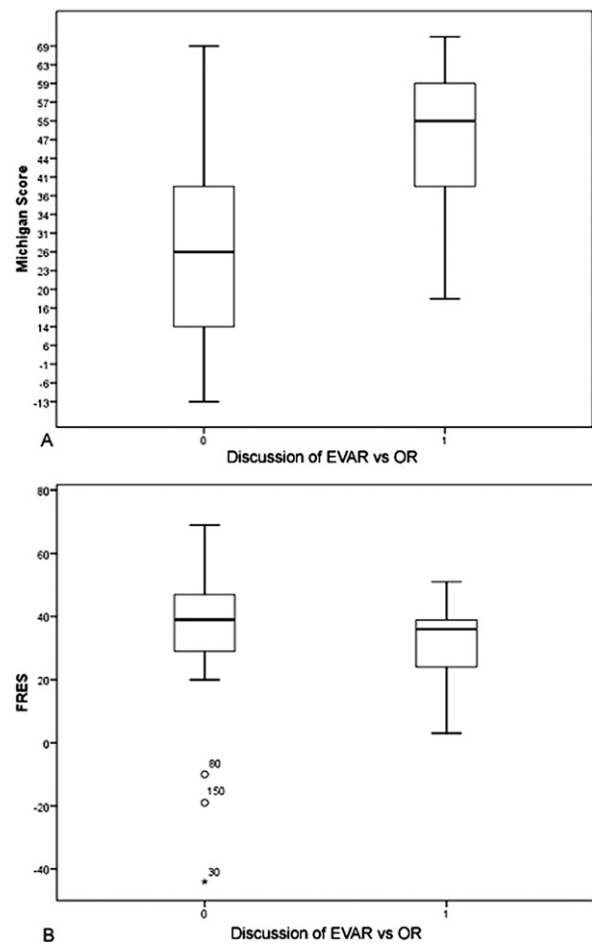


Fig 2. Box and whisker plot compares the (A) Michigan score and the (B) Flesch Reading Ease score (*FRES*) in Web sites with (1) a discussion of the pros and cons of endovascular aneurysm (*EVAR*) and open repair (*OR*) vs those without (0). Median (interquartile range) scores: (A) 52 (38.75–59) vs 26 (14–38), $P < .001$; and (B) 36 (25.5–38.75) vs 39 (29–47), $P = .2$. The horizontal line in the middle of each box indicates the median; the top and bottom borders of the box mark the 75th and 25th percentiles, respectively; and the whiskers mark the 90th and 10th percentiles.

AAA repair and EVAR. These Web sites also had a significantly higher median (IQR) Michigan score (52 [38.75–59] vs 26 [14–38]; $P < .001$) and a lower FRE score, although this was not statistically significant (36 [25.5–38.75] vs 39 [29–47]; $P = .2$; Fig 2).

No Web site included any information on the volume–outcome relationship in aneurysm surgery. The 10 Web sites that included information on both the risk–benefit intervention threshold and the differences between open repair and EVAR (Table III) had the greatest quality scores (median [IQR]) compared with sites containing neither (58.5 [50–59.75] vs 28 [13–36.5]; $P < .001$, Fig 3), but were no different in FRE score or search engine ranking.

Search engine ranking. The ranking of search results by Google was not correlated with Michigan score ($r_s =$

Table III. A comparison of Web sites containing both quality markers

Web site	Country of origin	HoN certificate	Highest search rank	FRE score	Michigan score
http://UpToDate.com	U.S.	No	17	37	70
Personal Web site					
Shane MacSweeny	U.K.	No	22	38	63
Andrew Bradbury	U.K.	No	35	39	45
EMedicine	U.S.	Yes	11	3	60
British Heart Foundation	U.K.	No	24	32	59
American Family Physician	U.S.	No	23	22	59
PatientUK	U.K.	No	7	47	58
Wikipedia	U.K.	No	4	24	56
NHS choices	U.K.	Yes	12	38	48
Intelli health	U.S.	Yes	37	35	38

FRE, Flesch Reading Ease; HoN, Health on the Net; NHS, National Health Service; U.K., United Kingdom; U.S., United States.

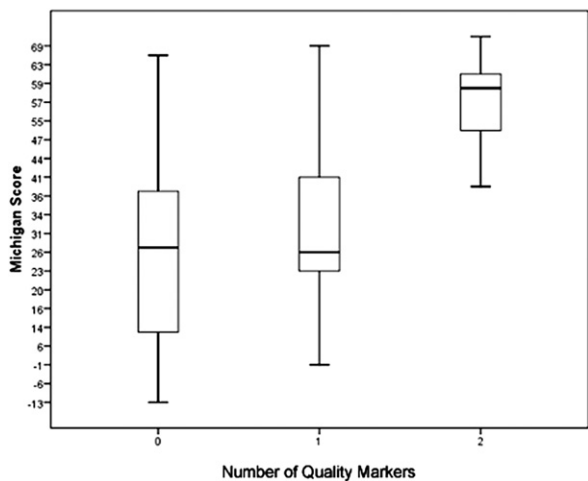


Fig 3. Comparison of Michigan score in Web sites with both (2), one (1), or neither (0) quality phrase marker: risk-benefit ratio and treatment threshold discussion and discussion of the pros and cons of endovascular and open repair. Kruskal-Wallis: $P < .001$; (0) vs (1) $P = .5$; (1) vs (2) $P = .01$; (0) vs (2) $P < .001$.

0.170; $P = .4$) or FRE score ($r_s = -0.028$; $P = .9$). There was a weak correlation of Michigan score and Yahoo! search ranking ($r_s = -0.35$; $P = .02$), but no correlation with FRE score ($r_s = -0.19$; $P = .2$). There was no correlation with the Michigan score ($r_s = -0.19$; $P = .3$) or FRE score ($r_s = -0.04$; $P = .8$) when searching with Bing.

Country of origin. One site (2%) was from Australia, 25 (45%) were from the U.K., and 29 (53%) were from the United States. The difference in the FRE or Michigan scores based on country of origin was not significant.

Organization type. Overall breakdown of organization type is shown in Fig 4. When 28 professional (51%) Web sites (health care providers, academic organizations,

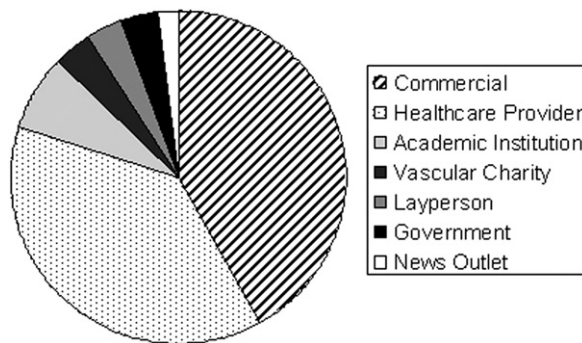


Fig 4. Pie chart demonstrates the origin of the 55 unique Web sites included in the quality analysis.

specialist charities, or government) and 26 nonprofessional (47%) Web sites (commercial sites, news outlets, and laypersons) were compared, the difference in FRE score or Michigan score was not significant. Most Web sites (93%) targeted patients, with the remaining 7% aimed at health care professionals.

HoN certification. Eight Web sites (15%) had HoN certification. The median (IQR) Michigan score for these sites was 43 (24.5-55.75) vs 31 (16.5-43; $P = .3$). There was no significant difference in FRE score.

DISCUSSION

Increasingly, patients are using the Internet as a vehicle to acquire information about their health problems.¹ Online patient education is appealing because patients can learn at their own pace, in their own home, driven by their own knowledge-seeking behavior and without significant financial outlay by the health care system compared with nurse-led or printed educational programs.¹⁸⁻²⁰ In controlled environments, patients appear to rate physician-designed electronic patient educational tools highly.²¹ In a real-world setting, however, patients can only use what is accessible to them.

The Internet remains controversial as a learning tool due to a lack of regulation, and as a consequence, the information provided is not necessarily accurate, updated, or relevant.^{22,23} In 1997, Silberg et al²³ identified four key quality attributes for any medical Web site: authorship, attribution, disclosure, and currency that form the basis of the Michigan score.

We found the quality of AAA-related Web sites was generally poor, although there were a small number of notable exceptions and seems to have improved little since Soot et al⁹ reviewed a series of vascular surgery Web sites in 1999. Only five sites scored good or excellent on the Michigan score, and the coverage of important information was often superficial, confusing, or absent. Too often authorship was unclear, as was the authority on which the site was written. A clear conflict of interest with regard to authorship of sites was common, with >40% of reviewed Web sites originating from commercial organizations with a vested interest in a specific AAA management strategy. The currency of sites was reported poorly, and when an update time was presented, it was often more than a year

out of date. This is particularly important given the evolving nature of our understanding of AAAs and the rapid pace of published AAA research.

We were unable to find a specific Web site-related factor associated with increased quality. Although HoN certification was associated with a trend toward higher-scoring Web sites, this was not statistically significant. The HoN Foundation (<http://www.hon.ch>) is a nonprofit, nongovernment organization established in 1995 that strives to promote useful and reliable online health information. Web sites can apply for HoN certification to establish their credibility, but this is a voluntary arrangement, which significantly weakens the concept. Further, the HoN survey revealed that patients rate the ease in which a site can be found using simple search engines above the accuracy of the information contained within the site or the trustworthiness of the source.²⁴

Only 27% of Web sites went beyond describing the threshold for intervention as “5.5 cm.” This is of concern, because it is critical to understanding the rationale for management of AAAs. Only 25% of Web sites satisfactorily outlined the advantages and disadvantages of open repair and EVAR, with many still describing EVAR as a “new technology, the role of which remains to be established.”

No Web site covered the volume–outcome relationship in AAA surgery. This was surprising, because this is currently a driver for major service reconfiguration in the U.K. and a key area where patients are able to exercise choice.⁸ Web sites containing a coherent statement on the threshold for intervention or the differences between open repair and EVAR had higher Michigan scores but had a higher reading level. Sites containing both statements were associated with the highest scores, and identification of these key messages in AAA Web sites may serve as a useful tool for clinicians to rapidly evaluate a particular Web site (eg, if used by a patient attending the outpatient clinic). A Web site containing satisfactory descriptions of both aspects is likely to be of higher overall quality. This style of assessment is more expedient than full Michigan scoring in our experience, which can take 20 to 30 minutes to complete, and is therefore more practicable in the clinical setting.

In addition to a general theme of poor quality, the language used in Web-based AAA information was above what a large proportion of the U.K. population is likely to be able to understand. The U.K. standard reading level equates to an FRE of 60 to 70 and a reading age of ~15 years,²⁵ which limits the ability of patients to understand the information contained within them, regardless of the quality of the content. Only two Web sites had a score that equated to a standard reading level, the rest having more complicated language. This pattern has also been demonstrated for Web sites providing information on diabetes²⁶ and orthopedic surgery²⁷ and is something that needs to be addressed to facilitate better patient comprehension of available information.

There was no significant correlation between the Michigan score and Web site ranking in the results list for any of the three search engines evaluated. This highlights

an important challenge in providing good-quality health education online. Even if a perfect AAA patient educational Web site were available, disseminating it to patients through a congested information landscape would still be a significant challenge²⁸; our search term alone generated >3.9 million results across the three search engines interrogated. Despite efforts by many large organizations to provide online education, the most commonly searched site for health-related queries is Wikipedia,²⁹ which featured in the top six search results in all three search engines in this study. Wikipedia had a Michigan score of 56 and an FRE score of 24. Whether the popularity of Wikipedia represents a significant hurdle to providing good-quality, accessible online health education or a unique opportunity remains to be seen.³⁰

Only the top 50 search results for each search engine were reviewed in this study and only with one search phrase; clearly, this is only a fraction of the potential number of Web sites in existence on our topic of interest and a limitation of the study. We found that using related search terms yielded very similar results. Further, most users searching for health care-related terms focus on the first page of search results, with an exponential decay in traffic thereafter,³¹ and consequently, we believe our strategy, which included five pages of results, included those sites most likely to be considered by patients. We respect that our search results reflect a snapshot in time from a single location and recognize the fluidity of information available online. Our results provide information for reflection, to drive change, and to serve as a comparison point for reassessment in the future.

The Michigan score has a number of limitations. Despite being a detailed, objective Web site scoring tool designed for health care-related Web site assessment in an objective manner, many of its scoring points rely on a significant degree of user-dependent analysis, adding a subjective element to the score. Because it is a generic scoring tool, it lacks topic-specific elements. However, we found it was highly reproducible between the two assessors. The Michigan score is more complex than other scoring systems described due to its more comprehensive nature, and although this gives it more reliability as a tool, it also makes it much more time-consuming to use: the assessment of a single site took up to 30 minutes. The weighted scoring system is nonlinear and may skew scores toward the poor end of the spectrum. It is therefore advisable to consider the relative scores of sites in the same topic area as well as the quality label.

The FRE score is a universally applicable readability score first developed in 1948 and used extensively by the U.S. military and in instructional development.³² Although readability is not the same as “understandability,” it is a useful surrogate marker.

CONCLUSIONS

The current AAA-related information available to patients on the WWW is of generally poor quality with difficult readability. Interrogation of Web sites by clinicians for statements

on the risk–benefit threshold for treatment and a coherent discussion on the advantages and disadvantages of EVAR can help establish higher-quality sites in the clinical setting. Further work is required to enhance the quality and readability of online AAA information to patients, but ensuring the accessibility of this information to our patients remains a significant challenge for the international community with a vested interest in AAAs. It is important that clinicians treating patients with AAAs are aware of the limitations of the currently available online “lay literature” that their patients may have access to, and we encourage active involvement in improving quality. It is imperative that sites are coherent, comprehensive, and above all, current.

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AUTHOR CONTRIBUTIONS

Conception and design: MB, PC, JS

Analysis and interpretation: MB, PC, SS, SR, MT

Data collection: MB, PC, KG

Writing the article: MB, PC, KG

Critical revision of the article: SS, SR, MT

Final approval of the article: JS

Statistical analysis: MB, SS

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Overall responsibility: JS

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