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Wikipedia vs Peer-Reviewed Medical Literature for Information About the 10 Most Costly Medical Conditions

To the Editor:

In their May article in *The Journal of the American Osteopathic Association*, "Wikipedia vs Peer-Reviewed Medical Literature for Information About the 10 Most Costly Medical Conditions," Hasty et al[1] attempted to evaluate the accuracy of medical articles in Wikipedia, focusing on the 10 most costly medical conditions in the United States. The researchers reported a statistically significant difference in the assertions (ie, "statements of fact") presented in Wikipedia compared with the peer-reviewed literature for 9 of the 10 costliest conditions they identified. They concluded that the results of their study "cast serious doubt on Wikipedia's authority as a medical reference repository."[1] Unfortunately, the study has several flaws and limitations. Some of these were identified by the authors; however, we believe the most serious ones were overlooked.

First, the reviewers only looked at 1 Wikipedia article for each condition, yet for many conditions there may be several articles available but under slightly different headings. In our research on the topic, we found more than 1 relevant Wikipedia entry for most of the health-related topics that we looked at.[2]

Second, it seems that Hasty et al[1] had no firm criteria for selecting either the Wikipedia or the peer-reviewed articles. Several times the reviewers assessed Wikipedia topics that were only weakly related to the ones they were supposed to assess. For example, for the categories of cancer, mental disorders, and heart disease, they used Wikipedia articles on lung cancer, depression, and coronary artery disease, respectively. Likewise, the selection of the peer-reviewed articles was left up to the reviewers; the quality of the "standard" against which Wikipedia was compared could itself be called into question.

Because the research described in this study is fraught with so many methodologic errors, we believe the results cannot be interpreted with any confidence. In particular, we challenge the authors' key conclusion that their study provides evidence that most Wikipedia articles on the 10 medical conditions they included contain "many errors." (doi:10.7556/jaoa.2014.146)

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1. Hasty RT, Garbalosa RC, Barbato VA, et al. Wikipedia vs peer-reviewed medical literature for information about the 10 most costly medical conditions. *J Am Osteopath Assoc.* 2014;114(5):368-373. doi:10.7556/jaoa.2014.035.
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To the Editor:

In their May 2014 article, Hasty et al[1] reported that Wikipedia contains errors. This finding is based on 2 assumptions about knowledge dissemination in medicine that we question. The first is that the peer-reviewed literature is an accurate reflection of the raw data. The second is that nonspecialists can quickly access a source, such as Up-to-Date,

and verify the truthfulness of complex issues. The authors assumed that third-year residents with no specific expertise could correctly ascertain the accuracy of claims made on Wikipedia by comparing them with statements in the peer-reviewed literature.

Hasty and colleagues have not made their dataset public, so it is impossible to confirm the veracity of their conclusions. This is disappointing because, in this day and age, publicly available data can easily be posted online to facilitate reanalysis and discussion. The authors did share with us a small subset of their dataset on major depressive disorder. We closely examined 2 statements from Wikipedia that the researchers identified as inaccurate. To illustrate the problematic nature of these findings, we discuss them in-depth in the following paragraphs.

Antidepressants have not been found to be beneficial in children.[2]

This statement was coded as being contradictory to the peer-reviewed literature, with one coder noting, "No, fluoxetine is approved for age 8 and older." This statement further illustrates the problems with the study methods. The US Food and Drug Administration (FDA) approval only means that there is a statistically significant difference between the medication and placebo, and a closer look at the data and methods is necessary if one wishes to understand the clinical significance of the results. In 1 of the 2 studies submitted to the FDA for fluoxetine's approval, in addition to a commonly practiced placebo run-in phase, there was a fairly unique medication run-in phase to ensure that only children who were medication responders were allowed into the study. Yet, even with this advantage, for the prospectively defined primary outcome measure, 65% of the children taking Prozac had a beneficial response compared with 53% of the patients taking placebo, a result that was not statistically significant. It was only by looking at other measures that clinical significance was found; on the patient- and parent-rated scales there was no advantage to Prozac, but on 1 of the clinician-rated scales there was a slight advantage to Prozac. Although Russell Katz, MD, of the FDA wrote, "one could argue that this post hoc choice of primary outcome is inappropriate," the FDA accepted the post hoc change and approved Prozac for children.[3]

In fact, there is perhaps no more contentious and complex issue in medicine right now than the use of antidepressants in young children. Even in adults there is an ongoing debate about the efficacy of antidepressants.[4] In the case of antidepressants there is evidence of selective reporting,[5] ghostwritten papers, and a well-documented difference between the published and unpublished clinical trial data.[6] Several years ago, an editorial in *The Lancet* summarized the peer-reviewed research on pediatric antidepressant use as "confusion, manipulation, and institutional failure."[7] In reference to the pediatric use of antidepressants, Healy referred to the difference between the published data and the actual raw clinical trial data as the "greatest known divide in all of medicine."[8]

In 2004, a study in the *BMJ* examined the methods and reporting of the published trials of the newer antidepressants in children younger than 18 years.[9] According to these researchers, the drugs offered only a modest benefit over placebo but had significant risks. In their conclusions they noted that: "Antidepressant drugs cannot confidently be recommended as a treatment option for childhood depression." These researchers also noted that in the original Prozac pediatric trials submitted to the FDA, Prozac did not show efficacy over placebo on the primary end points.

Psychotherapy is the treatment of choice for people younger than 18 years.[2]

The coders also found fault with this statement and mentioned that combination therapy should be used. Again, this is an area rife with debate. For instance, the European Medicines Agency recommends that, for children and adolescents aged 8 years or older, medication should only be used if the patient is unresponsive to psychological therapy. The European Medicines Agency does not recommend medication for children younger than 8 years.[10] The recent Treatment for Adolescents With Depression Study (TADS) is often cited as evidence for the superiority of fluoxetine plus cognitive behavioral therapy, but support for this therapy comes from the unblinded arm of the study. Some researchers have stated that it is a failed trial of Prozac: "TADS found no statistical advantage of fluoxetine over placebo on the primary end point, the children's depression rating scale (CDRS-R; P=0.10), but this was not mentioned in the abstract."[11]

Peer-Reviewed Literature

It seems problematic to conclude that statements made in Wikipedia are wrong based on peer-reviewed literature. The peer-reviewed literature is filled with ambiguity, different viewpoints, and debate. As the editors of *Nature* stated, "scientists understand that peer review per se provides only a minimal assurance of quality, and that the public conception of peer review as a stamp of authentication is far from the truth."[12]

Much of the problem with the medical literature stems from a failure of pharmaceutical companies to release data. The current debate about Tamiflu is just one example.[13] In general, seasoned readers of the clinical trial literature assume that the beneficial effects of a trial medication are exaggerated and that the adverse effects are downplayed. Only a naive reader would assume a published clinical trial portrays a true picture of all of the data. Vioxx is another example of a medication, in which there was a substantial disconnect between the published literature and the actual clinical trial data, yet it had been approved by the FDA.[14] Many of the leaders in medical publishing and academic medicine are now calling for researchers to freely share data so that others can analyze it (eg, the AllTrials campaign, http://www.alltrials.net/). Several pharmaceutical companies are now agreeing to share their data in principle.[15]

It seems to us that trial data selected for publication should be looked upon skeptically unless all of the data are freely available. This critical viewpoint seems to be especially important when interpreting the study by Hasty et al[1] because they claimed that a widely used website has made misleading statements, but the authors do not identify the actual statements. We found problems with their coding by examining just a small subset of statements on major depressive disorder—whether the same problems would apply to other diseases they examined (eg, heart disease, hypertension, diabetes) is unknown. To verify their conclusions would require that the entire dataset be available, increasingly an ideal within most scientific disciplines.[16] Ironically, the lack of access to their data is in direct contrast to Wikipedia, where the debate about any given statement is freely available for all to see.

The purpose of this letter is not to debate the use of antidepressants in children but simply to point out that, because there is a healthy debate in the medical literature about these medications, it is hard to summarize the veracity of complex statements in an Excel file with simple yes or no answers. It is not surprising that some information in Wikipedia and in the peer-reviewed literature is controversial, biased, or even wrong. However, the methods and conclusions of Hasty et al[1] suggest that physicians and researchers are not sufficiently skeptical of the medical literature. This lack of skepticism has profound implications for public health, much more so than potentially erroneous statements made in Wikipedia. (doi:10.7556/jaoa.2014.147)

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To the Editor:

It seems to have become popular to use Wikipedia and similar online resources as references; therefore, the article by Hasty et al[1] caught our attention. We are in agreement with the opinions of Hasty et al[1] that health care providers should be aware of the limitations of nonrefereed online sources. However, the study could have been better designed and the data more appropriately analyzed.

The authors looked at the accuracy of Wikipedia articles as a source of health care information, but they did not evaluate the accuracy of peer-reviewed articles. While these sources are generally accurate, errors can still exist. At the same time, the accuracy of peer-reviewed literature cannot be simply classified as either correct or incorrect. Discrepancies often occur among articles regarding a certain topic. Therefore, the measurement of the accuracy of peer-reviewed literature would not just be binary. Because Hasty et al[1] did not identify a specified number of assertions for each condition and did not measure whether Wikipedia and peer-reviewed literature were correct or not, respectively, their use of the McNemar test to compare Wikipedia vs peer-reviewed medical literature was inappropriate. The McNemar test is used to compare proportions for paired data.[2] If for example there were 100 items to be examined and we determined that both Wikipedia and peer-reviewed sources were correct in 70 of them, both were incorrect in 5, Wikipedia was correct but peer-reviewed sources were incorrect in 8, and Wikipedia was incorrect but peer-reviewed sources were correct in 17, then the McNemar test would be the appropriate method of comparison. However, this is not the type of data presented in Hasty et al.[1] For example, if we take the data Hasty et al[1] presented for osteoarthritis in the article's table 3 and interchange the rows under "dissimilar" (*Chen Table*), the data remain the same, but the *P* value for the McNemar test would be .522 instead of .003.

Because the authors make the assumption that peer-reviewed articles are correct, it is more appropriate to study the percentage of concordance. Reviewer 1 and reviewer 2 in the study may be viewed as 2 randomly selected individuals who examined the assertions for each condition. It is unclear whether the same person reviewed more than 1 article, but we are not able to rule out that possibility. Also, according to their data, 2 reviewers for the same article, in general, did not review exactly the same assertions for the assigned article, which can be seen in the different total numbers. As a result, we can use the overall percentage from each reviewer ("Both" in table 3). It is then reasonable to use the average percentage of concordance from the 2 reviewers as if they were independent. The average percentages of concordance of 10 conditions ranged from 65.9% to 91.0%, with a median of 77.5% (mean [SE], 78.3%[2.8%]; 95% CI, 72.0%-84.6%).

If a reviewer found concordance, it is reasonable to assume that the concordance is true. On the other hand, if a reviewer did not find concordance, the discordance is not necessarily 100% sure. Therefore, the percentages based on table 3 may likely be underestimated, which we believe would have a relatively minor impact. Another issue is that concordance and correctness are not the same. The data in the article are more adequate to reveal concordance than correctness with the peer-reviewed medical literature.

Because the authors assumed that the peer-reviewed articles were correct, they did not define a hypothesis regarding the accuracy of the Wikipedia articles. Although one may hypothesize that the average concordance percentage of Wikipedia articles is greater than a given value (eg, 70%), this cutoff value may be

Chen Table.
Dissimilar Assertions for Osteoarthritis by Concordance and Discordance

	Did Wikipedia Match Peer-Reviewed Literature?	
Reviewer	**Yes (Concordant)**	**No (Discordant)**
Reviewer 2	19	13
Reviewer 1	9	4

subjective. Moreover, a point estimation and CI need to be provided in addition to a *P* value. We believe that our analyses are appropriate. A 78% concordance rate (95% CI, 72-85) reflects that many experts contributed to the Wikipedia articles. However, Wikipedia is an open-edited online encyclopedia, which may lower the accuracy.[3]

From our interpretation of the data presented by Hasty et al,[1] Wikipedia is not a bad online source. However, for patient care and for medical research, we agree that Wikipedia articles should not replace peer-reviewed medical literature. (doi:10.7556/jaoa.2014.148)

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To the Editor:

Regarding the statistical analysis used in the May 2014 article by Hasty et al, "Wikipedia vs Peer-Reviewed Medical Literature for Information About the 10 Most Costly Medical Conditions,"[1] I believe that use of the McNemar test was wholly inappropriate. The data presented in the study do not meet the statistical considerations required for this analysis.

The McNemar test for correlated proportions requires paired observations that could be placed into a 2×2 contingency table. Consider *Gurzell Table 1*, a hypothetical, counterfactual example that could be used to test whether the assertions found in Wikipedia agree with peer-reviewed sources.

The McNemar test assesses whether there is marginal homogeneity between paired observations[2] (eg, no statistically significant difference between dichotomous observations between Wikipedia vs peer-reviewed literature). In that the McNemar test evaluates correlated proportions, nothing is gained when they agree with each other; therefore, the calculation only takes discordant paired observations into account. Given *Gurzell Table 1*, the McNemar test results in a χ^2 test statistic obtained from the following formula:

$$\chi^2 = \frac{([B–C]–1)^2}{(B+C)}$$

The collected data in the published study[1] evaluated whether an assertion made in a Wikipedia article was verified by peer-reviewed sources. This structure constitutes a single dichotomous observation (verified vs not verified) and cannot be used in a McNemar test because one cannot construct the appropriate 2×2 contingency table.

I believe that the authors mistakenly used the McNemar test for the data presented in their article's table 3.[1] Given that the rows are 2 independent observations from reviewers 1 and 2, applying the above calculation to the data would be inappropriate.

The data organized in the Hasty et al article was organized as shown in *Gurzell Table 2*. I am able to recreate the *P* values by assuming that the table is set up for a McNemar test, with the resulting equation:

$$\chi^2 = \frac{([N_1–M_2]–1)^2}{(N_1+M_2)}$$

I am concerned that I am able to replicate 29 of the 30 *P* values reported in Hasty et al's table by incorrectly performing the McNemar test in the way described above (using both GraphPad software and VassarStats online calculator). I believe that the data presented in Hasty et al[1] were inappropriately analyzed using the McNemar test, thus leading to nonsensical statistical output.

I respect and agree with the assertion that Wikipedia is not an appropriate medical reference, and I agree with the authors' take-home message that medical professionals and medical students should consult Wikipedia with caution and, when available, use peer-reviewed science.

However, I believe that the study here was incorrectly analyzed and inappropriately published through the same peer-review process that Hasty et al are holding to such high esteem. It is highly unlikely that I would be able to systematically replicate all but 1 (osteoarthritis, "dissimilar data") of their *P* values by inappropriately entering data points taken from table 3 of their article into the McNemar test. (doi:10.7556/jaoa.2014.149)

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Gurzell Table 1.
Hypothetical Table for McNemar Test of Whether Assertions in Wikipedia Agree With Peer-Reviewed Sources

	Peer-Reviewed Literature	
	Correct	Incorrect
Wikipedia Article		
Correct	A	B
Incorrect	C	D

Gurzell Table 2.
Organization of Data in Table 3 of Study by Hasty et al[1]

	Did Wikipedia Match Peer-Reviewed Literature?	
Reviewer	Concordant (M=Match)	Discordant (N=No Match)
Reviewer 1	M1	N1
Reviewer 2	M2	N2

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Response

We appreciate the comments by Fraser and Temple,[1] Leo and Lacasse,[2] Chen and Xiong,[3] and Gurzell[4] regarding our May 2014 study [5] on Wikipedia articles.

As we identified in our article,[5] one of the study's limitations was that reviewers could use any peer-reviewed reference that was published or updated (within the past 5 years) as a standard. A future study could be conducted that would limit the type of references that could be used. Fraser and Temple1 also question whether there might have been a selection bias to the articles that were representative of the 10 most costly medical conditions. The representative articles were chosen before any analysis of the content to reduce the chance of a selection bias. It is important to note that there are more than 30,000 articles in Wikipedia pertaining to medical conditions[6] and that our study only examined 10 of those articles. In addition, our study was designed to look for errors rather than omissions of information. We made no comment or criticism on the breadth of information covered on each subject or its completeness. A future study could be conducted to examine a larger number of representative articles. However, for the purposes of our study, examining more articles would not have lessened the importance of the errors we found in the articles we studied.

Leo and Lacasse[2] present an analysis of a sampling of raw data on major depressive disorder from our study. One Wikipedia assertion they mention in their analysis was "antidepressants have not been found to be beneficial in children."[7] They challenge the finding the reviewer cited from UpToDate, in which the reviewer reported, "No, fluoxetine is approved for age 8 and older" and discussed the US Food and Drug Administration approval process.[5] Unfortunately, Leo and Lacasse did not mention that the reviewer in our study went on to cite a meta-analysis that examined 19 studies and found "an overall benefit of SSRI [selective serotonin reuptake inhibitor] medications compared to placebo for children and adolescents," although this meta-analysis did go on to say that these results "should be interpreted with caution."[8]

Another Wikipedia assertion mentioned in the Leo and Lacasse analysis was, "Psychotherapy is the treatment of choice for people younger than 18 years." The researcher in our study cited a guideline for adolescent depression, which stated, "however, the results of a recent RCT [randomized controlled trial] demonstrated superior efficacy of combination therapy (medication and CBT [cognitive behavioral therapy]) versus CBT alone.... When indicated by clinical presentation (clear diagnosis of MDD [major depressive disorder] with no comorbid conditions) and patient/family preference, an SSRI should be used."[9] This finding does not support the assertion made in Wikipedia.

Although their analysis highlights controversial topics in major depressive disorder, it is important to note that the Wikipedia article Leo and Lacasse referenced did not include the controversy in

their 2 assertions.[7] If Wikipedia articles are considered review articles, then it would be expected that major controversial points would be discussed rather than presented from one perspective. If such a discussion occurred in the Wikipedia article (as would likely have occurred in a peer-reviewed review article), Wikipedia would not have been found as discordant with the literature on this topic. Overall, the analysis of the subset of data given to Leo and reported by Leo and Lacasse is not complete, and the 2 examples they cited support the study as designed. We would encourage them to reproduce our study to see if they find similar results.

Chen and Xiong[3] as well as Gurzell[4] question the use of the McNemar test and the statistical analysis of the data in our study. The study's null hypothesis was that "there would be concordance between the Wikipedia article and peer-reviewed sources." Our study dealt with correlated proportions; therefore, we matched the peer-reviewed results with the Wikipedia results (by keywords).[5] For greater clarity, our table 3 should have indicated "Peer-Reviewed" as a row header instead of "Reviewer 1" and "Reviewer 2," and then under this header we should have had 2 rows: "Concordance" and "Discordance." The column header should have been "Wikipedia." For example, we calculated the following proportions for the lung cancer assertions: $PPeerR=(73+27)/201=0.49$ and $PWiki=(73+83)/201=0.77$. The McNemar test results for 2 tails shows $P<.0001$ (using the exact binomial probability calculation). Thus, we rejected the null hypothesis for the similar assertions. Because of the large number of possible errors, we did not measure the accuracy but estimated the significance of the difference between the peer-reviewed and Wikipedia statements, which is why we did not report CIs. (doi:10.7556/jaoa.2014.150)

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