Patient-Oriented Methotrexate Information Sites on the Internet: A Review of Completeness, Accuracy, Format, Reliability, Credibility, and Readability

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ABSTRACT. ***Objective.*** With continuing use of the Internet, rheumatologists are referring patients to various websites to gain information about medications and diseases. Our goal was to develop and evaluate a Medication Website Assessment Tool (MWAT) for use by health professionals, and to explore the overall quality of methotrexate information presented on common English-language websites.
Methods. Identification of websites was performed using a search strategy on the search engine Google. The first 250 hits were screened. Inclusion criteria included those English-language websites from authoritative sources, trusted medical, physicians', and common health-related websites. Websites from pharmaceutical companies, online pharmacies, and where the purpose seemed to be primarily advertisements were also included. Product monographs or technical-based web pages and web pages where the information was clearly directed at patients with cancer were excluded. Two reviewers independently scored each included web page for completeness and accuracy, format, readability, reliability, and credibility. An overall ranking was provided for each methotrexate information page.
Results. Twenty-eight web pages were included in the analysis. The average score for completeness and accuracy was 15.48 ± 3.70 (maximum 24) with 10 out of 28 pages scoring 18 (75%) or higher. The average format score was 6.00 ± 1.46 (maximum 8). The Flesch-Kincaid Grade Level revealed an average grade level of 10.07 ± 1.84, with 5 out of 28 websites written at a reading level less than grade 8; however, no web page scored at a grade 5 to 6 level. An overall ranking was calculated identifying 8 web pages as appropriate sources of accurate and reliable methotrexate information.
Conclusion. With the enormous amount of information available on the Internet, it is important to direct patients to web pages that are complete, accurate, readable, and credible sources of information. We identified web pages that may serve the interests of both rheumatologists and patients. (First Release Nov 1 2008; J Rheumatol 2009;36:41–49; doi:10.3899/jrheum.080430)

Key Indexing Terms:
INTERNET   METHOTREXATE   INFORMATION   SEARCH

Accurate communication of information concerning the risks and benefits of medications is important for adherence and patient safety. However, communication between health professionals and patients is inherently problematic. From the perspective of a health professional, a number of barriers exist, including the use of technical terminology, the volume of information to be conveyed, time constraints, and lack of patient familiarity with the information. During conversations with patients, technical terminology is often used because it is precise, familiar, and often because there are no exactly equivalent nontechnical words available[1].

Further, health and medication-related information is unfamiliar to the majority of patients. An overwhelming volume of new information and instructions concerning unfamiliar material makes comprehension much more difficult. As a solution to this problem, healthcare professionals, including rheumatologists, often direct their "Internet-literate" patients to websites to learn about medications such as methotrexate (MTX). However, in a systematic review of studies assessing the quality of health information on the Internet, 70% of the studies concluded that the quality of information on the Internet was a problem[2]. Unfortunately, no standards are required for medication information on the Internet.

The goal of our study was to develop and evaluate a Medication Website Assessment Tool (MWAT) and to explore the overall quality of MTX information published on English-language websites.

MATERIALS AND METHODS

This study was conducted in June 2007, at St. Joseph's Health Centre, an

academic teaching hospital affiliated with the Schulich School of Medicine, University of Western Ontario, London, Ontario, Canada.

Identification of reliable MTX information on the Internet was performed using the search engine Google (http://www.google.com). Google was selected as it is one of the most frequently used search engines and therefore the one most likely to be used by patients when searching for medication related information[3]. The following preference settings were used: interface language: English, search language: English, safe search filtering: moderate, number of results per page: 100 per page. An advanced search strategy was created beginning with the phrase "methotrexate OR Rheumatrex OR Trexall AND information." Two further iterations of the search strategy were performed with the addition of the word "arthritis" followed by the word "patient." The first 250 results returned were reviewed by 2 independent reviewers.

For the purpose of this report, the term "website" will refer to "a collection of files that are arranged on the World Wide Web under a common address and allows retrieval via a browser" and a "web page" will refer to "an HTML document on the Internet, usually one of many together that make up a website."

Inclusion criteria. The reviewers' initial screening strategy identified those websites from authoritative sources including national medical bodies (i.e., American College of Rheumatology, The Arthritis Society, Arthritis Research Campaign), trusted medical institutions (i.e., Mayo Clinic, Johns Hopkins University), trusted medical sources (i.e., up to date), physicians, and common health-related websites (i.e., WebMD.com, About.com). Websites from pharmaceutical companies, online pharmacies, and where the purpose seemed to be primarily advertisements were reviewed as patients may obtain information from these sources. Only websites written in English were included.

Exclusion criteria. Product monographs or technical-based websites with "prescribing information" clearly aimed at healthcare professionals were excluded from the study. Websites where the information was clearly directed at patients with cancer were also excluded due to significant differences in high versus low-dose MTX.

Development of Medication Website Assessment Tool (MWAT). MWAT was developed using the assessment categories of content, format, credibility, and readability.

Content review. Content from each of the included websites was initially reviewed for completeness and accuracy. The framework for this review was based upon the recommendations of the US Department of Health and Human Services Steering Committee "action plan" for evaluating and improving the usefulness of written medical information[4]. This action plan defined 8 criteria for appropriate content for useful medication information pamphlets (Table 1).

Content from each website was reviewed and scored for completeness and accuracy based on the framework given below (Table 2). Completeness of content was defined as meeting the criteria from the action plan, and each item was given a score of 1 point if it was present and 0 if absent for a maximum total score of 12 for completeness and a minimum score of 0.

Accuracy of content was determined through independent review by one practicing academic rheumatologist and one senior rheumatology fellow based on the MTX product monograph and clinical experience. Accuracy, for the purposes of this study, was defined as "a lack of flagrant misinformation." For example, debating the frequency of side effects was not considered an error in accuracy, whereas stating a side effect that was incorrect was considered an error in accuracy. Information found to be accurate was given a score of 1 point, whereas websites providing inaccurate information were penalized and given a score of –1 point for a maximum total score of 12 points for accuracy and a minimum score of –12. Therefore each website could receive a total of 24 points for completeness and accuracy.

When there were differences in assessments between reviewers, the final score was reached based on consensus after discussion. An arbitrary cutoff of 18 out of 24 points (75%) was created to separate websites with complete and accurate content from those without.

Format review. Category 8 of the action plan addresses the format of the medication information pamphlet. Websites found to be compliant with the formatting guidelines received 1 point for each criterion present, for a maximum score of 8 points and a minimum score of 0 (Table 3). When there were differences, a final score was reached based on review of the website and consensus after discussion. An arbitrary cutoff of 6 out of 8 points (75%) was created to separate websites with appropriate format from those without.

Reliability and credibility review. The reliability and credibility review for each website was done using the Health on the Net Foundation's (HONcode) Code of Conduct for medical and health website addresses[5]. The HONcode does not intend to rate the quality of the information provided by a website. It defines a set of rules to hold website developers to basic ethical standards in the presentation of information; and to help ensure readers always know the source and the purpose of the data they are reading. The HONcode has 8 principles that a website must conform to in order to be granted HON certification (Table 4). Each website was searched in the Health on the Net database to determine if the site had received HON certification.

Readability review. Readability of the MTX information from the included websites was determined using the Flesch-Kincaid Grade Level by using the "Readability Statistics" tool of MicroSoft Word 2002. The measure was determined by selecting the educational and informational text on the web page using the "copy" feature, then pasting the text into a blank MicroSoft Word 2002 document using "Paste Special" with "Unformatted Text." This isolated the text without hypertext markup language (HTML) code, thereby eliminating possible artifacts of the code on readability scores. The Flesch-Kincaid Grade Level and Flesch Reading Ease are measures of readability based on the average number of syllables per word and words per sentence. The Flesch-Kincaid Grade Level score rates text based on the US high school grade level system (i.e., a score of 7.0 would mean an average 7th grade student should be able to comprehend the text). We did not include a cutoff level for readability since many quality websites would be excluded based on readability. We acknowledged those websites with readability at the 8th grade level or less[6]. Due to limitations of the Flesch-

Table 1. Action plan criteria for defining useful medication information.

Criterion	Description
1	Drug names, indications for use, and how to monitor for improvement
2	Contraindications and what to do if they apply
3	Specific directions on how to use and store the medication and overdose information
4	Specific precautions and warnings about the medication
5	Symptoms of serious or frequent possible adverse reactions and what to do
6	Certain general information including encouraging patients to communicate with health care professionals and disclaimer statements
7	Information that is scientifically accurate, unbiased in tone and content, and up to date
8	Information in an understandable and legible format that is readily comprehensible to consumers

Table 2. Framework for determining content completeness and accuracy.

Criterion	Completeness		Accuracy		Total Score
	Present (1 pt)	Absent (0 pts)	Yes (1 pt)	No (–1 pts)	
Medication name					
Indicators for use					
Dosing instructions					
How to store MTX					
Who should not take MTX					
What should be avoided while taking MTX					
Folic acid					
Common side effects					
Rare side effects					
Monitoring blood tests					
Pregnancy/lactation					
What to do in case of an overdose					
			Total Score (out of 24)		

Table 3. Criteria for determining appropriate format.

Criterion	Present (1 point)	Absent (0 points)
Use 10-point or larger type size		
Do not use ornate typefaces and italics. Choose a bolder type over a thin version of the same style		
Use upper and lower–case lettering, not all capitals		
Use bold-face type or a box to call attention to important information, rather than highlighting or underlining		
Provide adequate space between letters, lines, and paragraphs		
Do not use a line length that is too long		
Select text and screen color that gives a strong contrast. Black, dark blue, or brown ink on white		
Use short paragraphs and bullets where possible		
Total Score (out of 8)		

Table 4. Eight principles of the HON Code.

Principle	Description
1. Authoritative	Any medical advice provided and hosted on this site will only be given by medically trained and qualified professionals unless a clear statement is made that a piece of advice offered is from a non-medically qualified individual/organization
2. Complementarity	The information provided on this site is designed to support, not replace, the relationship that exists between a patient/site visitor and his/her existing physician
3. Privacy	Confidentiality of data relating to individual patients and visitors to a medical Website, including their identity, is respected by this Website. The Website owners undertake to honor or exceed the legal requirements of medical information privacy that apply in the country and state where the Website and mirror sites are located
4. Attribution	Where appropriate, information contained on this site will be supported by clear references to source data and, where possible, have specific HTML links to that data
5. Justifiability	Any claims relating to the benefits/performance of a specific treatment, commercial product, or service will be supported by appropriate, balanced evidence in the manner outlined in Principle 4 above
6. Transparency	The designers of this Website will seek to provide information in the clearest possible manner and provide contact addresses for visitors that seek further information or support. The Webmaster's E-mail address will be clearly displayed throughout the Website
7. Financial disclosure	Support for this Website will be clearly identified, including the identities of commercial and noncommercial organizations that have contributed funding, services, or material for the site
8. Advertising policy	If advertising is a source of funding it will be clearly stated. A brief description of the advertising policy adopted by the Website owners will be displayed on the site. Advertising and other promotional material will be presented to viewers in a manner and context that facilitates differentiation between it and the original material created by the institution operating the site

Kincaid method, websites were also reviewed for the use of technical terminology. Technical terminology was defined as the use of technical medical terms in the document that patients would have difficulty understanding. Each web page was reviewed and categorized as significant, slight, or no technical terminology. Examples of significant technical terminology include terms such as pneumonitis, hepatitis, mucositis, anemia, neutropenia, etc. Examples of slight technical terminology include terms such as inflammation and menstrual.

Reliability and validity. Evidence for content validity was determined using the criteria developed by the US Department of Health and Human Services Steering Committee action plan for evaluating and improving the usefulness of written medical information[4], the MTX product monograph, and scoring by rheumatologists who commonly prescribe MTX. Interrater reliability was determined for both content and format review.

Overall MWAT ranking. As an estimate of the overall ranking of each web page, the list of included sites was ranked first by content for completeness and accuracy. We felt that the most important aspect of medication information on the Internet is that it is complete and accurate and thus web pages with content scores ≥ 18 (75%) were included in the final ranking. Web pages were next ranked for readability, followed by format. Finally, credibility was ranked; this included issues such as author transparency, unbiased content, revision dates, and references. We believe that our review of content for completeness and accuracy was a form of credibility in itself. Information about MTX, as used in rheumatology, is relatively static; therefore, revision dates, although useful, would not be a reflection of the quality of information.

External validity: comparison with the Healthcare Website Assessment Tool (HWAT) 3.0. To date, there is no gold-standard tool that validly assesses the quality of a medication website on the Internet. As a measure of external validity, the top websites included in the analysis were then scored using the HWAT 3.0 tool by the investigators. A specific website was given the HWAT acknowledgment of approval if it received a score > 80, as this would put the website into the top one-third of sites, as defined in the HWAT 3.0 study[7]. It is important to note that the HWAT 3.0 was created with emphasis on credibility, whereas the credibility for the MWAT comes from the accuracy of the content.

RESULTS

The first iteration of the search revealed a total of 1,090,000 hits; adding the word "arthritis" reduced these to 672,000, and adding the word "patient" reduced the hits to 494,000. After reviewing the first 250 hits from each search using the initial screening strategy, 24 suitable web pages were identified on 23 websites (Table 5). Ten websites were from the United States, 8 from the United Kingdom, 1 from Canada, 1 each from South Africa, New Zealand, and Malaysia, and 1 was unknown. Three web pages (Google no. 103, 115, and 124) held exactly the same information in slightly different formats, and one website (Google no. 24) contained 2 different web pages containing MTX information sheets. Despite this, websites for the Arthritis Foundation (USA), The Arthritis Society (Canada), and the Australian Rheumatology Association were not found during our search. However, we chose to review them as they are frequently referred to in the respective countries. Further, we also chose to review the MTX information on Wikipedia.com, as it is a popular and frequently used website in North America.

Content review. Content from each of the 28 included web pages was independently reviewed by 2 reviewers (AET, SLG) for completeness and accuracy. The interrater reliabil-

Table 5. Web pages included in the analysis.

Web Page Number	Google Rank	Website	Country of Origin
1	1	Drdoc online[18]	South Africa
2	3	UpToDate[19]	USA
3	4	ACR[20]	USA
4	7	About Arthritis[21]	USA
5	8	Arthritis Research Campaign[22]	UK
6	9 & 21	National Patient Safety Agency[23]	UK
7	17	Quest Diagnostics[24]	USA
8	24	RheumInfo[25,26]	Canada
9	25	RheumInfo[26]	Canada
10	32	New Zealand Rheumatology Association[27]	New Zealand
11	38	MedlinePlus[28]	USA
12	40	WebMD[29]	USA
13	50	Drugs.com[8]	USA
14	55	Malaysian Society of Rheumatology[30]	Malaysia
15	56	MedicineNet.com[31]	USA
16	89	DocDerm.com[32]	USA
17	90	Dudley Group of Hospitals[33]	UK
18	103	Royal Berkshire NHS Foundation Trust[10]	UK
19	115	Cornwall Health Community[34]	UK
20	120	Johns Hopkins Arthritis Center[35]	USA
21	124	University Hospitals of Leicester[36]	UK
22	136	British Association of Dermatologists[37]	UK
23	179	Skin Site.com[38]	Unknown
24	195	Mount Auburn Hospital[39]	UK
25	Not ranked	The Arthritis Society[40]	Canada
26	Not ranked	The Arthritis Foundation[41]	USA
27	Not ranked	Wikipedia[42]	USA
28	Not ranked	Australian Rheumatology Association[43]	Australia

ity measured by Pearson's correlation coefficient was r = 0.81 (p < 0.0001). The scores for content completeness and accuracy ranged from 10 to 24, with a mean score of 15.48 ± 3.70 (Table 6). Ten of the 28 web pages received content scores > 75%; however, 3 of these web pages contained identical content.

Web pages most commonly lost content points for lack of information. Twenty-one web pages (75%) did not include information on storage of MTX, 12 pages (43%) did not include warnings about lactation, and 23 pages (82%) did not include information about overdose.

Format review. Content from each of the 28 web pages was independently reviewed by 2 reviewers (AET, SLG) for format. The interrater reliability measured by Pearson's correlation coefficient was very good (r = 0.89, p < 0.0001). Consensus was achieved for completeness and accuracy for each web page (Table 6). The mean score for format was 6.00 ± 1.46, with a range from 3 to 8. Sixteen of 28 web pages received format scores > 6 (75%); however, 3 of these pages contained the same content.

The most common reasons for loss of format points were not using bold-face type or boxes to call attention to important information, not using short paragraphs with bullets, and using wordy paragraphs with important information embedded within them.

Reliability and credibility review. The reliability and credibility review using the Health on the Net Foundation's (HONcode) Code of Conduct found 8 out of 28 websites had received HON certification.

Admittedly our reliability and credibility assessment is limited as each website must individually apply for HON certification. Therefore, some of the websites in our study that had not received HON certification may have been eligible. Seven of the 8 websites receiving HON certification were located in the United States, with the remaining website located in Canada.

Readability review. Each of the 28 web pages was reviewed for Flesch-Kincaid Grade level (Table 6). The average reading grade level for all reviewed web pages was 10.07 ± 1.84, with a range from 7.2 to a maximum of 12. Eleven of 28 web pages did not include any technical terminology, with the remaining 17 including slight to definite technical terminology.

Overall ranking and description of the included websites. The included web pages were ranked based on the criteria described above, revealing 8 top MTX information web

Table 6. Content, format, readability, and credibility of Websites analyzed.

Website	Completeness and Accuracy Score (out of 24)	Format Score (out of 8)	Reliability and Credibility (HON-Yes/No)	Readability (Flesch-Kincaid Grade Level)	Technical Terminology
National Patient Safety Agency[23] Royal Berkshire[10]	24	7	No	7.5	None
Cornwall Health Community[34] University Hospitals of Leicester[36]	20	8	No	7.2	Slight
RheumInfo[25]	20	7	Yes	9.0	None
Australian Rheumatology Association[43]	20	7	No	9.8	Slight
Arthritis Research Campaign[22]	20	7	No	10.5	Slight
RheumInfo[26]	18	8	Yes	7.6	None
The Arthritis Society[40]	18	7	No	11.7	Slight
Drugs.com[8]	18	6	Yes	11.7	Slight
British Association of Dermatologists[37]	16	7	No	7.4	None
Dudley Group of Hospitals[33]	16	5	No	7.8	None
DocDerm.com[32]	16	5	No	9.3	Definite
New Zealand Rheumatology Association[27]	16	6	No	10.7	None
MedlinePlus[28]	16	4	Yes	10.8	None
Johns Hopkins[35]	14	4	Yes	10.1	None
Quest Diagnostics[24]	14	6	No	12.0	Slight
UpToDate[19]	14	5	No	12.0	Slight
ACR[20]	14	5	Yes	12.0	Slight
Mount Auburn Hospital[39]	14	5	No	12.0	Slight
Malaysia Society of Rheumatology[30]	12	8	No	9.7	None
Drdoc On-line[18]	12	3	No	10.2	Significant
About Arthritis[21]	12	7	Yes	12.0	Slight
MedicineNet.com[31]	12	5	Yes	12.0	Slight
WebMD[29]	12	4	Yes	12.0	Slight
The Arthritis Foundation[41]	10	7	No	9.8	None
Skin Site.com[38]	10	5	No	10.6	Slight
Wikipedia[42]	10	5	No	12.0	Definite

pages. Of the 8 top web pages, 3 had readability scores < grade 8 and the remaining 5 had readability scores ranging from grade 9.0 to 11.7. Of the top websites, 3 were from the UK, 3 from Canada, one from the USA, and one from Australia. A brief description of the top 8 websites is given in Table 7.

External validity: comparison with HWAT 3.0. The top 8 websites from the MWAT were scored using the HWAT 3.0 (Table 8). Seven of the top 8 websites had an HWAT 3.0 score ≥ 88, and would have been in the top 10% of websites in the original HWAT 3.0 analysis. A single website, the lowest of the top 8 websites, achieved a score of 78 on the HWAT 3.0[8]. This site lost points because of the lack of transparency of the authors, excessive distracting advertising on the site, absence of a recently stated revision date, and a higher reading level.

DISCUSSION

Many instruments for rating websites have been created and evaluated. The main limitation to these instruments has been a lack of reliability and validity documentation. In a recent publication, a healthcare website assessment tool (HWAT 3.0) was created to measure quality of medical information on the internet[7]. The HWAT 3.0, which uses the assessment categories of content, credibility, navigability, currency, and readability, showed excellent intraobserver reliability. We reviewed the potential use of the HWAT 3.0 in our study, but found that it did not fit with our assessment methods, given that it is heavily weighted toward credibility and navigability. Despite this, 7 out of 8 of our top websites achieved scores that would have fallen within the top 10% of websites in the original HWAT 3.0 study. However, we believe that independent review (by experts) of medication information contained on a web page is, in itself, a form of credibility of the information on the site. This is especially true with medications such as MTX, where there have been few or no new changes to dosing, side effects, or warnings. We developed our own evaluation system for medication information on the Internet (MWAT) that focused on the completeness and accuracy of information based on the US Department of

Table 7. Top ranked methotrexate websites.

Website	Address	Characteristics
National Patient Safety Agency	www.npsa.nhs.uk[23]	• Very easy to read • Grade 7 to 8 with no technical terminology • Available in pdf • 25 pages long therefore difficult to print
RheumInfo	www.Rheuminfo.com[25]	• Well laid out, single page for easy printing • Question and answer format • Grade 9 level with no technical terminology • Available in html and pdf formats • HON certification
University Hospitals of Leicester, Cornwall, & Royal Berkshire	www.lmsg.nhs.uk[36] www.cornwall.nhs.uk[34] www.royalberkshire.nhs.uk[10]	• Three web pages contain the same information with slightly different formatting • Well worded 5 page document • Question and answer format • Grade 7 to 8 level • pdf format for easy printing
Australian Rheumatology Association	www.rheumatology.org.au[43]	• Well written 4–page document • Question and answer format • Grade 9.8 level • pdf format for easy printing
Arthritis Research Campaign	www.arc.or.uk[22]	• Well written html • Question and answer format • Higher reading level (Grade 10 to 11)
RheumInfo Pictopamphlet	www.RheumInfo.com[26]	• Very creative • Contains pictograms accompanied by short textual information • Single pdf page for easy printing • HON certification • Reading level of 7.6 • Accompanying pictures may help lower-literacy patients
The Arthritis Society	www.arthritis.ca[40]	• Short but comprehensive • html document • Higher grade level of 11.7
Drugs.com	www.Drugs.com[8]	• Well laid out html document • HON certification • Higher grade level of 11.7

Table 8. Comparison with HWAT 3.0 for top websites.

Website	HWAT 3.0 Score	Reason for Lost Points
RheumInfo[26]	100	
RheumInfo[25]	96	Flesch-Kincaid > 8
Australian Rheumatology Association[43]	90	No HON Code
		Flesch-Kincaid > 8
Arthritis Research Campaign[22]	90	No HON Code
		Flesch-Kincaid > 8
The Arthritis Society[40]	90	No HON Code
		Flesch-Kincaid > 8
National Patient Safety Agency[23]	88	No HON Code
		No recent revision date
Royal Berkshire NHS Foundation Trust[10]	88	No HON Code
Cornwall Health Community[34]		No recent revision date
University Hospitals of Leicster[36]		
Drugs.com[8]	78	No recent revision date
		Many advertisements
		Authors were not clearly identified
		Flesch-Kincaid > 8

Health and Human Services Steering Committee action plan for evaluating and improving the usefulness of written medical information[4]. This method revealed excellent interrater reliability for content and format of medication-related websites. This is not surprising, as healthcare professionals usually agree with one another on website quality ratings, and patients generally agree with healthcare professionals, especially for top-rated websites[7].

Our study found that 5 of the top 8 rated MTX information websites were within the first 25 results of our Google search. This finding is in keeping with another study evaluating 116 websites about carpal tunnel syndrome, which showed that a high Google match was an indication of accuracy of the medical information provided[9]. However, one of the highest quality MTX information websites was found at position no. 103 in our Google search[10] and 2 of our top websites were not found using our Google search strategy.

All our top 8 rated MTX information websites were from nonsponsored sources including national organizations, hospitals, and HON accredited sites. This is concordant with a study of 60 websites on chronic liver disease, which found a correlation between quality scores and sponsorship, with commercial websites most likely to have low ratings[11].

An evaluation of 55 websites related to rheumatoid arthritis found the Internet was a poor source of information for patients, with scarce quality information, which was time-consuming to find[12]. The authors of that article correctly concluded that the Internet should not be used as a single source of information unless professionally endorsed websites are recommended. The practical aspect of our study was to identify a list of top-rated MTX information websites to recommend to patients.

The results from the International Adult Literacy Survey found that the average adult in the United States is unable to read above a grade 8 level[6]. To address patient literacy problems, a number of experts have recommended that patient education materials be written at a grade 5 to 6 level[6,13,14]. However, most patient education on the Internet is written at a grade level of 10 or higher[15,16]. None of the web pages reviewed in this study were written at a grade 5–6 level, which is also recommended by the US Department of Health and Human Services Steering Committee action plan[4].

Universal excellence in web-based medication information is unlikely to happen. It will be difficult to create one universal scale to define and measure the quality of patient information on the Internet due to content and context. A scale such as the HWAT, which may be valid and reliable for assessing osteoporosis information on the Internet, may not be as valid or reliable for assessing MTX information on the Internet. The most important aspect of assessing the quality of a website is the development of an instrument that is valid and reliable for its intended purpose. However, it is also important to disseminate this information to inform healthcare providers of top quality health information websites so that patients can be well informed.

Our study had several limitations. The websites evaluated for the study were retrieved from matches from a search engine at one point in time (June 2007) and may not be representative of matches from other search engines at other times. Other limitations include (1) the failure to identify other reputable websites; (2) the search terms used may not have been all-encompassing; and (3) we could not control the manner in which Google ranks websites. These limitations are not exclusive, and will affect all individuals who use search engines to find medication information. In this regard, we felt our search strategy was representative of a typical search strategy for information about MTX.

Our formatting assessment was initially created for paper-based documents. We applied the same rules to

HTML and PDF-based documents. Admittedly, there are some differences in formatting with these different document formats and future iterations of our assessment tool will address this issue.

Rankings in our study did not emphasize credibility of a website. Many excellent web pages in our study were not HON-certified. However, our assessment of content and accuracy of a website was felt to be a form of credibility.

Finally, our readability review was performed using the Flesch-Kincaid reading formula. Readability formulas have been criticized for artificially inflated scores from medical terminology, for not accounting for all of the variables that can affect the difficulty of a particular piece of text, and for a wide variation in readability estimates for the same text[17].

A Medication Website Assessment Tool was developed for use by healthcare professionals. Interrater reliability and validity were assessed by 2 physicians and using predetermined content instruments. Significant variability in website quality was observed. Eight websites for information about methotrexate have been recommended, with comments about the relative strengths and weaknesses of each. More research and refinement of a tool to specifically measure the quality of medication website information, reliability, and credibility are needed.

REFERENCES

1. Houts PS, Doak CC, Doak LG, Loscalzo MJ. The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. Patient Educ Couns 2006;61:173-90.
2. Eysenbach G, Powell J, Kuss O, Sa ER. Empirical studies assessing the quality of health information for consumers on the world wide web: a systematic review. JAMA 2002;287:2691-700.
3. Fox S. On-line health search 2006. Washington, DC: Pew Internet and American Life Project; 2006.
4. Guidance on useful written consumer medication information. Rockville, MD: United States Food and Drug Adminsritation; 1996.
5. Health on the Net Foundation. Internet. Available from: http://www.hon.ch/. Accessed Aug 22 2008.
6. Doak CC, Doak LC, Root JH. Teaching patients with low literacy. Philadelphia: Lippincott; 1996.
7. Lewiecki EM, Rudolph LA, Kiebzak GM, Chavez JR, Thorpe BM. Assessment of osteoporosis — website quality. Osteoporos Int 2006;17:741-52.
8. Drugs.com. Internet. Available from: http://www.drugs.com/pdr/methotrexate.html. Accessed Aug 22 2008.
9. Fricke M, Fallis D, Jones M, Luszko GM. Consumer health information on the Internet about carpal tunnel syndrome: indicators of accuracy. Am J Med 2005;118:168-74.
10. Royal Berkshire NHS Foundation Trust. Internet. Available from: http://www.royalberkshire.nhs.uk/download/dermatology/Methotrexate. Accessed Aug 22 2008.
11. Fraquelli M, Conte D, Camma C, et al. Quality-related variables at hepatological websites. Dig Liver Dis 2004;36:533-8.
12. Culver M, Chadwick A. Internet information on rheumatoid arthritis: an evaluation. Musculoskel Care 2005;3:33-43.
13. Monsivais D, Reynolds A. Developing and evaluating patient education materials. J Contin Educ Nurs 2003;34:172-6.
14. Winslow EH. Patient education materials. Am J Nurs 2001;101:33-8.
15. D'Alessandro DM, Kingsley P, Johnson-West J. The readability of pediatric patient education materials on the World Wide Web. Arch Pediatr Adolesc Med 2001;155:807-12.
16. Williams DM, Counselman FL, Caggiano CD. Emergency department discharge instructions and patient literacy: a problem of disparity. Am J Emerg Med 1996;14:19-22.
17. Krass I, Svarstad BL, Bultman D. Using alternative methodologies for evaluating patient medication leaflets. Patient Educ Couns 2002;47:29-35.
18. Drdoc on-line. Internet. Available from: http://www.arthritis.co.za/methotrexate.htm. Accessed Aug 25 2008.
19. UpToDate. http://patients.uptodate.com/topic.asp?file=arth_rhe/5016. Internet. Accessed Aug 25 2008.
20. American College of Rheumatology. Patient education. Internet. Available from: http://www.rheumatology.org/public/factsheets/methotrexate.asp. Accessed Aug 25 2008.
21. About.com. Arthritis. Internet. Available from: http://arthritis.about.com/od/mtx/p/methotrexate.htm. Accessed Aug 25 2008.
22. Arthritis Research Campaign. Internet. www.arc.or.uk
23. UK National Health Service. National Patient Safety Agency. Internet. Available from: http://www.npsa.nhs.uk/site/media/documents/1877_Leaflet.pdf. Accessed Aug 25 2008.
24. Quest Diagnostics. Patient Health Library. Internet. Available from: http://www.questdiagnostics.com/kbase/topic/detail/drug/aa18961/detail.htm. Accessed Aug 25 2008.
25. RheumInfo.com. http://bombay.directrouter.com/~rheuminf/content/view/23/97
26. RheumInfo.com. http://bombay.directrouter.com/~rheuminf/content/view/59/376/info/med_info/methotrexate_pictopamphlet.pdf. Internet.
27. New Zealand Rheumatology Association. http://www.rheumatology.org.nz/patient-information.cfm?fuseaction=Methotrexate1#Methotrexate1. Internet.
28. US National Library of Medicine; National Institutes of Health. Medline Plus. http://www.nlm.nih.gov/medlineplus/druginfo/medmaster/a682019.html. Internet. Accessed Aug 25 2008.
29. WebMD®. http://www.webmd.com/drugs/drug-3441-Methotrexate+(Anti-Rheumatic)+Oral.aspx?drugid=3441&drugname=Methotrexate+(Anti-Rheumatic)+Oral. Internet. Accessed Aug 25 2008.
30. The Malaysian Society of Rheumatology. http://www.msr.org.my/html/members%20only/doctors_only_f.htm. Internet.
31. MedicineNet.com. http://www.medicinenet.com/methotrexate/article.htm. Internet. Accessed Aug 25 2008.
32. DocDerm.com. http://www.docderm.com/patient_information/methotrexate.htm. Internet. Accessed Aug 25 2008.
33. The Dudley Group of Hospitals. UK National Health Service. http://www.dgoh.nhs.uk/_public/_servportals/rheumatology/_documents/Methotrexate.pdf. Internet. Accessed Aug 25 2008.
34. Cornwall Health Community. UK National Health Service. http://www.cornwall.nhs.uk/RCHT/Caringforyou/PatientInformation/Documents/PDFs/RCHT810_methotrexate.pdf. Internet. Accessed Aug 25 2008.
35. The Johns Hopkins Arthritis Center. Arthritis Drug Information Sheets. http://www.hopkins-arthritis.org/edu/druginfo.html. Internet. Accessed Aug 25 2008.
36. University Hospitals of Leicester. UK National Health Service. http://www.lmsg.nhs.uk/Other/pdfdocs/UHLMethotrexatePatientLeaflet%20.pdf. Internet. Accessed Aug 25 2008.
37. British Association of Dermatologists. http://www.bad.org.uk/healthcare/official_responses/BAD_recommended_A6_NPSA_593_

monitoring_booklet_130705.pdf. Internet. Accessed Aug 25 2008.

38. The Skin Site™.com.http://www.skinsite. com/info_methotrexate.htm. Internet. Accessed Aug 25 2008.

39. Mount Auburn Hospital. http://www.mountauburnhospital.org/body.cfm?xyzpdqabc=0&id=6 &action=detail&AEProductID=HW_Knowledgebase&AEArticleID =aa18961&AEArticleType=DrugDetail. Internet. Accessed Aug 25 2008.

40. The Arthritis Society. http://www.arthritis.ca/tips%20for%20living/understanding%20 medications/disease%20modifying/methotrexate/default.asp?s=1. Internet. Accessed Aug 25 2008.

41. The Arthritis Foundation. http://www.arthritis.org/drug-chart.php. Internet. Accessed Aug 25 2008.

42. Wikipedia. http://en.wikipedia.org/wiki/Methotrexate. Internet. Accessed Aug 25 2008.

43. Australian Rheumatology Association. http://www.rheumatology.org.au/community/documents/MTX21020 8.pdf. Internet. Accessed Aug 25 2008.