Journal of the American Pharmacists Association xxx (2016) 1–4

Contents lists available at ScienceDirect

Journal of the American Pharmacists Association

journal homepage: www.japha.org

RESEARCH NOTES

Accuracy and completeness of drug information in Wikipedia medication monographs

Timothy Reilly*, William Jackson, Victoria Berger, Danielle Candelario

ARTICLE INFO

Article history:
Received 6 July 2016
Accepted 15 October 2016

ABSTRACT

Objectives: The primary objective of this study was to determine the accuracy and completeness of drug information on Wikipedia and Micromedex compared with U.S. Food and Drug Administration–approved U.S. product inserts.

Methods: The top 10 brand and top 10 generic medications from the 2012 Institute for Health Informatics' list of top 200 drugs were selected for evaluation. Wikipedia medication information was evaluated and compared with Micromedex in 7 sections of drug information; the U.S. product inserts were used as the standard comparator.

Results: Wikipedia demonstrated significantly lower completeness and accuracy scores compared with Micromedex (mean composite scores 18.55 vs. 38.4, respectively; $P < 0.01$). No difference was found between the mean composite scores for brand versus generic drugs in either reference (17.8 vs. 19.3, respectively [$P = 0.62$], for Wikipedia; 39.2 vs. 37.6, [$P = 0.06$] for Micromedex). Limitations to these results include the speed with which information is edited on Wikipedia, that there was no evaluation of off-label information, and the limited number of drugs that were evaluated.

Conclusion: Wikipedia lacks the accuracy and completeness of standard clinical references and should not be a routine part of clinical decision making. More research should be conducted to evaluate the rationale for health care providers' use of Wikipedia.

Clinicians must have complete and accurate drug information to make appropriate treatment decisions and to educate patients. In the past, medical resources were limited to peer-reviewed journals and academic textbooks, but the rise of Internet-based applications, and specifically Wikipedia, has changed the way that information is created and disseminated on the Internet.[1] Wikipedia is the seventh most popular Internet site and contains more than 150,000 medical articles across 255 languages.[2,3] Among search engine rankings, Wikipedia was the top search result for 85% of generic and branded drug ingredients on Bing and Yahoo.[4] Wikipedia is an open-source platform that allows users, regardless of their background or training, to share information with other users, which is contrary to established procedures for publishing medical literature.[5]

Recent evidence has shown that health care professionals are turning to the World Wide Web to answer treatment-related questions.[2-4,6-9] A recent Institute of Medical Science Institute for Healthcare Informatics report found that 50% of U.S. physicians who use the Internet for professional purposes report using Wikipedia.[6] Furthermore, a 2009 survey indicated that only 28% of pharmacists who used Wikipedia for medical information were aware of who edits and manages the site.[9] Students also are using Wikipedia as a classroom reference, even though 97% of these users reported finding errors in the monographs.[10] Despite this high prevalence of Wikipedia use, there is scant evidence supporting the accuracy and credibility of drug information found on Wikipedia. Kupferberg et al.[11] previously identified inconsistencies in Wikipedia information, but the review was limited to a small sampling of HMG-CoA reductase inhibitor medications. Clauson et al.[12] conducted a study comparing Wikipedia with Medscape Drug Reference for answering drug information

Disclosure: Dr Reilly's spouse is an employee of Acro Service Corporation, which provides contract support to the pharmaceutical industry. At the time of writing, Drs Jackson and Berger were postgraduate fellows at Ernest Mario School of Pharmacy, Rutgers, The State University of New Jersey, and their fellowship included work in Medical Affairs at Bristol-Myers Squibb; they are both currently employed by Bristol-Myers Squibb. Dr Candelario has nothing to disclose.

Previous presentation: This work was presented as a poster session at the 2015 International Forum on Quality and Safety in Healthcare, London.

* **Correspondence:** Timothy Reilly, PharmD, Clinical Assistant Professor, Department of Pharmacy Practice and Administration, Ernest Mario School of Pharmacy, 160 Frelinghuysen Road, Piscataway, NJ 08854.
E-mail address: tjreilly@pharmacy.rutgers.edu (T. Reilly).

http://dx.doi.org/10.1016/j.japh.2016.10.007
1544-3191/

questions and found both to be deficient, with scores for completeness of 40.0% and 82.5%, respectively. Another study conducted by Hasty el al.[13] demonstrated the poor concordance between disease state Wikipedia articles and their corresponding peer-reviewed sources, identifying that 9 out of the 10 disease state articles contained assertions that were not supported by peer-reviewed literature. In addition, Kraenbring et al.[14] evaluated the accuracy and completeness of German and English Wikipedia monographs compared with German pharmacology textbooks. That study used an academic reference that would not be used in clinical practice, did not assess all of the common sections of a monograph that a clinician would use, and did not necessarily use the most frequently prescribed agents.

Although Wikipedia is an open access reference designed for the general public, the literature indicates that it is being used by many clinicians in a manner similar to subscription-based medical references, such as Micromedex.[15] To date, there has not been a systematic review of the accuracy and completeness of drug monographs located on Wikipedia compared with the U.S. Food and Drug Administration–approved U.S. product insert (USPI).

Objective

The primary objective of the present study was to determine the accuracy and completeness of drug information on Wikipedia and Micromedex compared with the USPI. Secondary objectives included the comparison of brand and generic drug information on both Wikipedia and Micromedex for accuracy and completeness. The individual sections of drug information were also evaluated.

Methods

Selection of comparator references

The USPI was chosen as the standard reference to define accuracy and completeness. The USPI is federally regulated, readily available, and based on the highest quality of information available. Micromedex was selected as a comparator to Wikipedia, because it is a widely used medication reference created and continuously updated by medical professionals.[16]

Category selection and scoring methodology

Seven essential sections of clinically important drug information were selected and served as the basis of our analysis: indications, dosage and administration (adult dosing, pediatric dosing, and dosing in renal and hepatic dysfunction, if available), adverse events, contraindications, drug-drug interactions, use in pregnancy and lactation, and mechanism of action (type of interaction, specific receptor, and biologic effect).

To quantify the completeness and accuracy of each reference, a scoring system (Table 1) was adapted from a previously published study.[12] This scoring system was applied to 7 sections. Each section could receive up to 3 points each for completeness and accuracy, for a total score of 6. A composite score was then calculated to a maximum of 42 points. To minimize inter-rater variability, 1 person accessed and scored all of the monographs.

Table 1
Composite scoring system

Score	Completeness scale	Accuracy scale
3	All items present	All items accurate
2	>50% of items present	>50% of items accurate
1	<50% of items present	<50% of items accurate
0	No items present	No items accurate

Drug selection and monograph retrieval

Brand and generic medications that had the highest prescription volume, based on the 2012 Institute for Health Informatics' Top 200 Drugs list, were selected for evaluation (see Supplemental Appendix for a complete listing).[17]

USPIs were obtained from either the manufacturers' websites or U.S. Food and Drug Administration website. Monographs were retrieved from the Micromedex and Wikipedia websites. Because Micromedex and Wikipedia are updated daily, all monographs were downloaded on a single day to ensure consistency of the content.

Statistical analysis

Descriptive statistics were used to summarize the scores for the monographs; data are presented as means with standard deviations. Microsoft Excel 2011 was used to calculate unpaired *t* tests to compare the results for Wikipedia and Micromedex and the results for brand and generic drugs. Institutional Review Board approval was not required for this study.

Results

Compared with Micromedex, Wikipedia demonstrated significantly lower composite scores as well as lower completeness and accuracy scores (Table 2); there was no difference between the mean composite scores for brand versus generic medications in either reference (Micromedex: 39.2 vs. 37.6, respectively [$P = 0.06$]; Wikipedia: 17.8 vs. 19.3, respectively [$P = 0.62$]).

When the composite scores for each section were analyzed individually, Wikipedia had significantly lower scores for each category (Table 2). The completeness score of each section was significantly lower for Wikipedia compared with Micromedex; there was no difference detected in the accuracy scores for drug-drug interactions and use in pregnancy and lactation, but Wikipedia scored significantly lower in all of the other sections. The Wikipedia section with the highest composite score was use in pregnancy and lactation; the Micromedex section with the highest composite score was adverse events.

Discussion

This study indicates that Micromedex is a more complete and accurate drug reference than Wikipedia, based on an analysis of 7 key drug information sections. These findings were consistent for both brand and generic drugs.