

The Accuracy of Health Information on Wikipedia

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Abstract

Wikipedia is different from other well known websites with health information in that it allows anyone – subject experts and laypeople – to contribute and edit information that it presents. Given that anyone with access to the site can edit it, scholarly studies have found to the surprise of Wikipedia's critics that scientific information on the site is as nearly as accurate as that found in *Encyclopedia Britannica*. This also goes against the reasoning of established measures of health information accuracy like the standards of the HONcode. Instead of having strict editorial procedures involving subject experts, Wikipedia's culture fosters and regulates a sizable community of ardent editors who are devoted to protecting the information integrity of the site, and scholars speculate that their motivations are not altruistic. Through the diligence of active Wikipedia users and the establishment of standards, procedures, boundaries of responsibilities, and sanctions, the site has articles with accurate information. To discuss Wikipedia's accuracy, this paper reviews the scholarly literature about Wikipedia's accuracy in relation to health information. This discussion will focus on the the following topics: Wikipedia's contribution to consumer health information sites on the Internet, metrics used to measure the quality of health information on the Internet, its level of accuracy, what aspects of its community culture enable it to maintain remarkably high accuracy levels, and the characteristics and aims of other collaborative websites like Wikipedia.

Introduction

To the surprise of many, the journal *Nature* announced in 2005 that after studying scientific articles on the website Wikipedia, it found that the information on the wiki is almost as accurate as the scientific information *Encyclopedia Britannica* publishes. *Nature's* reporter Jim Giles (2005) explains that: “The exercise revealed numerous errors in both encyclopedias, but among 42 entries tested, the difference in accuracy was not particularly great: the average science entry in Wikipedia contained around four inaccuracies; Britannica, about three” (p. 900). Like *Nature*, Devgan, Powe, Blakey, and Makary (2007) report that health information related to 39 of the most commonly performed medical procedures in Wikipedia articles is nearly as accurate as that provided by expert edited publications.

Wikipedia critics argue that the rather democratic editing and vetting system of the site, which allows anyone to add and edit information, has the danger of allowing incorrect or inaccurate information to appear as fact (Pho, 2009; Denning, Horning, Parnas, & Weinstein, 2005). This is *Encyclopedia Britannica's* (2006; *Nature*, n.d.) argument against the ultimate value of Wikipedia. Despite these concerns, many members of the public turn to Wikipedia for information – including health issues, and some experts have concluded its information is comparatively accurate in comparison to other commonly used expert edited publications. Thus, it is important to understand why Wikipedia – with its lax contributor and editorial guidelines that do not restrict editing and contribution privileges to credentialed and vetted subject experts – maintains a high level of accuracy with its health information. This is even more interesting when considering the fact that Wikipedia does not meet all of the standards of the HONcode (Boyer and Geissbuhler, 2005) as well as those that Fallis and Fricke (2002), which are discussed

later in this paper.

It is also very important to note that accuracy is not the only factor in determining the quality of information. An important caveat of Devgan et al.'s (2007) report is that health information on Wikipedia is not as broad and as in-depth as that presented by expert led sources of information. Therefore, it is important to acknowledge that while health information on Wikipedia has a comparable level of accuracy to other sources, its information is not as complete as these other sources. However, this paper will only briefly discuss the completeness of Wikipedia information since it is not the focus of the thesis.

This paper reviews the scholarly literature about Wikipedia's accuracy in relation to health information. This discussion will focus on the the following topics: Wikipedia's contribution to consumer health information sites on the Internet, metrics used to measure the quality of health information on the Internet, its level of accuracy, what aspects of its community culture enable it to maintain remarkably high accuracy levels, and the characteristics and aims of other collaborative websites like Wikipedia.

Wikipedia's Contribution to Consumer Health Informatics Online

According to Kamel Boulos and Wheeler (2007) Wikipedia falls into the Web 2.0 category of websites on the Internet, and the establishment of Web 2.0 health sites greatly increases the utility and value of the Internet for health care professionals, patients, and care givers. Initially the Internet served mainly as a platform for content distribution. Most sites were considered “flat” as they only presented content – whether it be text, images, audio, or video – but provided limited, if any, ability for direct interaction through websites. Granted, e-mail, chat rooms, and discussion boards have existed since before the public usage of the World

Wide Web really began to burgeon in the mid 1990s. However, Web 2.0 technologies enable people to better interact with each other and the content on the Internet. In Wikipedia's case, Kamel Boulos and Wheeler (2007) explain that before Web 2.0 technologies the general public had to rely upon expert maintained websites like the *Encyclopedia Britannica*, but a Web 2.0 site like Wikipedia enables a layperson to share and collaborate on the presentation of health information.

Kamel Boulos and Wheeler (2007) further report that the Web 2.0 technologies enable the Internet to better serve the health information needs of people. Robinson (2005) states that Web 2.0 sites make up the “People-centric Web” since they provide tools that help create forums for more personal support groups (Sharp, 2006) with a greater sense of community (Wallace, 1999). As Wikipedia enables people to converge around common interests and experiences with health related topics, they can better connect to support each other while sharing information that is more tailored to the individual's or group's needs. With this ability, Wikipedia provides so much more than health information – it also gives people the ability to better help each other find useful information.

Devgan et al. (2007) report that Wikipedia is one of the most popular websites in the world and the most widely read site. They further assert that as Internet usage burgeons, more and more people are turning to websites like Wikipedia to find information about the medical procedures recommended to them by health care professionals. Thus, members of the general public turn to the Internet for additional medical opinions (Fox, 2008). Pho (2009) reports that according to a survey conducted by Manhattan Research, a health care market research firm, nearly fifty percent of doctors use Wikipedia as a medical information source.

Sources of Information on Health Sites	
<i>Site</i>	<i>Main Contributors</i>
AskDrWiki.com	Healthcare practitioners
Drugratingz.com	Members of the general public
MayoClinic.com	In-house experts
MedlinePlus.com	U.S. government agencies
NetDoctor.co.uk	Healthcare practitioners
NHSDirect.nhs.uk	British government agencies
WebMD.com	In-house experts and third parties
Wikipedia	Mainly members of the general public
Yahoo! Health	In-house experts and third parties
Yedda.com	Mainly members of the general public

However, Wikipedia is far from the only source of health information on the Internet. In fact, there are plenty of wikis, blogs, and social media sites through which both laypeople and health care professionals share information (*Journal of Visual Communication in Medicine*, 2008; Hasman & Chiarella, 2008; Denecke & Nejdil, 2009). There are many other health sites that have Web 2.0 features but are more focused on presenting information like Wikipedia than focusing on connecting people to work on a common project. Such sites include: WebMD.com, MayoClinic.com, MedlinePlus.gov, and Yahoo! Health. Unlike Wikipedia, the sites just listed are edited and maintained by health experts although they take different approaches to acquiring and presenting information. WebMD.com produces its own original content while also providing information from trusted third party content providers (WebMD, n.d.). MayoClinic.com provides information that the Mayo Clinic develops in-house (Mayo Clinic, n.d.). MedlinePlus.com is a United States federal government website that aggregates health information from government agencies (U.S. National Library of Medicine, n.d.). Yahoo! Health

is part of a greater portal that presents information and services for a wide range of needs and interests both within and outside the scientific realm, and it partners with many content providers that a staff of health experts edit and present on the site (Yahoo!, n.d.). Although these other websites are popular and widely used, many people still use wikis like Wikipedia.

Since wikis are designed to facilitate updating information, Hasman and Chiarella (2008) argue that this enables them to quickly incorporate the latest accurate information available. This advantage of wikis helps make Wikipedia an important part of online consumer health information. Depending upon a wiki's permission levels, they can certainly have more up-to-date information than their counterparts. Some wikis restrict editing privileges to select users (for instance, subject experts who collaborate in a private wiki to collaborate on a project while there are other public wikis that subject experts must approve contributions from laypeople). Expert maintained websites may spend more time verifying and vetting new information before editing their information. This more stringent editorial policy is not necessarily a disadvantage, but sites like Wikipedia can update themselves more rapidly without institutionally based vetting and editing procedures.

When placing Wikipedia in proper context of medical information sources on the Internet, accuracy of information is not the only factor to consider. Website specialty and purpose are also important factors to consider (Denecke & Nejd, 2009).

Denecke and Nejd (2009) focus on the specific purposes of different medical information sites and the needs they address, and they focus on social media sites offering medical information. They hypothesize that social media site features – like blogs and interactive question and answer tools – will spark discussion about a wide variety of medical topics ranging

from anatomy, disorders, and treatments on the same site, but their data only partially supports this hypothesis. They find that sites like Q & A portals and blogs can cover a wide range of topics, but the number of topics covered is more directly tied to the type of people who create and use the site than its format.

When examining sites that mainly aim to present information like the non-profit AskDrWiki.com, a physician created wiki intended for other current and prospective health care practitioners, and encyclopedia MedlinePlus from the US federal government, Denecke and Nejdil (2009) find that they mainly focus on anatomy. Thus, neither site offers much in-depth information that is not directly related to anatomy. Further, they also examined over 3,700 reviews of 630 pharmaceutical drugs on Drugratingz.com. The topical focus of this site restricts the variety of topics it covers to only drug related information.

On the other hand, Denecke and Nejdil (2009) report that medical blogs and Q & A portals – including: NetDoctor.co.uk, MayoClinic.com, Yedda.com, and NHSDirect.nhs.uk – are better information sources for individuals searching for information about disorders and pharmaceutical drugs. That is because the content creation of the Q & A portals is driven by questions from site visitors who are more concerned about many different conditions and disorder treatments. When examining the medical blogs they discuss, Denecke and Nejdil (2009) find that the type of person writing it affects the topical focus. Doctors tend to relate experiences and provide information about medical decisions, different treatments, and political issues. Nurses cover a wide gamut of general topics about their experiences dealing with both doctors and patients but tend to not focus on providing medical information. Patients tend to share experiences about the conditions they are confronting as well as provide medical information that they have found or know from

other patients.

None of the studies cited in this article examine the breadth of topics covered by Wikipedia, but due to its encyclopedic format, it is safe to say that Wikipedia presents health facts and does focus on enabling people to collaborate for projects. Thus, while Wikipedia does connect individuals passionate about disseminating information, other health focused social media sites have a much broader range of health related topics that they address. Having said that, Wikipedia does play a valuable role in health websites since it attracts a large audience.

Assessing the Quality of Health Information

Although *Nature* (Giles, 2005) and Devgan et al. (2007) do not use the same metrics as other organizations when determining the accuracy of scientific and health information on Wikipedia, it is important to note some of the other various factors and considerations that are used to determine the quality of information on other sites. This analysis will help reveal how Wikipedia compares to other sites. Thus, it is worth noting how Wikipedia adheres or does not adhere to these standards.

Since usage of the World Wide Web by members of the general public began to grow starting in the 1990s, many people are now able to disseminate information through this network. Although this concern exists for information sources in other media, websites tend to concern people more since anyone with sufficient technical equipment can access websites. Further, it is far cheaper and easier to spread information than it is to secure the ability to publish print publications and periodicals. In the past, typically publishers have vetted experts for the topics that they desire to distribute information about, but on the Internet virtually anyone can pose as an expert. That is why organizations formed to track the accuracy of web sites.

In relation to health information on the Internet, some organizations have established standards and metrics to determine if a health website is accurate. In 1995, just as the public access and use of the Internet began to rapidly grow, several health experts founded the Health On the Internet (HON) Foundation in order to promote quality health information on the Internet through accreditation of adhering to standards (Boyer & Geissbuhler, 2005).

In order to achieve this objective, the foundation created a set of standards – known as the HONcode – to determine the information quality on sites. The HONcode stipulates that information quality relies upon:

- **Authority** – Credentialed health care professionals provide the information.
- **Complementarity** – Information provided augments the practitioner-patient relationship.
- **Privacy** – Personal data collected is protected.
- **Attribution** – Citations are provided to the sources of information presented on the site.
- **Justifiability** – The site can back up its claims.
- **Transparency** – Site administrator and author contact information is provided.
- **Financial Disclosure** – The source of the site's funding is identified.
- **Sponsorship** – Editorial content is clearly distinguished from advertising (Health on the Net Foundation, n.d.).

Upon successful compliance with the HONcode, a site can display a HON logo that indicates to site visitors that the health information adheres to these standards. Before providing accreditation to sites, HON reviews candidate sites to ensure that they did indeed meet all of the standards. After accreditation, HON follows up on reviewing sites to ensure that they continue to adhere to the standards (*ibid*).

It is very important to note that the appearance of the HON seal on a site – indicating its compliance to the HONcode – does not necessarily mean that the health information is accurate or complete. Fallis and Fricke (2002) report instances when sites display the seal without securing accreditation. A site can simply reproduce the seal and display it to claim legitimacy. However, Fallis and Fricke find that the display of the HON seal is a much better indicator of a site's health information quality than if a site displays a copyright symbol since HON regularly reviews sites that display its seal. If a site falsely claims accreditation by displaying the seal, HON requests removal of the seal.

Fallis and Fricke (2002) also examined websites providing information about how to treat children who have fevers. In their study they tested the importance of several factors to help determine the quality of the information the sites provide. The factors that are correlated with accurate health information are: displaying the HONcode seal, using an organizational domain (ie .org and .edu), and displaying a copyright symbol. While Fallis and Fricke explain that the HONcode seal tends to serve as a better indicator of accurate health information, a site displaying a copyright symbol is also indicative of a quality health site. Further, using an organizational domain also can help indicate the quality of a site since .org or .edu sites are typically associated with an established entity like a non-profit research or academic institution that are not primarily driven by the profit motive like commercial organizations that tend to use domains like .com and .biz. An important caveat that Fallis and Fricke point out is that there are sites that do not have these three characteristics that do provide accurate health information.

Interestingly in their study, Fallis and Fricke (2002) also challenge established and accepted guidelines for determining the reliability of health sites. For instance, they report that

Wikipedia and the HONcode	
Authority	Does not adhere
Complementarity	Adheres
Privacy	N/A
Attribution	Some articles adhere while other do not adhere
Justifiability	N/A
Transparency	Adheres
Financial Disclosure	Adheres
Sponsorship	N/A but does not have advertisements

sites providing content created by credentialed health care professionals may not correlate to the quality of information on the site. Due to the fact that a very limited number of sites they examined cite peer-reviewed material, they also were unable to find a correlation between citing peer-reviewed material as an indication of a site's accuracy. Accuracy is also not correlated with the currency (how up-to-date) of a site, but Fallis and Fricke concede that this relates to the fact that information regarding treating fevers in children has remained stable for years. Further, Fallis and Fricke also find that the presence of advertising on a health website does not necessarily make it inaccurate. In fact, it is important to note that several reputable websites like MayoClinic.com and Yahoo! Health display advertisements.

Examining Wikipedia's accuracy helps determine how robust the HONcode and standards that Fallis and Fricke use are when determining accuracy of health information.

How Accurate is Wikipedia?

Wikipedia does not adhere to all of the standards of the HONcode as reported by Boyer and Geissbuhler (2005). First, on the basis of authority, anyone with access to the site and an understanding of the Wikipedia's platform can edit articles, and that includes individuals who

are not credentialed health care professionals (Bryant, Forte, & Bruckman, 2005). Regarding attribution, there are plenty of articles that Wikipedia editors mark as “citations needed” to indicate that the information presented in an article is not easily verifiable. Having said that, there are plenty of articles with plenty of citations that enable visitors to check the information provided (Garfinkel, 2008). Concerning complementarity, Wikipedia mainly aims to provide information. The standards of privacy, justifiability, and sponsorship really do not apply since the site really does not use personal data to report health information or to make claims. It also does not have advertisements. When it comes to transparency, as with other wikis, Wikipedia tracks each version of the page by recording the time, date, and user who edited the article (Wagner, 2004), which users can see. When it comes to financial disclosure, there are fund raising links throughout the site that explain how individuals can contribute to the site and learn how the non-profit organization supporting the site, the Wikimedia Foundation, is financially supported (Wikimedia Foundation, n.d.).

Wikipedia also does not adhere to all of the accuracy metrics that Fallis and Fricke (2002) report on. It does not have a HONcode seal since it, as explained before, does not adhere to its standards. The site does not display a copyright sign but does have a Creative Commons License explanation at the bottom of each article page. However, the site does use a .org site since the Wikimedia Foundation is a non-profit (Wikimedia Foundation, n.d.).

Despite the fact that Wikipedia does not completely adhere to standards of the HONcode or those used by Fallis and Fricke, other scholars have found reasons why the site can have accurate information. Devgan et al. (2007) find that the accuracy of a Wikipedia health article is positively correlated with how many times it is edited. The more times an article is edited, its

accuracy and quality tend to increase as well. Further, Luyt, Aaron, Thian, and Hong (2008) point to a German study conducted by Brändle (2006) that suggests that the more authors who contribute to an article, the higher its quality. These findings seem consistent with analysis conducted by Forte, Larco, and Bruckman (2009) as they report that there is a sizable population of ardent Wikipedia users who edit and curate information presented by the site. They report that users playing various roles help secure the integrity and accuracy of the site by editing and verifying information. In fact, some of them form topic specific task forces to monitor and improve specific types of articles.

While the findings of Devgan et al. (2007) deem more than 85 percent of the articles they examined as suitable for the public, they do not provide much detail in their analysis of Wikipedia articles that they investigated, which are related to the most commonly performed outpatient procedures in the United States of America. On the other hand, the *Nature* study that examined 42 scientific articles provided information on the types of errors – inaccurate information or serious omissions (Luyt et al., 2008). While *Encyclopedia Britannica* articles had about three errors, corresponding Wikipedia articles averaged around four inaccuracies. In regard to total minor inaccuracies (factual errors, omissions, and misleading verbiage), *Britannica* had 123 while Wikipedia had 162. Further, of the eight serious errors found by the *Nature* commissioned reviewers, both information sources had four apiece (Giles, 2005).

Related to accuracy is completeness. Devgan et al. (2007) report that medical information on Wikipedia is not as broad or in-depth as that found in expert maintained information sources. When assessing numerous types of Wikipedia articles – mainly relying upon word count for comparison – to encyclopedia articles during November 2006, Royal and

Kapila (2009) find that the completeness of information presented on Wikipedia varies. For example, when examining articles about Academy Award winning films – with only a few notable exceptions for extremely popular and influential films like *Gone with the Wind* from 1939 and *Casablanca* from 1943 – the more recently a film was released, the longer and more comprehensive the Wikipedia article for that film is. Therefore, Royal and Kapila surmise that Wikipedia reflects the interests and emphases of its community.

Therefore, while the comprehensiveness of information on Wikipedia may not compare to that of articles in expert moderated sources like *Encyclopedia Britannica*, the accuracy of the articles is comparable. When considering the fact that Wikipedia does not hold accreditations like the HONcode, it appears that when it comes to accuracy the site is an exception to the notion that subject experts must exercise control of health information sites that are suitable for use by members of the general public. Perhaps the fact that Wikipedia is accurate even though it does not adhere to all of the standards employed by the HONcode and Fallis and Fricke relates to the fact that these other standards were established before collaborative sites like Wikipedia gained popularity. Since collaborative technologies are more widespread and used on the Internet, standards that evaluate information accuracy should consider the aspects of groups instead of mere individuals.

What Keeps Wikipedia so Accurate?

Part of Wikipedia's appeal is its democratic notion that allows anyone to edit its content. However, this notion is what concerns many of its critics since non-experts can add inaccurate information or omit crucial information (Pho, 2009; Denning et al., 2005; *Encyclopedia Britannica*, 2006; *Nature*, n.d.). What these critics downplay is that there is a devoted user base

and culture established on the site that helps foster an environment in which only presenting accurate and verifiable information is the goal (Bryant, Forte, & Bruckman, 2005; Rafaeli & Ariel, 2008). This user base is rather sizable as Rafaeli and Ariel (2008) report that as of their writing, based upon Wikipedia statistics, there are approximately 300,000 users who have made at least 10 edits, and this population is exponentially growing at a rate between five and ten percent per month. Having said that they also report that 2.5 percent of Wikipedia users create 80 percent of the content, and one percent of these users – who are mainly laypeople who volunteer to work on the site – create about half of the content. Thus, while the vast majority of Wikipedia's audience members are lurkers who merely view the information, the small and ardent portion who actively curate the site do pretty well in volume and accuracy of information. They do so through site-wide governance, defined roles, and self-centered motivations.

It is very important to note that as Wikipedia has grown and expanded, the governance of the site has adjusted to meet the needs of a growing community and site. Forte, Larco, and Bruckman (2009) report that governance on the site is growing more decentralized, but community members still take on the important role of policing each other's edits and sanction violators who do not adhere to the standards established by the community. These standards result in well defined norms, policies, and technical architecture to support the site's mission to provide accurate information as a more traditional encyclopedia does. Standing committees – established, for instance, to handle conflict resolution between community members and other tasks – exist to manage the community. They further find that among registered users, there are several different roles that users take based upon ideology, function, and content. Ideological groups divide into camps based on common beliefs; one such difference is between deletionists

who have strong standards on what information belongs in an encyclopedia and inclusionists who are against excluding information from Wikipedia. Functional groups monitor the site and perform functions like cleaning up vandalism on articles and attempt to restrict access to known vandals. Content groups focus on managing the content of the site. In fact, when considering content and dividing it into manageable sections, the researchers report that there are WikiProjects that are designed to enlist Wikipedia users who are passionate experts about specific topics to focus on policing related articles. For example, the WikiProject Military History focuses on military history, and project members break up into task forces to focus on specific topics like World War I and World War II. Such projects also create what the researchers refer to as local boundaries that can also designate which editors are responsible for certain articles to better ensure consistency.

While investigating Wikipedia's user base Bryant, Forte, and Bruckman (2005) interviewed several different site participants to determine their roles, motivations, and activities when they help shape the site. The researchers divide the users into two groups: novices and experts. Majchrzak, Wagner, and Yates (2006) make a similar distinction between users; however, their classification – adders and synthesizers – is based more upon the role that users take and not the extent of their Wikipedia experience. Their adder users are closely related to novices who are primarily concerned with ensuring the accuracy and overall quality of information while synthesizers take on a much more broad view and are concerned about the cohesiveness of the community and overall reputation of the site like expert users.

Novices primarily use Wikipedia for information gathering purposes. However, when they find an error or omission on an article, they at times will edit the article in order to correct

the mistake. Several interviewed novices explain that instead of merely fixing an error, they sometimes will write a stronger article on the topic. However, Bryant, Forte, and Bruckman (2005) explain that typically in these cases, novices who write stronger versions of articles typically have in-depth knowledge about the given topic. For instance, while one novice user read an article about where he is from in Wales, he found it inaccurate and wrote a new version of the article. Another novice initially simply wanted to bolster an existing article with relevant links (to railroad historical societies) but ended up contributing a more complete article about the topic. While these interviewees certainly made dramatic changes to existing articles, they did not feel like they had much authority to make changes when they were newcomers to the site. They revealed that at first they were hesitant to make more than minor changes (perhaps to a simple fact or correcting grammar) since they did not want to make changes to an article that they know little about. However, they tend to make more significant edits to articles covering topics that they have personal or professional knowledge about.

It is very important to note that Bryant, Forte, and Bruckman (2005) report that many Wikipedia novices exercise restraint in changing information on the site. In most cases they view themselves as information consumers and not producers, but at this stage they play a crucial role in the community since as consumers, they create a market that Wikipedia needs to address. However, through their caution towards editing, this helps indicate that active Wikipedia editors – otherwise known as “Wikipedians” – care greatly about the quality of information presented by the site since they recognize that their edits can affect its quality and reputation.

Further, when novices – or anyone else for that matter – make edits to Wikipedia articles, these changes are tracked. As with any typical wiki software package, Wikipedia creates a log of

changes that indicates who made them (registered users are notated by their username while those who are not logged are identified by their IP address) and enables users to revert a page back to a previous version if deemed necessary. Thus, when expert Wikipedia users check articles, they can see what was changed and reverse them if necessary (Bryant, Forte, & Bruckman, 2005).

It is also important to note that Fishkin (2008) observes, it is typically better for an unregistered or novice user to suggest edits to an article on its discussion page. Each Wikipedia article has a discussion page in which people can discuss the topic in a more conversational tone and debate the recent page edits or the need to make specific edits. Even if a user makes a needed correction to an article, there is a chance that a Wikipedia editor monitoring changes made to that article will revoke it unless it obviously is correct or substantiated through provided citations to reputable sources. The discussion page mechanism further helps protect the actual articles from having errors or unsubstantiated information. As Forte, Larco, and Bruckman (2009) note, members of the Wikipedia community value consensus building, and such activity helps more individuals evaluate and vet proposed changes to articles in a way that can foster quality of information.

Bryant, Forte, and Bruckman (2005) further find that as Wikipedia users transition from novices to expert users, their aspirations and self-appointed role changes. While novices typically focus on the quality of individual articles, expert users have broader concerns. Experts certainly still care about the quality of individual articles and make corrections if necessary, but they are much more concerned about the quality of Wikipedia as a site and community more than the novice users. They focus on the site as a whole.

When interviewing Wikipedia users about their motivations and actions during their expert stage, many comment that improving the quality of the site helps contribute to a greater good (Bryant, Forte, & Bruckman, 2005; Forte, Larco, & Bruckman, 2009; Gaved, Heath, & Eisenstadt, 2006). The core mission of the site is to codify all of the knowledge in the world and make it accessible to everyone, and expert users feel a strong tie to this mission and derive great satisfaction from working towards it. One interviewee even explains that curating information in this site is much more lasting and can have a much more broad and profound effect than participating in a listserv or group space since those are typically limited to group members and subscribers. Bryant, Forte, and Bruckman (2005) also report that expert users typically take personal responsibility for the articles that they edit and monitor. It is common for them to respond with “my” before mentioning articles or tasks. In essence, they feel that the quality of Wikipedia reflects upon them.

Bryant, Forte, and Bruckman's (2005) divisions of Wikipedia users sheds interesting light on to the community's culture, other researchers find additional aspects of Wikipedia's culture that help explain how accuracy is maintained on the site. Rafaeli and Ariel (2008) note that while Wikipedia's mission is rather democratic, the user base is not democratic as there are a variety of strata amongst the users. For instance, some users create personal pages that allow people to learn more about them personally while others use pseudonyms or do not login and are only identified by their IP address. Gaved, Heath, and Eisenstadt (2006) posit that Wikipedia users are either placeholders, completers, or housekeepers. Placeholders create sparse new articles that others can come provide more information for. Completers focus on contributing to a limited amount of articles but tend to make more substantive contributions on those that they

do collaborate. Housekeepers check for article completeness and integrity of hyperlinks. Thus, users – whether expert or novice (or synthesizer or adder) – can play a variety of specialized roles to maintain the quality of the site.

Understanding the different types of roles that users play helps explain how Wikipedia maintains such a remarkable level of accuracy on highly specialized areas of knowledge since its community of users is devoted to accuracy and has established procedures to protect the quality of the information on the site. What makes this strong sense of values even more impressive is that scholars speculate that Wikipedia users contribute and safeguard the site for reasons other than altruism (Donath, 1999; Yates, Wagner, & Majchrzak, in press) and attribution of individual aspects of their work on the site since it is hard to claim credit for such a dynamic and collaborative site which works best with numerous participants (Ciffolilli, 2003; Bryant, Forte, & Bruckman, 2005). Instead, Kollock (1999) surmises that people contribute to community sites for other reasons including:

- **Future Reciprocity** – As a user collaborates with other users who share a common interest, they hope that in the future their collaborators will give them help and favors.
- **Self Efficacy** – Wikipedians view their contributions to the site about highly specific information as a sign that they possess competence and the ability to grapple with advanced knowledge.
- **Reputation** – By spearheading and actively contributing to Wikipedia, individuals can gain attention and the affinity of others as people who are knowledgeable and intelligent.

While such motivations seem rather selfish, the fact that ardent Wikipedia users partially stake their reputations and future prospects through the quality of the site helps motivate them to

promote accuracy.

It is through site-wide governance, established roles, and selfish motivations that Wikipedia users maintain accurate information on complex health-related topics.

Other Collaborative Websites

Wikipedia is not the only wiki on the Internet. There are plenty of wikis that are formatted like encyclopedias, but some are more specialized by focusing on specific topics. It is interesting to discuss these other wikis since Wikipedia does not completely represent all of the uses of wiki sites. Although Wikipedia has accurate health information, other health wikis have different editorial policies to ensure information quality in other ways necessitated by the specific purpose of the site. As the discussion of the HONcode (Boyer & Geissbuhler, 2005) and Fallis and Fricke's (2002) factors use to determine information accuracy helps evaluate Wikipedia's accuracy, considering policies employed by other sites to promote accuracy helps reveal how collaborative sites can maintain accurate information. Understanding this helps reveal why Wikipedia does not completely meet the needs of consumers of health information and of information in general. While Wikipedia focuses on presenting information, people use other sites to share and edit information. They do so to advance a specific project while others use sites to facilitate sharing opinions and personal tactics – like how a cancer sufferer maintains his or her happiness on a daily basis – that are not meant to come across as scientific fact.

Get A Note From Your Doctor at www.ganfyd.org is a medical wiki that, unlike Wikipedia, only licensed medical practitioners can edit (Ganfyd, n.d). It is primarily set up to serve medical students and other health care professionals; in essence, the wiki serves as an evolving textbook that aims to augment the information shared on the collaborative site

Doctors.net.uk, a source of medical professional development materials. The wiki arose from a discussion among those who use Doctors.net.uk, and they decided that using a wiki helps them share and expand upon current medical information. Thus, the restriction of editing rights to those who are licensed practitioners likely results from the fact that the wiki is mainly meant to help an established group of individuals. However, this group has decided to make the information that they collaborate on publicly accessible.

Beyond medical related collaborative sites, there are several examples of other sites that contrast Wikipedia's editorial culture.

Politically conservative writer and attorney Andy Schlafly started Conservapedia at conservapedia.com since he feels that many Wikipedia articles tend to have a liberal slant. Further, he feels that Wikipedia has too much gossip, profanity, and verbose prose that is unsuitable for education, and that is why Schlafly enlisted almost 60 home schooled high school aged children to start the encyclopedia (Calore, 2007). Regardless of the alleged bias of Wikipedia, Conservapedia articles take a rather socially conservative slant. For instance, when it comes to health, the article for sexually transmitted diseases states: “People who have been sexually active before marriage can transmit their sexual diseases to their partner after marriage, therefore failure to use proper protection with an unfaithful spouse can still lead to infection” (Conservapedia, n.d.). While the scientific gist of this statement is sound, it is clearly presented in a way that caters to its target audience of socially conservative individuals. This is an example of a collaborative website in which politically like-minded individuals have teamed up to present information that conforms to their worldview.

In response to Wikipedia's lack of subject expert editorial power, one of the site's

purported co-founders, Larry Sanger, launched the Citizendium wiki at citizendium.org. It also is an encyclopedic website that anyone can participate in creating, but it has more stringent editorial standards. For instance, contributors must use their real names when editing articles so that site visitors can more easily find out who edited an article. Further, Citizendium enlists subject experts and gives them editorial control over articles about topics in which they have expertise. These editors are charged with identifying gaps of information on the site, guide the creation of articles, and must approve edits to articles before they appear on the site (Catone, 2007). Sanger hopes that by giving subject experts editorial control, the site can consistently have more accurate and complete information than Wikipedia.

Scholarpedia at scholarpedia.org takes a similar approach to Citizendium's model of content creation and maintenance. Articles are only written by experts – either elected by the public or selected by the site's existing editors – and other selected experts conduct peer reviews of the information before articles are published. Further, curators are designated for each article (sometimes the curator is the article's author), and they moderate any suggested edits and the relevancy and how up-to-date the information is on the article (Scholarpedia, n.d.). Like Citizendium, Scholarpedia's founders hope that placing editorial control in the hands of subject experts will help ensure the quality of information presented on the site.

In 2008 Google launched a collaborative site named Knol at knol.google.com to compete with Wikipedia. However, Knol emphasizes authorship unlike Wikipedia which allows individuals to contribute anonymously while merely providing their IP address or using pseudonyms. Google requires Knol article creators to authenticate their identity (one option is providing credit card information), and contributors set up profile pages that can include their

picture and biographic information so that site visitors can better understand who is providing information. Site visitors can suggest article edits, but the author must approve them. Further, Knol allows for multiple articles to cover the same topic (Lardinois, 2008). By focusing on authorship, Knol aims to not only allow site visitors to assess the quality of information by the credentials and reputation of the author, it also further encourages authors to provide quality information since their reputation is at stake.

It is very important that collaborative websites are not always developed to merely present information. Some organizations have selected to use such sites since they are great forums for people to collaborate on topics that naturally evolve. Hasman and Chiarella (2008) chronicle the development of another health wiki with a specific mission. It focuses on pain management techniques for cancer patients and their caregivers. In addition to providing an innovative way for patients to find information, the wiki is viewed as a valuable source that is easy to maintain and update. Another example is wikiCancer.org – a site that has a primary mission to foster a community of cancer patients and their loved ones together (wikiCancer, n.d.). While site visitors can certainly compare notes on the medical information given to them by health care practitioners, grappling with cancer requires so much more than scientific facts. This site specifically solicits its visitors to share their stories on how they handle the cancer in their lives. Information shared includes ideas of how to get one's mind off their own condition by exercising or staying positive, patient reviews of cancer sites, and dietary advice. By harnessing Web 2.0 technology, organizations are able to equip health care practitioners and members of the general public to team up in finding solutions to issues – like dealing with different cancer patients – that have a lot of variance from case to case (Kamel Boulos &

Wheeler, 2007; Sharp, 2006; Wallace, 1999).

While Wikipedia is certainly a popular collaborative website, it does not use all of the available tools to connect individuals together to accomplish a goal. Other sites like the ones listed here use other tools and methods while employing different approaches – in some cases in reaction to Wikipedia – to foster a community focused on information.

Conclusion

Wikipedia is one of the most popular websites on the Internet, and it plays an important role in the realm of consumer health informatics. Since many people turn to it as an information source for health related information, it is important that it presents accurate information. Thus, concerns over the fact that the site allows anyone to contribute and edit information are understandable, but to the chagrin of many people who question the accuracy of Wikipedia, these concerns are largely unfounded since expert conducted studies have concluded that the site's accuracy levels are comparable to those of more traditional sources of information like the *Encyclopedia Britannica* that have stringent editorial policies and vigilant fact checking and vetting processes.

Instead of having such formal procedures in place, Wikipedia has a very well developed culture fostered by a sizable community of ardent editors who are devoted to protecting the information integrity of the site, and as scholars speculate, their motivations are selfish and not altruistic. Through their diligence and establishment of roles, standards, procedures, boundaries of responsibilities, and sanctions, the site maintains articles with accurate information (Bryant, Forte, & Bruckman, 2005; Ciffolilli, 2003; Donath, 1999; Kollock, 1999; Yates, Wagner, & Majchrzak, in press). While such an explanation helps explain why Wikipedians are concerned

about accuracy of information on Wikipedia, this does not explain why these motivations do not result in better overall quality of information – which includes other factors like comprehensiveness – on the site. For instance, as explained earlier, health information on Wikipedia is not as comprehensive as that found in sources like *Encyclopedia Britannica* (Devgan et al.,2007). Future scholarship should focus on why these motivations help with accuracy but have not seemed to help with comprehensiveness of information.

Another topic worth scholarly attention is the accuracy of information on wikis that foster a community of specific types of users – like wikiCancer.org focuses on cancer patients and their caregivers. It seems reasonable to expect users of wikiCancer.org to have expertise about cancer since they confront the topic on a regular basis. Further, they have experience in applying information that health care professionals give them. Also, these site users have a very strong motive for only sharing accurate information since it is either their own well-being or that of loved ones that this information affects. Future research can shed light on how these factors affect accuracy of information on these wikis.

Attention should also focus on the various editorial policies employed by collaborative sites other than Wikipedia. For instance, determining if restricting edit approval privileges to vetted subject experts, as Citizendium and Scholarpedia do, and emphasizing authentic authorship like Google's Knol site are measures that result in higher quality of information than that which is found on sites like Wikipedia that have editorial policies that do not emphasize such standards (Catone, 2007; Lardinois, 2008; Scholarpedia, n.d.). Such analysis can help determine if collaborative site managers should adopt these standards.

Finally, as Wikipedia harnesses the community bolstering features of wiki software to

promote accuracy, other health wikis employ these aspects to foster collaboration between experts in specific fields as well as enable those suffering from medical maladies to support each other. In all of these cases, sharing accurate information is important for all parties, and it is important to understand how to foster accurate information creation and dissemination on all types of collaborative sites.

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