Informatics in Radiology


Jonathan L. Streeter, MD • Michael T. Lu, BA • Frank J. Rybicki, MD, PhD

Recent developments in online collaborative technologies such as Wikipedia (www.wikipedia.org) have demonstrated the potential usefulness of an online reference resource produced as the collective effort of many users. Although this type of resource has enjoyed success in the public arena, however, its value remains unproved in the academic community. RadiologyWiki (www.RadiologyWiki.org) was created to apply the technology and methods of collaborative authorship to create a dynamic online radiology educational resource. The World Wide Web site capitalizes on the core technology of Wikipedia, allowing individuals with little technical experience to easily create, categorize, and search for articles by using a standard Web browser. RadiologyWiki shows promise for applications in the field of radiology, although issues pertaining to copyright, peer review, and academic motivation must be overcome if it is to make a meaningful contribution in this context. Nevertheless, it is hoped that RadiologyWiki will develop into a free, simple, and rapid collaborative authorship tool for communication and education in radiology.

©RSNA, 2007

Abbreviation: HTML — HyperText Markup Language

RadioGraphics 2007; 27:1193–1200 • Published online 10.1148/rg.274065090 • Content Codes: ED, GN, IN

From the Department of Radiology, Brigham and Women’s Hospital and Harvard Medical School, 75 Francis St, Boston, MA 02115. Presented as an infoRAD exhibit at the 2005 RSNA Annual Meeting. Received May 4, 2006; revision requested July 27; final revision received January 19, 2007; accepted February 5. All authors have no financial relationships to disclose. Address correspondence to F.J.R. (e-mail: frybicki@partners.org).

©RSNA, 2007
Introduction
The past 5 years have seen a fundamental shift in the way information is stored and delivered over the Internet. Many successful World Wide Web sites (eg, Google, Amazon) have adopted technology that harnesses “collective intelligence” (ie, makes use of the aggregate behavior of individual users to improve the site for subsequent users). With this approach, the more a site is used, the more useful it becomes. For example, Amazon.com allows users to enter reviews and ratings of books, allowing future users to gain a nonmarketing perspective on a product. By tracking and displaying products that are often purchased together, Amazon draws upon the collective experience of prior customers to quickly find related and highly-rated items.

TAKE-HOME POINTS

- One strength of Wikipedia.org is that its underlying technology is open source and thus both freely distributed and modifiable. As a result, a great number of sites, termed wikis, share Wikipedia’s underlying technology and emphasis on collaborative authorship.

- RadiologyWiki.org is a Web site that was developed to use the wiki model of collaborative authorship to create a dynamic online radiology resource (3). The core wiki functionalities of the Web site allow medical practitioners to easily create, categorize, and search for articles by using a Web browser, requiring only minimal technical expertise.

- The scope of RadiologyWiki includes any topic germane to medical imaging, including clinical considerations, education, physics, and technology.

- Education regarding the role of RadiologyWiki may act as a catalyst, but the end product will ultimately depend on the reactants, namely, the community of contributing authors. One model for increasing contributions from academic sites focuses on resident training.

- The wiki technology has proved successful in nonacademic settings and shows promise for application to diagnostic radiology. However, for the site to make a meaningful contribution to radiology, issues pertaining to copyright, peer review, and academic motivation must be overcome.

A closely related technology, “collaborative authorship,” allows multiple authors to collaborate over the Internet in the creation of Web content. Wikipedia.org, a free online encyclopedia, has demonstrated the usefulness of collaborative authorship. The Wikipedia Web site is designed to allow any user to create, contribute to, or edit an article on any topic. This approach allows the creation of a true living document, one that is constantly being accessed, updated, and improved upon by the community of users. Supporters claim that this decentralized approach improves the quality, comprehensiveness, and timeliness of the contributions. Detractors note that contributions by novices may be difficult to distinguish from those submitted by experts, which limits the site’s reliability. Regardless, the Wikipedia Web site has experienced tremendous popular support (1), with over 1 million user-written articles being created since its inception in 1999.

One strength of Wikipedia.org is that its underlying technology is open source and thus both freely distributed and modifiable. As a result, a great number of sites, termed wikis, share Wikipedia’s underlying technology and emphasis on collaborative authorship. The academic community has begun to adopt the wiki model; for example, OpenWetWare.org is a collaborative site developed at the Massachusetts Institute of Technology to facilitate the exchange of information, protocols, and reagents among bioengineering researchers and laboratories (2). Since its inception, the site has grown to encompass over 750 users at 21 participating institutions.

RadiologyWiki.org is a Web site that was developed to use the wiki model of collaborative authorship to create a dynamic online radiology resource (3). The core wiki functionalities of the Web site allow medical practitioners to easily create, categorize, and search for articles by using a Web browser, requiring only minimal technical expertise.

The scope of RadiologyWiki includes any topic germane to medical imaging, including clinical considerations, education, physics, and technology.

Education regarding the role of RadiologyWiki may act as a catalyst, but the end product will ultimately depend on the reactants, namely, the community of contributing authors. One model for increasing contributions from academic sites focuses on resident training.

The wiki technology has proved successful in nonacademic settings and shows promise for application to diagnostic radiology. However, for the site to make a meaningful contribution to radiology, issues pertaining to copyright, peer review, and academic motivation must be overcome.

RadiologyWiki.org
Methods for constructing and presenting material on the Internet have resulted in new terminology. These existing systems and the associated termi-
nology are first defined in the context of how and why a wiki is well suited for creating a dynamic Web site. A “blog,” or Web log, is typically a Web page containing an individual’s journal entries presented in reverse chronologic order. Blogs typically have a single author; thus, their scope and intent are usually limited and specific to one individual. Blog entries may be “tagged” with pertinent keywords, allowing the entries to be indexed and navigated more easily. “Newsgroups” are message forums organized by topic that facilitate written communication between members. Content authored by group members is typically a threaded discussion, similar to extended e-mail correspondence. Messages are usually archived for content searching. However, there is no additional organization. The scope and intent of a newsgroup are dynamic in that individual members can contribute. However, there is no system for indexing, such as with a reference site.

The traditional educational Web site is typically static and presents a defined set of information; that is, only the site’s authors update the content. A wiki is a Web site that allows users to create, interlink, categorize, and otherwise modify content. The fundamental goal is to facilitate collaborative creation of an online reference resource. A single page of a wiki is called a wiki page. When a user modifies the content of a wiki page, tasks such as linking to other wiki pages, categorization, and complex formatting are simplified through the use of special automated tags. The wiki is a fundamentally different educational resource in that the scope and intent are determined and the review and editing performed by contributing members.

RadiologyWiki.org is designed to become a dynamic general radiology reference Web site. Built upon the most widely used wiki server technology, RadiologyWiki.org differs in purpose, method, and content from other types of Web sites such as blogs, newsgroups, and traditional educational Web sites. The organization and features of RadiologyWiki.org are outlined in the following sections.

**Organization**

The scope of RadiologyWiki includes any topic germane to medical imaging, including clinical considerations, education, physics, and technology. With such a broad scope, clear organization and intuitive navigation are essential. As an article is created, it is tagged with one or more categories indicating the general topics to which the content of the article pertains. For example, an article about the reverse S sign of Golden could be tagged as belonging to the category “Signs in Radiology” as well as to “Obstructive Airway Lesions.” Each of these categories is designated as a subcategory of broader topics, which are designated as subcategories of even broader topics, and so on. With the addition of these metadata, the article is automatically categorized in a hierarchic content structure that facilitates navigation of the Web site. Content may thus be accessed in several ways.

The home page for RadiologyWiki.org (Fig 1) demonstrates the hierarchy of subspecialty categorization. By clicking on a broad general category, the user is able to navigate the hierarchy of more specific topics. Another means of finding content is based on the curricula endorsed by subspecialty societies (eg, Society of Thoracic Imaging, American Society of Musculoskeletal Radiology). These curricula consist of organized lists of pathologic entities, imaging findings, methods, and so on, which serve as an ideal index to the essential topics in radiology. A section of the Web site devoted to linking topics included in these curricula to articles in RadiologyWiki has been created and given the name “Wiki Kuriki.” This section gives added value to these curricula by facilitating quick review of topics for test preparation or some other purpose. Content can be navigated by selecting the desired subspecialty section from the Wiki Kuriki section on the main page of RadiologyWiki.

**Searching RadiologyWiki**

Users who have an interest in a specific article may be better served by the site’s search engine.
The site provides a familiar search interface that queries the content of every article present on RadiologyWiki and is available on every page of the site. Results are displayed with a context snapshot of where the search term appears in the article.

**Contributing to or Editing an Article**

At its heart, RadiologyWiki facilitates collaborative authorship over a Web browser (Fig 3). Registered users can edit an article by selecting the “edit” tab at the top of the article. Articles are written in Wiki Markup, a simplified alternative to HyperText Markup Language (HTML). Wiki Markup consists of simple tags that specify section headings, text embellishments, image placement, page links, and tables. The Web site automatically converts Wiki Markup into appropriately formatted HTML, viewable with all standard Web browsers. An explanation of the markup language used for the example in Figure 3 appears in Appendix A.

**Registration**

Open systems such as Wikipedia, which require no user registration for contributions, occasionally encounter malicious users who intentionally submit incorrect or inflammatory content. To avoid this sort of “content vandalism,” confirmation of the identity of contributors is of great im-

(Fig 2). The site provides a familiar search interface that queries the content of every article present on RadiologyWiki and is available on every page of the site. Results are displayed with a context snapshot of where the search term appears in the article.

**Contributing to or Editing an Article**

At its heart, RadiologyWiki facilitates collaborative authorship over a Web browser (Fig 3). Registered users can edit an article by selecting the “edit” tab at the top of the article. Articles are written in Wiki Markup, a simplified alternative to HyperText Markup Language (HTML). Wiki Markup consists of simple tags that specify section headings, text embellishments, image placement, page links, and tables. The Web site automatically converts Wiki Markup into appropriately formatted HTML, viewable with all standard Web browsers. An explanation of the markup language used for the example in Figure 3 appears in Appendix A.

**Registration**

Open systems such as Wikipedia, which require no user registration for contributions, occasionally encounter malicious users who intentionally submit incorrect or inflammatory content. To avoid this sort of “content vandalism,” confirmation of the identity of contributors is of great im-

(Fig 2). The site provides a familiar search interface that queries the content of every article present on RadiologyWiki and is available on every page of the site. Results are displayed with a context snapshot of where the search term appears in the article.

**Contributing to or Editing an Article**

At its heart, RadiologyWiki facilitates collaborative authorship over a Web browser (Fig 3). Registered users can edit an article by selecting the “edit” tab at the top of the article. Articles are written in Wiki Markup, a simplified alternative to HyperText Markup Language (HTML). Wiki Markup consists of simple tags that specify section headings, text embellishments, image placement, page links, and tables. The Web site automatically converts Wiki Markup into appropriately formatted HTML, viewable with all standard Web browsers. An explanation of the markup language used for the example in Figure 3 appears in Appendix A.

**Registration**

Open systems such as Wikipedia, which require no user registration for contributions, occasionally encounter malicious users who intentionally submit incorrect or inflammatory content. To avoid this sort of “content vandalism,” confirmation of the identity of contributors is of great im-

(Fig 2). The site provides a familiar search interface that queries the content of every article present on RadiologyWiki and is available on every page of the site. Results are displayed with a context snapshot of where the search term appears in the article.

**Contributing to or Editing an Article**

At its heart, RadiologyWiki facilitates collaborative authorship over a Web browser (Fig 3). Registered users can edit an article by selecting the “edit” tab at the top of the article. Articles are written in Wiki Markup, a simplified alternative to HyperText Markup Language (HTML). Wiki Markup consists of simple tags that specify section headings, text embellishments, image placement, page links, and tables. The Web site automatically converts Wiki Markup into appropriately formatted HTML, viewable with all standard Web browsers. An explanation of the markup language used for the example in Figure 3 appears in Appendix A.

**Registration**

Open systems such as Wikipedia, which require no user registration for contributions, occasionally encounter malicious users who intentionally submit incorrect or inflammatory content. To avoid this sort of “content vandalism,” confirmation of the identity of contributors is of great im-

(Fig 2). The site provides a familiar search interface that queries the content of every article present on RadiologyWiki and is available on every page of the site. Results are displayed with a context snapshot of where the search term appears in the article.

**Contributing to or Editing an Article**

At its heart, RadiologyWiki facilitates collaborative authorship over a Web browser (Fig 3). Registered users can edit an article by selecting the “edit” tab at the top of the article. Articles are written in Wiki Markup, a simplified alternative to HyperText Markup Language (HTML). Wiki Markup consists of simple tags that specify section headings, text embellishments, image placement, page links, and tables. The Web site automatically converts Wiki Markup into appropriately formatted HTML, viewable with all standard Web browsers. An explanation of the markup language used for the example in Figure 3 appears in Appendix A.

**Registration**

Open systems such as Wikipedia, which require no user registration for contributions, occasionally encounter malicious users who intentionally submit incorrect or inflammatory content. To avoid this sort of “content vandalism,” confirmation of the identity of contributors is of great im-
portance. Thus, the security policy for Radiology-Wiki mandates that only registered users may edit articles. (This is one difference between Radiology-Wiki and Wikipedia.) Registration is designed to be simple and open. The user submits his or her true name and institutional e-mail address and a short personal profile. Editing privileges are granted after verification of the submitted information.

Once registered, the user becomes a part of the community of contributors to the Web site, thereby gaining access to features designed to promote communication and interaction between contributors. Users can customize their profiles to designate which personal information is displayed to other users of the site. In addition to creating and editing articles, registered users may add any article to a personal “watch list.” When watch-listed articles are changed, the user is automatically notified by e-mail. For example, a user creates an article providing a brief overview of an interesting diagnosis and adds it to his or her watch list. A second user encounters an actual case of the diagnosis and uploads an example image to the article created by the first user. The first user is then automatically notified by e-mail that a change has been made and may return to the site to review the article and make improvements.

Version Tracking
With a system that allows such a rapid evolution of content, it is necessary to document changes. For every article in Radiology-Wiki, a complete revision history can be accessed by means of the “history” tab found at the top of each page (Fig 4). The history screen shows a timestamp and user name for every modification made to the article since its creation. Selecting a user name brings up the personal profile of the user who made that specific edit. Selecting the timestamp link displays the version of the article saved at that particular time. If an article is adversely changed or inadvertently erased, reverting to an earlier version affords an easy solution. In effect, these features make it possible to view every historical version of every article and to identify all users who contributed.

If experience with other collaborative sites is any indication, users interested in specific topics will take ownership of articles related to their interests. The ability to view the profiles of users who have contributed to a related article provides a means of finding and communicating with others sharing the same interests. Clicking on the “discussion” tab at the top of the page provides access to a discussion forum specific to the article. This forum allows users who are interested in a specific topic to communicate in an informal way and can be used to establish a consensus on the scope and presentation of the article.

Copyright Guidelines
A majority of Web sites are subject to intellectual property rights in the form of copyright restrictions that limit the freedom of users to redistribute, copy, or modify the content of the site. One of the driving goals of RadiologyWiki is to create a body of medical imaging knowledge that is freely available to practitioners around the world with only minimal restrictions. Consequently, the textual content of RadiologyWiki is licensed with terms analogous to those governing most open-source software. Called the GNU Free Documentation License, this form of copyright ensures that every user can use, modify, and redistribute the work, so long as the same license applies to all derivative works.

Although the textual content of RadiologyWiki lies within the public domain, images are provided under one of several Creative Commons licenses. Creative Commons (http://creativecommons.org/) is a nonprofit organization that provides a number of free legal documents specifying tiers of Internet copyright. When uploading an image onto RadiologyWiki, the contributor chooses from among several licenses by inserting specific tags in the image description. Links to “human readable” summaries and the full legal texts of these licenses are available on Radiology-Wiki. The majority of contributors have chosen...
the Creative Commons Attribution-Noncommercial-Sharealike-2.5 license (http://creativecommons.org/licenses/by-nc-sa/2.5/), which allows the duplication and distribution of licensed images so long as the following conditions are upheld: (a) the image is attributed to the original author, (b) all use is noncommercial, and (c) any derivative work retains the original copyright. Under this license, the original author retains the rights to future commercial use. We believe that these licensing terms for both the textual and graphical content of RadiologyWiki support the educational and academic goals of the medical community while respecting the autonomy and ownership of individual contributors.

In creating a site with the aforementioned copyright terms, close attention must be paid to the sources of both the images and the text. Specific site policies for RadiologyWiki have been established and are summarized in Appendix B.

Discussion
The success of RadiologyWiki will depend on the development of a supportive and informed community of users who generate content. To align RadiologyWiki more closely with the expectations of the radiology community, the authors have adopted policies that differ from those of Wikipedia. The process of establishing “wiki authorship” is fundamentally different from that of traditional publication in terms of copyright, accountability, and peer review. Nevertheless, as will be discussed, at present there is no framework for academic “currency,” which represents a significant barrier to motivation among potential authors in academic radiology. Although there are clear benefits to having a general reference Web site that capitalizes on this new technology, there are also many challenges yet to be overcome if the site is to be as useful for the radiology community as Wikipedia has proved to be for the general public.

Benefits
RadiologyWiki is not intended to replace or supplement original peer-reviewed publications. Rather, it is closer to (although not meant to entirely replace) a general reference resource. RadiologyWiki may develop into a broad-based resource and offers significant benefits for users who prefer an “interactive” environment. A radiologist confronted with a particularly interesting or challenging case commonly “looks up” images of the suspected diagnosis. Textbooks, both online and printed, will typically show only one example of the key finding. One way to perform a broader look-up is to use Google or another search engine. RadiologyWiki has an enormous potential advantage in this situation, but the key to its success is a community with a baseline value to encourage users, not only to look up a case, but also to submit their images and comments.

In addition to making available a growing number of cases, RadiologyWiki can serve as an interactive repository for clinically relevant information assimilated from pertinent peer-reviewed journal articles, established guidelines, or other generally accepted reference sources. A clear benefit of RadiologyWiki to the radiology community is having this information organized on a free, Web-based, indexed site that enjoys the same usability as Wikipedia. RadiologyWiki has another key advantage over existing textbooks, whether online or printed, in that it can be constantly updated to reflect current publications and advances in medical knowledge.

RadiologyWiki.org is built upon proved Wikipedia technology, and thus is robust in terms of both features and scalability. As discussed earlier, finding and editing articles requires only minimal technical expertise for basic content creation. It is hoped that this minimal requirement will encourage submissions to the site. The inherent auditing capabilities of the site enable users to identify the contributing authors and to view articles throughout their stages of development, providing a record of contributions as well as a built-in protection against degradation of content. Automated document indexing and table of contents creation facilitate standardized formatting of articles and instant linking and categorization of content. On a more fundamental level, the wiki method of rapid collaborative authorship allows a community of contributors to quickly build a fund of knowledge and display it in a way that previously would have been prohibitively labor and time intensive.

Challenges
RadiologyWiki was created because Wikipedia, which has enjoyed unprecedented success by several measures, represents an outstanding content creation model with potential for adaptation in medical education and as a reference resource. However, although the technical features of RadiologyWiki.org (eg, flexibility and open collaboration) have proved successful, several nontechnical challenges must be overcome if the Web site is to have a significant impact in the radiology community.

Peer Review.—RadiologyWiki does not conform to the traditional infrastructure of authoritative academic peer review. Instead, the universal peer
review inherent in a collaborative authorship will help maintain content and quality control. This model is an as yet unproved means of governing academic reference material, which is one reason why RadiologyWiki is not intended to replace traditional peer-review literature. However, the process of peer review inherent in the collaborative authorship paradigm can provide valuable input while encouraging a very rapid exchange of ideas that would, in the peer-review literature, take months or longer to develop. In addition, the open nature of the site will allow individuals to “publish” information in a form that may be useful, despite not being ready for publication in the peer-review literature. For example, an initial article, perhaps created by a diagnostic radiology resident, may describe a pathologic entity by providing a brief outline of basic information relevant to the topic and direct links to key articles from peer-reviewed sources. When reviewed by a second user, the article is further modified with the addition of a section on differential diagnoses and clarification of text that may have been ambiguous in its original form. As this process is repeated, the article evolves in structure and content. Anecdotal experience with Wikipedia demonstrates that, over time, this process of evolution leads to improved content in terms of both accuracy and structure.

**Accountability and Credit.**—A common critique of Wikipedia is the lack of accountability. Users can alter articles with near anonymity (identified only by the unique Internet protocol [IP] address of the computer used to make the change). Such an open, anonymous model lowers barriers for new users, but it is not appropriate for RadiologyWiki. At the same time, the challenge is to not discourage potential users with a complex authentication procedure. As mentioned earlier, with RadiologyWiki, users need only minimal technical expertise to create and maintain an account. This account serves two purposes. First, it authenticates each article’s modification history with the author, time, and specific nature of the content modification. It is hoped that registration will minimize the phenomenon of wiki vandalism, whereby articles are sabotaged by including references to commercial Web sites or outside content. More important, contributors with common interests can identify and contact one another and collaborate on the presentation and discussion of a particular topic. The second purpose of an account is to acknowledge authors for their contributions. At present, there is no academic currency for contributions to RadiologyWiki, so that professional motivation among academic radiologists will be limited. This may be the single largest obstacle to the success of the site. If RadiologyWiki is to be successful, users must understand and trust that content submitted to the site can also be used (by the submitting author) for peer-review publications. Even more important, over time, academic and university settings are very likely to more formally adopt and acknowledge a form of credit for Web-based scholarly activities. This complex process will be debated and will evolve slowly. However, as the full potential of Internet-based learning is realized, the speed and accuracy of crediting individual contributions will improve—which will in turn undoubtedly increase enthusiasm for submissions.

**Building a Community.**—The experience of Wikipedia suggests that more content leads to more traffic, which in turn leads to more contributions and yet more content. RadiologyWiki.org was introduced in 2005 (3), and the site has been available for routine use since July 2006. As of January 6, 2007, the site boasts 146 registered users, 253 new pages, 189,729 page views, and 3,129 edits. The fundamental task of gathering a “critical mass” has been challenging. Initial efforts to encourage contributions from staff at local institutions met with a mixed response. Individuals are enthusiastic about the idea and its potential, but the majority of potential contributors are not (or only vaguely) familiar with collaborative authorship. The intent of this article is to provide education to help overcome these obstacles.

Education regarding the role of RadiologyWiki may act as a catalyst, but the end product will ultimately depend on the reactants, namely, the community of contributing authors. One model for increasing contributions from academic sites focuses on resident training. In addition to increasing requirements for peer-review publications, most diagnostic radiology training programs in the United States require residents to prepare brief presentations for conferences, including radiologic-pathologic correlation, tumor board, quality control, and so on. At present, the vast majority of this information never reaches the publication stage, despite the fact that trainees may put considerable effort into these high-quality presentations. Moreover, the conferences are conducted with staff members serving as a local peer-review board. This type of educational content can provide an ideal starting point for RadiologyWiki articles. If the identical content were submitted to the appropriate page of RadiologyWiki under the direction of a supervising attending radiologist, a broad range of highly clinically...
relevant articles would accumulate. Furthermore, there are potential side benefits to this activity. A subset of radiology trainees will view the process of their “first publication” with great pride, and it is hoped that such exposure will encourage these trainees to continue to publish.

Conclusions
RadiologyWiki.org is a new general radiology reference Web site built around the concept of collaborative authorship. The wiki technology has proved successful in nonacademic settings and shows promise for application to diagnostic radiology. However, for the site to make a meaningful contribution to radiology, issues pertaining to copyright, peer review, and academic motivation must be overcome. The fundamental requirement for success is strong community support; toward this end, a model for diagnostic radiology residency program–driven contributions has been proposed. Because our imaging community is dedicated to providing the highest level of professional care, we hope that RadiologyWiki will develop into a free, simple, and rapid collaborative authorship tool for communication and education in radiology.

Appendix A: Wiki Markup
A markup language uses symbols or tags interspersed within text to represent images, hyperlinks, and formatting. For example, on the “Editing air crescent sign” page shown in Figure 3, the text “==Definition==” marks the word “Definition” as a heading, “*Opaque rim...*” creates a bulleted list, and “[Tuberculosis]” creates an internal link to the RadiologyWiki article on tuberculosis. “[http://radiology.rsna.org/cgi/content/full/218/1/230 The Air Crescent Sign–Abramson 218 (1): 230–Radiology]” (not shown on figure) creates an external link to primary literature from the journal Radiology. An image of invasive aspergillosis is represented by the tag “[[Image:air_crescent_frontal.jpg|thumb 300px|right|Invasive Aspergillosis–air crescent sign]].” This tag is a bit more complex and can be broken down as follows: The “[[Image:” tag specifies an image, with “air_crescent_frontal.jpg” being the name of the image; “thumb [300px|right]” specifies that the image should be displayed as a right-justified 300-pixel-wide thumbnail; “Invasive Aspergillosis–air crescent sign” is the figure legend; “<br>” represents a newline character; and “Image courtesy of Andetta Hunsaker MD” represents attribution text in italics and closes the image. Brief (http://en.wikipedia.org/wiki/Wikipedia:Tutorial) as well as comprehensive (http://en.wikipedia.org/wiki/Wikipedia:How_to_edit_a_page) primers on Wiki Markup are available.

Appendix B: Site Policies
Authors should adhere to the site policies of RadiologyWiki.org, which have been adapted from Wikipedia.org (http://en.wikipedia.org/wiki/Wikipedia_policies) and are as follows:

1. RadiologyWiki is an English language radiology educational resource. It is not a forum for other fields of medicine, current events, or other non-radiology-related topics.

2. RadiologyWiki is a reference resource, not primary literature. Original research data should not be presented on RadiologyWiki. A finding that is preliminary or controversial should be noted as such. External links to supporting articles from peer-reviewed journals should be supplied whenever possible.

3. RadiologyWiki is a free online resource. Text or images that infringe upon copyright may not be submitted. Links to external Web sites displaying copyright content are acceptable, so long as they satisfy the policies of the external site. Patient identifiers should be removed from all images.

References
Reprint order forms and purchase orders or prepayments must be received 72 hours after receipt of form either by mail or by fax at 410-820-9765. It is the policy of Cadmus Reprints to issue one invoice per order.

Please print clearly.

Author Name _______________________________________________________________________________________________
Title of Article _______________________________________________________________________________________________
Issue of Journal_______________________________           Reprint # _____________    Publication Date ________________
Number of Pages_______________________ ________                KB # _____________               Symbol RadioGraphics
Color in Article?    Yes   /   No       (Please Circle)
Please include the journal name and reprint number or manuscript number on your purchase order or other correspondence.

Order and Shipping Information

Reprint Costs (Please see page 2 of 2 for reprint costs/fees.)

________ Number of reprints ordered $_________

________ Number of color reprints ordered $_________

________ Number of covers ordered $_________

Subtotal $_________

Taxes $_________

(Add appropriate sales tax for Virginia, Maryland, Pennsylvania, and the District of Columbia or Canadian GST to the reprints if your order is to be shipped to these locations.)

First address included, add $32 for each additional shipping address $_________

TOTAL $_________

Shipping Address (cannot ship to a P.O. Box) Please Print Clearly

Name __________________________
Institution ______________________
Street __________________________
City ___________________________ State _______ Zip __________
Country _________________________
Quantity ________________________ Fax ______________________
Phone: Day ________________ Evening ______________________
E-mail Address __________________

Additional Shipping Address* (cannot ship to a P.O. Box)

Name __________________________
Institution ______________________
Street __________________________
City ___________________________ State _______ Zip __________
Country _________________________
Quantity ________________________ Fax ______________________
Phone: Day ________________ Evening ______________________
E-mail Address __________________

* Add $32 for each additional shipping address

Payment and Credit Card Details

Enclosed: Personal Check __________________
Credit Card Payment Details ____________

Checks must be paid in U.S. dollars and drawn on a U.S. Bank.
Credit Card: ___ VISA ___ Am. Exp. ___ MasterCard
Card Number __________________________
Expiration Date ________________________
Signature: ______________________________

Please send your order form and prepayment made payable to:

Cadmus Reprints
P.O. Box 751903
Charlotte, NC  28275-1903

Invoice or Credit Card Information

Invoice Address Please Print Clearly
Name __________________________
Institution ______________________
Department ______________________
Street __________________________
City ___________________________ State _______ Zip __________
Country _________________________
Quantity ________________________ Fax ______________________
Phone ________________________ E-mail Address __________________

Cadmus will process credit cards and Cadmus Journal Services will appear on the credit card statement.

If you don’t mail your order form, you may fax it to 410-820-9765 with your credit card information.

Signature __________________________ Date __________________________

Signature is required. By signing this form, the author agrees to accept the responsibility for the payment of reprints and/or all charges described in this document.
Black and White Reprint Prices

<table>
<thead>
<tr>
<th># of Pages</th>
<th>Domestic (USA only)</th>
<th>International (includes Canada and Mexico)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1-4</td>
<td>$213</td>
<td>$263</td>
</tr>
<tr>
<td>5-8</td>
<td>$338</td>
<td>$415</td>
</tr>
<tr>
<td>9-12</td>
<td>$490</td>
<td>$563</td>
</tr>
<tr>
<td>13-16</td>
<td>$655</td>
<td>$698</td>
</tr>
<tr>
<td>17-20</td>
<td>$763</td>
<td>$848</td>
</tr>
<tr>
<td>21-24</td>
<td>$875</td>
<td>$985</td>
</tr>
<tr>
<td>25-28</td>
<td>$985</td>
<td>$1,080</td>
</tr>
<tr>
<td>29-32</td>
<td>$1,008</td>
<td>$1,143</td>
</tr>
<tr>
<td>Covers</td>
<td>$95</td>
<td>$118</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># of Pages</th>
<th>Domestic (USA only)</th>
<th>International (includes Canada and Mexico)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1-4</td>
<td>$213</td>
<td>$263</td>
</tr>
<tr>
<td>5-8</td>
<td>$338</td>
<td>$415</td>
</tr>
<tr>
<td>9-12</td>
<td>$490</td>
<td>$563</td>
</tr>
<tr>
<td>13-16</td>
<td>$655</td>
<td>$698</td>
</tr>
<tr>
<td>17-20</td>
<td>$763</td>
<td>$848</td>
</tr>
<tr>
<td>21-24</td>
<td>$875</td>
<td>$985</td>
</tr>
<tr>
<td>25-28</td>
<td>$985</td>
<td>$1,080</td>
</tr>
<tr>
<td>29-32</td>
<td>$1,008</td>
<td>$1,143</td>
</tr>
<tr>
<td>Covers</td>
<td>$95</td>
<td>$118</td>
</tr>
</tbody>
</table>

Minimum order is 50 copies. For orders larger than 500 copies, please consult Cadmus Reprints at 800-407-9190.

Reprint Cover
Cover prices are listed above. The cover will include the publication title, article title, and author name in black.

Shipping
Shipping costs are included in the reprint prices. Domestic orders are shipped via UPS Ground service. Foreign orders are shipped via a proof of delivery air service.

Multiple Shipments
Orders can be shipped to more than one location. Please be aware that it will cost $32 for each additional location.

Delivery
Your order will be shipped within 2 weeks of the journal print date. Allow extra time for delivery.

Color Reprint Prices

<table>
<thead>
<tr>
<th># of Pages</th>
<th>Domestic (USA only)</th>
<th>International (includes Canada and Mexico)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1-4</td>
<td>$218</td>
<td>$268</td>
</tr>
<tr>
<td>5-8</td>
<td>$343</td>
<td>$419</td>
</tr>
<tr>
<td>9-12</td>
<td>$471</td>
<td>$583</td>
</tr>
<tr>
<td>13-16</td>
<td>$601</td>
<td>$698</td>
</tr>
<tr>
<td>17-20</td>
<td>$738</td>
<td>$742</td>
</tr>
<tr>
<td>21-24</td>
<td>$872</td>
<td>$891</td>
</tr>
<tr>
<td>25-28</td>
<td>$1,004</td>
<td>$1,072</td>
</tr>
<tr>
<td>29-32</td>
<td>$1,140</td>
<td>$1,143</td>
</tr>
<tr>
<td>Covers</td>
<td>$95</td>
<td>$118</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># of Pages</th>
<th>Domestic (USA only)</th>
<th>International (includes Canada and Mexico)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1-4</td>
<td>$218</td>
<td>$268</td>
</tr>
<tr>
<td>5-8</td>
<td>$343</td>
<td>$419</td>
</tr>
<tr>
<td>9-12</td>
<td>$471</td>
<td>$583</td>
</tr>
<tr>
<td>13-16</td>
<td>$601</td>
<td>$698</td>
</tr>
<tr>
<td>17-20</td>
<td>$738</td>
<td>$742</td>
</tr>
<tr>
<td>21-24</td>
<td>$872</td>
<td>$891</td>
</tr>
<tr>
<td>25-28</td>
<td>$1,004</td>
<td>$1,072</td>
</tr>
<tr>
<td>29-32</td>
<td>$1,140</td>
<td>$1,143</td>
</tr>
<tr>
<td>Covers</td>
<td>$95</td>
<td>$118</td>
</tr>
</tbody>
</table>

Tax Due
Residents of Virginia, Maryland, Pennsylvania, and the District of Columbia are required to add the appropriate sales tax to each reprint order. For orders shipped to Canada, please add 7% Canadian GST unless exemption is claimed.

Ordering
Reprint order forms and purchase order or prepayment is required to process your order. Please reference journal name and reprint number or manuscript number on any correspondence. You may use the reverse side of this form as a proforma invoice. Please return your order form and prepayment to:

Cadmus Reprints
P.O. Box 751903
Charlotte, NC 28275-1903

Note: Do not send express packages to this location, PO Box.
FEIN #:541274108

Please direct all inquiries to:
Rose A. Baynard
800-407-9190 (toll free number)
410-819-3966 (direct number)
410-820-9765 (FAX number)
baynardr@cadmus.com (e-mail)