

The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education¹

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Abstract

Web 2.0 sociable technologies and social software are presented as enablers in health and health care, for organizations, clinicians, patients and laypersons. They include social networking services, collaborative filtering, social bookmarking, folksonomies, social search engines, file sharing and tagging, mashups, instant messaging, and online multi-player games. The more popular Web 2.0 applications in education, namely wikis, blogs and podcasts, are but the tip of the social software iceberg. Web 2.0 technologies represent a quite revolutionary way of managing and repurposing/remixing online information and knowledge repositories, including clinical and research information, in comparison with the traditional Web 1.0 model. The paper also offers a glimpse of future software, touching on Web 3.0 (the Semantic Web) and how it could be combined with Web 2.0 to produce the ultimate architecture of participation. Although the tools presented in this review look very promising and potentially fit for purpose in many health care applications and scenarios, careful thinking, testing and evaluation research are still needed in order to establish 'best practice models' for leveraging these emerging technologies to boost our teaching and learning productivity, foster stronger 'communities of practice', and support continuing medical education/professional development (CME/CPD) and patient education.

Background

The early World Wide Web (Web 1.0) has demonstrated powerful capability to connect clinicians, patients and materials. In this paper, we explore how this connective matrix may further grow through the impact of the democratic and social nature of Web 2.0. We discuss its application to education within a health and health care context and outline some of the social web's key features. We compare Web 2.0 with Web 1.0, and

look forward to the arrival of Web 3.0—the Semantic Web. Throughout, we provide documented uses of social software such as wikis, blogs, social tagging, and emerging uses of social technology such as collaborative writing, aggregative content management, RSS (Really Simple Syndication) feeds and podcasting in health care contexts.

The social Web

The second incarnation of the Web (Web 2.0) has been called the 'social Web', because, in contrast to Web 1.0, its content can be more easily generated and published by users, and the collective intelligence of users encourages more democratic use. Originally, the World Wide Web (WWW)

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¹All website addresses given in this article were last accessed on 29 December 2006.

Table 1 Web 1.0 and 2.0 differences: adapted from O'Reilly⁹

Web 1.0	Web 2.0
Encyclopaedia Britannica http://www.britannica.com/	Wikipedia http://en.wikipedia.org/
Personal Web sites	Blogs (Web logs)
Publishing (Content Management)	Participation
Taxonomies	Folksonomies
Directories	Tagging
'Stickiness'	Syndication

was intended to be used to share ideas and promote discussion within a scientific community. Web 2.0 heralds a return to these original uses, and prompts significant changes in the ways the World Wide Web is being used in health care and education.

Making connections

On the back of the exponential growth of Web 1.0, Web 2.0 software has emerged to facilitate new online activities, many of which could not have been previously achieved. Online social interaction has been enriched through the use of wikis, blogs and podcasts.¹ Web 2.0 encourages a more human approach to interactivity on the Web, better supports group interaction² and fosters a greater sense of community in a potentially 'cold' social environment.³ As Abram⁴ has claimed, the social Web '... is about conversations, interpersonal networking, personalization and individualism'. It is the 'People-centric Web'.⁵

Students can feel socially isolated if they are geographically separated or studying during unsociable hours. Social isolation poses a significant barrier for some learners, as can a reduction in motivation normally derived from traditional, on-campus education.⁶ The benefits of making connections, albeit virtual, provide impetus and motivation for students to persist in their studies. Although Web 2.0 has not supplanted Web 1.0, it has undeniably changed and challenged the perceptions and expectations of those who use it.

Collaboration in Web 2.0. Collaborative activity is an important component for success in web-based environments. Kear⁷ found that students participate collaboratively mainly to obtain help and guidance from others. McConnell⁸ maintains

that collaborative learning is an activity where learners who are brought together through the Internet focus on working together as a learning community in which they share resources, knowledge, experiences and responsibilities. We will demonstrate throughout this paper that Web 2.0 software can open up new possibilities for collaborative networked learning in health and health care.

A useful starting point is to compare earlier web-based applications with emerging features of the social Web, which can be seen as more student centred, open and democratic (Table 1).

Flexibility in Web 2.0. Greater levels of participation, agency and democracy are possible in the social Web, where users act simultaneously as readers and writers. This has been very much helped by the significant growth of computer ownership and Internet usage over the past decade.^{9,10} The rigidity of Web 1.0 directory systems (taxonomies) is improved by the facility to formulate 'folksonomies'—fluid and flexible categorizations uniquely created by each interest group to provide quicker, more relevant access to practice-specific knowledge. The notion of 'stickiness' can also be challenged—content in Web 2.0 environments is never permanent but always open to changes, updates, remixing and reuse.

An 'architecture of participation'. Web 2.0 emphasizes the pre-eminence of content creation over content consumption. Information is liberated from corporative control (traditional content owners or their intermediaries), allowing anyone to create, assemble, organize (tag), locate and share content to meet their own needs or the needs of clients, courtesy of the emergence of new flexible content licensing models like creative Commons (<http://creativecommons.org/>). Web 2.0 is structured

around open programming interfaces that allow widespread participation.

Increased user contribution leads to the growth of 'collective intelligence', and re-usable dynamic content. Such engagement with content promotes a sense of community, empowerment and ownership for users. There are several instances of amateur knowledge surpassing professional, when the right kind of systems and tools are available. Of these, Wikipedia (<http://wikipedia.org>) is certainly the most recognized example.^{11,12}

Interactivity in Web 2.0. Web 2.0 also encourages significantly more interaction between users, a feature that many theorists argue is vital in e-learning. Interaction encourages deeper and more active learning engagement, builds communities of learning¹³ and enables feedback from tutors to students.¹⁴ In recent studies, associations have been reported between tutor–student interaction in online learning and raised levels of student motivation.^{15,16}

An overview of the emerging Web 2.0 sociable technologies and their current and potential roles in health and health care education

A growing spectrum of applications

Barsky and others enumerate several emerging technologies and applications under the Web 2.0 platform. These include RSS, wikis, blogs, and the user comment functionality found in various websites. Examples of the latter include *British Medical Journal* Rapid Responses (http://bmj.bmjournals.com/cgi/eletters?lookup=by_date&days=1), and the user comment functionality at Patient.co.uk, which patients can use to record their experiences (e.g. <http://www.patient.co.uk/comments/23068811/#comments>); Patient.co.uk readers can also rate existing 'Patient Experience' entries, and report any unsuitable or offensive entries they might come across. The list of Web 2.0 technologies and applications goes on to comprise web and desktop personalization (e.g. Windows Live <http://www.live.com/getstarted.aspx> and Windows Live Gallery of desktop gadgets <http://gallery.microsoft.com/>), photo sharing (e.g. Flickr <http://flickr.com/> and Zoomr <http://zoomr.com/>), video sharing

(e.g. YouTube <http://youtube.com/>), streaming media, podcasting and MP3 files (e.g. Odeo <http://odeo.com/>), social networking software (e.g. MySpace <http://myspace.com/>), social bookmarking (e.g. del.icio.us <http://del.icio.us/>), user-driven ratings (e.g. Digg <http://digg.com/>), open-access content (e.g. PLoS ONE—Open Access 2.0 <http://www.plosone.org/>), open source software (e.g. SourceForge <http://sourceforge.net/>) and AJAX (Asynchronous JavaScript And XML) and API (Application Programming Interface) programming (e.g. as used in Google Maps/mashups <http://maps.google.com/> and Gmail <http://mail.google.com/>).^{11,12,17–20}

A number of Web 2.0 applications can be added, including next generation web-based office/'social writing' applications which facilitate shareable documents. Multiple users can collaborate online and track changes (e.g. Gliffy <http://www.gliffy.com/>, Google Docs and Spreadsheets <http://docs.google.com/>, Microsoft Office Live <http://officelive.microsoft.com/>, and social calendars like <http://upcoming.org/>).

The collaborative concepts underpinning these Web 2.0 applications are very similar to the notion of web-based, shareable and distributed electronic health/patient records. Patients and clinicians can securely and simultaneously access these records across multiple institutions and places, facilitating speedy information exchange, communication and collaboration among clinicians, and between them and their patients, to potentially improve clinical outcomes and cost reduction.

Recent advances in peer-to-peer (P2P) networking and Grid computing technologies have also made it possible to provide services that interconnect large communities without centralized infrastructures for data and computation sharing, which is necessary to build heterogeneous, multi-organizational collaboration, and document sharing networks.

For a comprehensive list of Web 2.0 applications with selected examples, see Software Development of the Real World: Best of the Best Web 2.0 Web Sites²¹ and SEOMoz's Web 2.0 Awards.²²

Wikis

Wikis are good examples of 'social writing' software. A wiki is a collaborative software that allows users to add content but also allows that content to be

edited by anybody.² Wikis, and their combination with blogs and podcasting, are covered in greater detail with many medical and health-related examples in Boulos *et al.* 2006.¹⁸ Wikis can be used for sharing knowledge (encyclopaedia-style wiki), e.g. Wiki Surgery (<http://www.wikisurgery.com>)²³ and/or running community projects. A good example of the latter is OpenStreetMap (http://wiki.openstreetmap.org/index.php/Main_Page), the Free Wiki World Map, a collaborative project to create free maps using data from portable GPS (Global Positioning System) devices.

Recently, 23 British academics who wrote to Parliament outlining their concerns about the progress of the National Programme for IT in England set up their own public wiki to track media reports and act as a resource for NHS IT (http://editthis.info/nhs_it_info/Main_Page). They used EditThis.info service (<http://editthis.info/>), a site where anyone can create a free wiki.

An interesting enterprise wiki, Socialtext (<http://www.socialtext.com/>), touts itself as a good solution to 'e-mail overload' by enabling the use wiki-style 'social text' among groups of collaborators, while still being as simple to use as e-mail. An interesting and common observation in large public wiki projects like Wikipedia is that only a very small fraction of users contribute most of the content, while the majority of visitors are lurkers, merely visiting and experiencing the community passively.²⁴

The strong localization capabilities in MediaWiki (<http://www.mediawiki.org/wiki/MediaWiki>), one of the most popular free wiki software engines available today, have enabled the rapid flourishing of non-English/foreign-language content and associated online communities (see, for example, the Hebrew Wikipedia project <http://he.wikipedia.org/>). Similarly, blogs and other Web 2.0 projects are now available in multiple non-European languages, e.g. this Arabic-language news blog about diabetes mellitus <http://www.diabetespost.com/languages/arabic.php?u=diabetic-blog/>.

Blogs

Blogs are simple content management tools enabling non-experts to build easily updatable web diaries or online journals.² They are published chronologically, with links and commentary on

various issues of interest. Frequently, blogs are networked between several users who post thoughts that often focus upon a common theme.¹⁷

TrackBack is a powerful mechanism for communication between blogs. If a blogger writes a new entry commenting on, or referring to, an entry found at another blog, and both blogging tools support the TrackBack protocol, then the commenting blogger can notify the other blog with a 'TrackBack ping'; the receiving blog will typically display summaries of, and links to, all the commenting entries below the original entry. This allows for conversations spanning several blogs that readers can easily follow.²⁵

Blogs are easy to create and contribute to [using free services like LiveJournal (<http://www.livejournal.com/>) and Google Blogger (<http://www.blogger.com/>)], hence their popularity. Some services like NETCIPIA (<http://www.netcipia.com/>) allow the creation of blogs with wiki support (blikis). The founder of Wikipedia is now offering Openserving (<http://www.openserving.com/>), another service featuring free tools for building community sites. Blog search engines also exist, e.g. Technorati (<http://www.technorati.com/>), IceRocket (<http://icerocket.com/>), and Google Blog Search (<http://blogsearch.google.com/>) (see also 'Web 2.0 special search features and social search engines' below). Blogging has the potential to open new professional practice and communication channels.^{17,18}

Neologisms such as the 'blogosphere' (the blog ecosystem) are emerging, with some star bloggers (web diarists) commanding audiences numbering tens of thousands.² Nearly 80% of online users under 28 say they regularly visit blogs; 40% report creating their own.²⁶ Kevin Kelly, writing in *Wired* magazine in August 2005, estimated that a new blog is created every two seconds.²⁷

Technorati is tracking more than 57 million blogs as of October 2006, reporting that around 55% are 'active', i.e. updated at least every 3 months. Technorati ranks a blog depending on how many sites link to it. The blogging elite, defined by Technorati as those having more than 500 other blogs linking to them, number about 4000. In October 2006, Technorati also reported that every day 100 000 new blogs are created and 1.3 million posts are made (these are the figures after filtering out/not counting identified spamblogs or splogs,

fake blogs used for promotion of affiliated websites).²⁸

According to the same Technorati report, English and Japanese remain the two most popular languages in the blogosphere. Despite anti-Web 2.0 democracy problems for bloggers in China and Iran²⁹ Chinese remains at number three, and Farsi (spoken in Iran and Afghanistan) has moved into the top 10 languages of the blogosphere.²⁸

While most blogs are currently focused on news, relationships and politics, many are medical/health related, e.g. the DrugScope DrugData Updated blog <http://drugscope.blogspot.com/>, the TRIP Database blog <http://tripdatabase.blogspot.com/>, and the DLnet blog for health librarians and trainers in the UK <http://dLnet.blogspot.com/>. But a significant proportion of health-related blogs are 'fuelled' by lay users (e.g. the 'Biography of Breast Cancer' blog: <http://biographyofbreastcancer.blogspot.com/>), most often with no professional input. The potential for misinformation is thus substantial,³⁰ although 'collaborative intelligence' can significantly compensate for this and ensure acceptable quality.³¹ Quality issues are discussed in greater detail in Boulos *et al.* 2006.¹⁸

Podcasting and streaming video services

Podcasts are time and location independent digital files. Free software enables computer users to subscribe to regular podcast feeds (audio/video RSS feeds), download them automatically, and transfer them to a portable device like an Apple iPod or MP3/MP4 player for later playback (or listen to/watch them on any laptop or desktop computer equipped with speakers and supported by media software such as Windows Media Player).^{17,18}

Podcasts have great impact potential in education.³² Several American Universities, including Drexel and Duke, have recently distributed iPods to their students, and have experimented with podcasting,¹⁷ although the final evaluation outcomes of the use of these technologies in education remain to be seen. Health care podcasts are also being used to communicate with tech-savvy seniors in the USA (<http://tinyurl.com/w3m47>). Podcast search engines also exist, including Yahoo! podcast search (<http://podcasts.yahoo.com/>),

Podscope (<http://www.podscope.com/>), and Odeo (<http://www.odeo.com/>).

Listeners' lines will transform podcasting into a two-way communication experience, although instant interactivity is still elusive. Examples of listeners' lines are available at http://www.asseenfromhere.com/Call_ASFH.htm and http://scottleffler.libsyn.com/index.php?post_category=Listener%20Line.

YouTube, a Web 2.0 video service whose motto is 'Broadcast Yourself', has recently been used for a children's anti-smoking campaign (see campaign video at http://www.youtube.com/watch?v=HZL_WaBvejA).³³

Social bookmarking, collaborative tagging (folksonomies) and tag clouds

Wikipedia defines social bookmarking as the practice of 'classifying resources by the use of informally assigned, user-defined keywords or tags'.³⁴ In essence, social bookmarking services enable users to collect and annotate (tag) their favourite web links in an online, open environment, which others are usually free to read and use (bookmarks stored in a central server location accessible from any machine). The end result is the sharing and easy distribution of resources.¹²

Social bookmarking services usually allow individual bookmarks to be designated as public (shared) or private. Visitors to social bookmarking sites can search for resources by keyword (tag), person, or popularity and see the public bookmarks, tags, and classification schemes (folksonomies = 'folk taxonomies' made of tags) that registered users have created and saved.³⁵

Examples of social bookmarking services include del.icio.us (<http://del.icio.us/>), Furl (<http://www.furl.net>), CiteULike (<http://www.citeulike.org/>—a social bookmarking site for academic papers), and Connotea (<http://www.connotea.org/>). The latter, created in December 2004 by Nature Publishing Group, is a free online reference management and sharing service for scientists, researchers, and clinicians (Fig. 1).³⁶

These services are worth using as a community-based tool because of their tagging capability. When users find a website they wish to bookmark, they simply click an installed browser toolbar

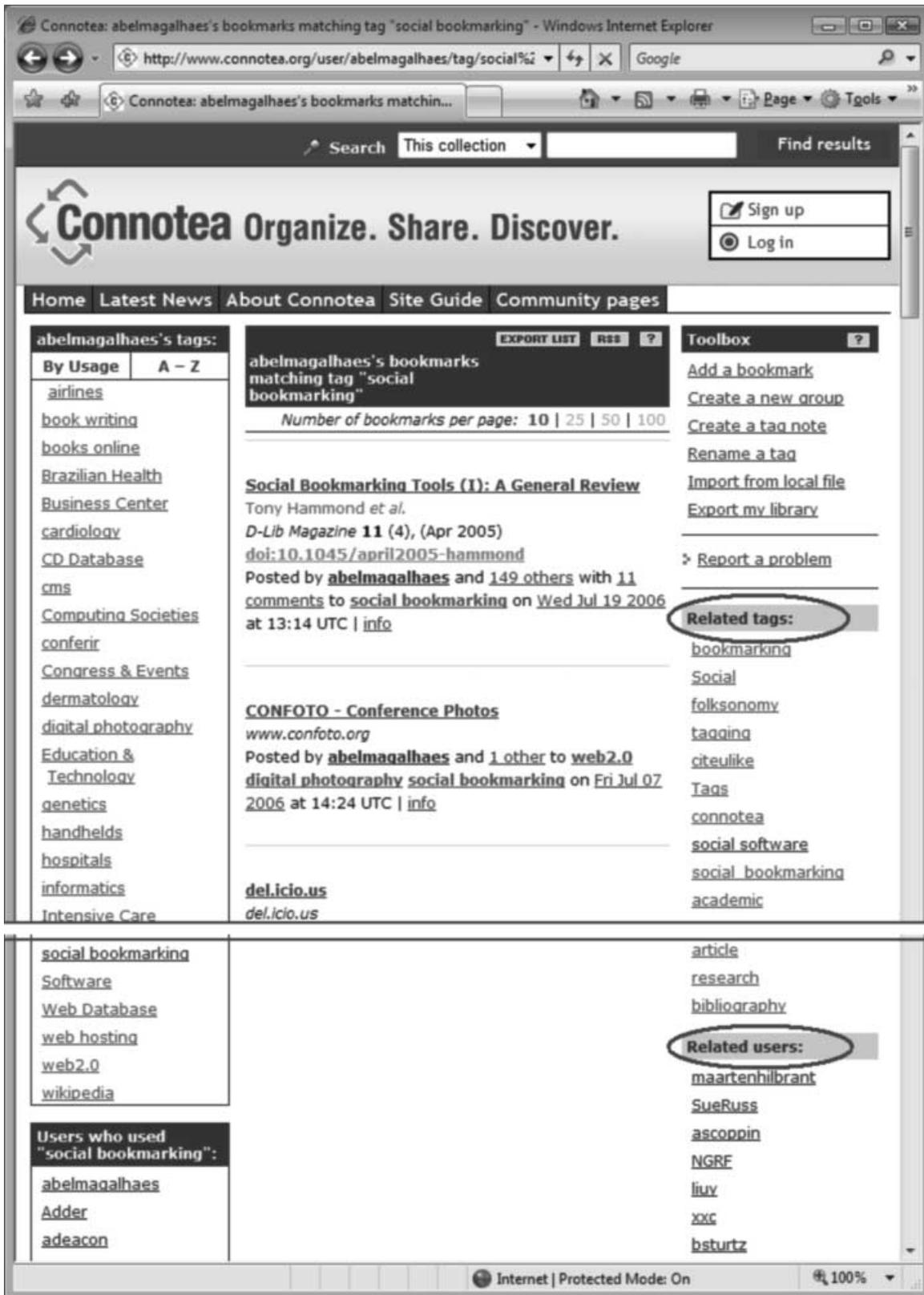


Figure 1 Screenshot of Connotea (<http://www.connotea.org/>). Note the 'Related tags' and 'Related users' features

button and ‘tag’ or annotate the site with some relevant keywords. If their bookmarks are made public, they can easily direct others to them. Others can also find the list through the keywords (tags). Also, when users bookmark a site, the service reports how many others have bookmarked the same site. If users click on that number, they can determine who else bookmarked the site and when they found it. A further click shows them the bookmark collections of others interested in ‘their’ site. Finally, if they choose a common tag, they can see all of the other sites that have been described with that particular tag. This makes group collection and aggregation of bookmarks (centred around common themes or interests) easier.^{12,35}

Some services automatically remind users of previously deployed tags, suggest tags, and note tags used by others. People tend to tag socially, learning from other taggers and responding to other published groups of tags, or ‘tagsets’.³⁷

Tags can also be arranged into concept maps called ‘tag clouds’³⁷—visual depictions of content tags used on a website. Popular tags are depicted in

a larger font, generally in alphabetical order (Fig. 2).³⁸

Using folksonomy-based tools for research enables users to capitalize on the insights of others to locate information related to their research topic, even in areas that are not obviously connected to the primary topic, thus opening new directions. Such tools also encourage users to return because folksonomy and resource collections are constantly evolving.³⁵

Because social bookmarking services indicate who created each bookmark and provide access to that person’s other bookmarked resources, contact is easily made with other like-minded individuals.³⁵ Some social bookmarking services combine features of other Web 2.0 applications like blogs and social networking services, allowing users to discuss content, and post and share personal profiles, beyond tagged bookmarks or media files.³⁷ Shadows (<http://www.shadows.com/>), for example, supports ‘Shadow pages’ for bookmarked pages. Other web resources can be discovered, folksonomically tagged, and shared in



Figure 2 The BuzzCloud (tag cloud) of an Swicki about diabetes

similar ways, e.g. images using Flickr (see, for example, Flickr—Photos from Clinical Cases and Images <http://www.flickr.com/photos/clinicalcases/> and Flickr—Photos tagged with ‘medical’ <http://www.flickr.com/photos/tags/medical/clusters/>) and videos using YouTube.

Strengths and limitations. Social bookmarking is an excellent resource discovery tool. It allows users to see the collective list of resources from all users who share a common research interest, and facilitates the development of communities of interest and expertise.¹²

Social bookmarking creates useful connections with online resources and contacts that are not just limited to individuals and their personal/private web favourites and contacts folders on their local machines, but rather represent the shared discoveries, consensus and judgements of a community of users (this is sometimes referred to as ‘collective intelligence’, community voting or peer reviewing—a community ranking system that functions as a ‘collaborative filter’). Alexander³⁷ describes five ways in which social bookmarking services enable collaborative information discovery.

- They act as an ‘outboard memory’ for storing and organizing in one place large numbers of scattered links that might otherwise get lost with time or become difficult to find again across different browser bookmark settings, or in e-mails, documents, and web pages.
- They facilitate locating people with related interests, where learning from others or by leading to new collaborations can improve the quality of work.
- The practice of user-created tagging can offer new perspectives for research, as clusters of tags reveal patterns or gaps not immediately visible.
- The ability to create multi-authored bookmark pages can be useful for team projects, student or patient groups, as each member can upload resources discovered, no matter what location or timing. Tagging can then surface individual perspectives within the collective.
- Following a bookmark site gives insights into the owner’s research, which could play well in a classroom setting as an instructor tracks students’

progress, and as students learn from their more experienced peers and professors’ discoveries.

Barsky and Purdon¹² suggest using social bookmarking tools to create Internet subject guides, giving the example of the University of Pennsylvania Library’s social tag cloud (<http://tags.library.upenn.edu/>), which provides the latest information on user behaviour at the library. In clinical practice, social bookmarking can simplify the sharing of web links among peers or patients. For example, clinicians from multiple sites can, collaboratively prepare and share with their patients custom bookmark lists of useful web resources about different clinical conditions (‘disease guides’). Similarly, laypersons and patient communities can develop their own health information portals [perhaps under the guidance of some clinical expert(s) to ensure the quality of these portals] by adopting a social bookmarking approach for discovering, tagging, sharing, rating and recommending relevant resources of interest among members of those communities, using their own patient/community-developed vocabularies and terms they can all understand.

Social calendars can also be used to chronologically and geographically bookmark, tag and share information about forthcoming online and face-to-face events of interest, e.g. CPD (Continuing Professional Development) and patient groups’ meetings and sessions.

It is important to remember that folksonomies are built from the bottom up; they are built by ordinary people, not professional indexers or librarians. They are democratic and inclusive, but as such they provide a snapshot of current users’ behaviour and preferences, and they are not stable or controlled like formal vocabularies.¹²

As social bookmarking is open to all, there is no oversight as to how resources are organized and tagged. This can lead to inconsistent tags or otherwise poor use of tags, incomplete, skewed inappropriate or pejorative descriptions of resources. Those preferring top-down taxonomies argue that an agreed set of tags enables more efficient indexing and searching of content.³⁹ Critics suggest folksonomies are characterized by flaws that formal classification systems are designed to eliminate, including polysemy, synonyms, and plural words. In addition, folksonomies all but invite

deliberately idiosyncratic tagging, the ‘meta-noise’ which burdens users and decreases the system’s information retrieval utility.³⁹

Barsky and Purdon¹² are not suggesting removal of the traditional subject taxonomies/controlled vocabulary use in medical and health-related resource indexing for enhanced information retrieval, but instead improving on these by allowing users to tag their favourite materials for all to use. It is important to remember that folksonomies and tagging are still nascent activities, and new features are constantly emerging.¹²

Web 2.0 special search features and social search engines

Technorati (<http://www.technorati.com/>), which is perhaps the most prominent blog-search tool in use today, emphasizes tagging as part of search and discovery, recommending (and rewarding) users who add tags to their blog posts. Bloggers can register their site freely with Technorati; their posts will then be searchable by content and supplemental tags. Moreover, as blogs and most social bookmarking tools are organized in reverse chronological order, their very architecture promotes front-page currency. Web 2.0 therefore supports queries for information and reflections on current news, papers offering latest research, and events of all sorts.³⁷

Feedster (<http://www.feedster.com/>), a blog, news feed and podcast search engine, enables users to subscribe to their own created search feeds to automatically receive updates about the latest search results matching their search keywords. PubSub (<http://www.pubsub.com/>) provides a similar ‘saved/shareable queries’ feature, enabling users to ‘search the future’ (follow a search over time). Another blog search and discovery engine, Waypath (<http://www.waypath.com/>), can also generate ‘topic streams’—categories of posts, based on analysis of blog posts within a given time period, while BlogPulse (<http://blogpulse.com/>) can be used to graphically visualize trends within blogospheric results.³⁷

It is noteworthy that PubMed (<http://www.pubmed.gov/>) now allows users to save their search strategies and receive automatic e-mails of search updates. PubMed users are also offered the option

to convert their queries to an RSS feed. HubMed (<http://www.hubmed.org/>) features a similar service allowing users to create custom PubMed web feeds (RSS and Atom), e.g. a feed about the theme of ‘Internet and medicine’ or an ‘eHealth’ feed (RSS and Atom are visited later in this paper). A free, handy HubMed search bookmarklet is also available for ‘quick access to searches’ (see Bookmarklet—Wikipedia⁴⁰ for some general information about bookmarklets).

Rollyo (<http://rollyo.com/createroll.html>) allows a searcher to select up to 10 websites to be searched, much like a whitelist restricts connections to a selected few (A whitelist blocks all sites or users not on a list). Users can publish and share their ‘searchrolls’.³⁷

A similar concept is adopted by Swicki (<http://swicki.eurekster.com/>—Fig. 2), which can be thought of as a community powered search engine, tailored to produce only the targeted search results that the search engine owner/creator and her/his community want. The search results from a Swicki are potentially more relevant than those produced by general search engines, as they represent focused, targeted web views, based on the search behaviour and search patterns of the associated community of users. Unlike other search engines, the community of a Swicki has control over the results. Swicki is thus using the ‘wisdom of crowds’ to continually tweak and improve search results (further refinement of the results is an ongoing process, as more like-minded users start engaging with the results, and determining and revising which websites to include in, or exclude from, their Swicki’s search pool).⁴¹

More recently, Google released its first cooperative/social search engine known as Google Co-op (<http://www.google.com/coop/>). Similarly to Swicki, Google Co-op enables custom search engine collaboration.^{42,43} An interesting ‘travelling recruiter bookmarklet’ (<http://www.google.com/coop/topics/marker>) can be made available to community members associated with a given Google Co-op search engine to enable them to mark sites for inclusion on-the-fly as they surf the Web.

An emerging standard, OpenSearch (<http://www.opensearch.org/>), is a collection of technologies that allow publishing of search results in a format suitable for syndication and aggregation. It is a

way for websites and search engines to publish search results in a standard and accessible format, and is now natively supported in the latest versions of MediaWiki wiki engine (<http://www.mediawiki.org/>), Windows Internet Explorer, and Mozilla Firefox among others.⁴⁴ Some academic institutions, such as the University of Huddersfield Library <http://webcat.hud.ac.uk/> have already added OpenSearch to their online library catalogues, and PubMed is now supporting OpenSearch (<http://www.library.gsu.edu/news/index.asp?view=details&ID=11336&typeID=56>).

RSS feeds, information aggregation and remixing, and mashups

RSS (Really Simple Syndication or Rich Site Summary) is a set of XML-based web-content distribution and republication/syndication protocols used by news sites and blogs to announce recent additions of content/updates to a website or user-defined query. A related standard is the Atom Syndication Format.⁴⁵ NewsGator (<http://www.newsgator.com/home.aspx>), a web-based RSS aggregator, Feedster (<http://www.feedster.com/>), and the latest versions of Windows Internet Explorer and Mozilla Firefox can all process RSS.^{2,18,46}

RSS can be seen as the syndication plumbing that allows free flow of content between applications and websites. Users subscribe to the feeds using an RSS aggregator, such as the native RSS support in most modern web browsers, or a web-based service like Bloglines (<http://www.bloglines.com/>), which then crawls the corresponding sites on a regular basis. An aggregator displays feeds and enables users to organize them and to access related web pages or content (e.g. audio MP3 files in the case of a podcast feed). RSS feeds are useful for receiving pushed content like blog updates, newspaper and journal article updates, press releases, announcements, news, and database updates.^{10,11}

Mapping mashups use online mapping services, such as those offered by Google (<http://maps.google.com/>) or Yahoo! (<http://developer.yahoo.com/maps/>), to display customized (user-defined), clickable markers showing points of interest and related information (e.g. geographically tagged news

items/feeds aggregated in real time from other/multiple websites) on an interactive web map.^{20,47} HEALTHmap (<http://healthmap.org/>), the Global disease alert mapping system, is a good example of a health-related geofeed in action.

The extensive growth of Web 2.0 projects has more recently given rise to tools that simultaneously make use of, or remix, multiple services and information sources, following the same principle of mashups. SuprGlu (<http://www.suprglu.com/>), for example, builds web pages in which users' RSS feeds from multiple services are aggregated, e.g. news and del.icio.us bookmark feeds alongside a series of blogs. By aggregating in one place user-selected feeds from a wide range of disparate sources, all covering a single topic or set of related topics, readers can very easily have a glimpse into the 'collective mind' of many people at a given moment. Finally, Flock (<http://flock.com/>), the social web browser, offers a Web 2.0 way of browsing. Using it, users can import Flickr content, then post it to del.icio.us or their blog from within the browser window ('drag and drop sharing/remixing').³⁷

Social networking services

Social networking services are essentially online group-forming applications that connect people through shared information interests. They allow users to locate links with people through mutual friends or acquaintances, build profiles, and update address books. Moreover, sites like Meetup (<http://www.meetup.com/>) provide social tools to build communities of practice with the purpose of facilitating *face-to-face* meetings across cities all over the world.²

Barsky and Purdon¹² argue that social networks are relatively new kinds of virtual communities that delineate and build on member relationships by virtue of their being part of that community. Informal social networking has existed since the inception of the Web (and even before during the early days of dial-up bulletin boards—see Discussion), but social networking sites have proliferated quickly since 2003. These sites collect data about members and then store this information as user profiles which are subsequently shared among site members. Social networks form as members link their web pages together, or search through other

sites to locate new friends who may share common interests.

Social networking services enable users to share information within a shifting network of colleagues through user profiles linking users to others posting similar information. In user profiles, each piece of data is a link; clicking on it displays everyone else in the network who included that element in their profiles. Other connections are more structured, based on user-created groups that typically have descriptive titles, e.g. 'Diabetes self-help'. Users can browse profiles based on criteria such as age or search the database for people they already know and contact them through private messages or public notes on their profiles. Group announcements can be sent, such as messages about patient support

events to those users self-identifying themselves through specific characteristics.⁴⁸

Medical and health-related examples of social networking services include the LibraryThing Medicine Group (<http://www.librarything.com/groups/medicine>), a library social network site promoting social interactions, book recommendations, self-classification, and monitoring of new books, and the MySpace 'CURE DiABETES group' (<http://groups.myspace.com/cureDiABETES>) run by patients and supporters. Some social networking services combine or bundle several Web 2.0 tools/features together, e.g. instant messaging (see below), social bookmarking, blogs and podcasts. Examples of these services include the Mental Health Social Network (<http://social.realmentalhealth.com/>—Fig. 3),



Figure 3 Screenshot from <http://social.realmentalhealth.com/>

and the IJS portal (<http://www.theijs.com/>), a global community portal centred around the *International Journal of Surgery*.⁴⁹

By nature, health care is community orientated, extending beyond the geographical reach of organizations, to embrace the way knowledge is shared between clinicians, and with their patients and members of the general public. Laypersons and patients also use the same tools to network and build their own virtual communities or support groups, transcending all conventional spatial boundaries. By creating discussion groups and communities of practice on MySpace or similar resources, some information needs of these groups could be met.¹² Indeed, establishing connections with other relevant players is an important factor in patient support, especially in chronic conditions.

Limitations. Social networking services attract a full spectrum of users, making them susceptible to offensive activities such as 'hate campaigns' against vulnerable groups, and online exploitation of minors. Moreover, there is little assurance that those behind online profiles are who they claim to be. Questions of libel and copyright apply when users post content created by others or comments about other people. A seemingly infinite web of connections poses a risk for continual aimless wandering, seeing who knows who, who likes what, and how it all fits together.^{2,48,50}

Also, some astute users of social networking services like MySpace have long questioned the uses to which their personal information is being put by these companies, for example, in data mining, as a means of generating revenue online. But despite this, many users remain quite comfortable and willing to exchange high-level personal details for access to the latest service offerings. The balance between privacy/anonymity and convenience is sometimes difficult to achieve.²

Reputation-management systems, peer rating/ community voting, and collaborative filtering: the 'collective wisdom' of the masses and the strength of 'weak ties'

Social tools cannot function without an appropriate system to represent user identity and mediate trust

between different members and parties of each diverse community formation. People desire control over what they have access to and who has access to them. Social Networking relies on reciprocal trust, the social glue binding participation in online applications and services. Informational pressure, deceitful conduct, and the challenge of evaluating quality, have spurred the development of reputation management systems. Slashdot (<http://slashdot.org/>), eBay (<http://www.ebay.com/>), ePinions (<http://www.epinions.com/>), Amazon's marketplace reputation management system (buyers' ratings of sellers—<http://www.amazon.com/>), and others all make use of collaborative filtering, user recommendation engines, or shared judgements of quality.²

Whereas Memeorandum (<http://www.memeorandum.com/>) and Google News (<http://news.google.com>) automate their ranking of topics and stories, Digg (<http://www.digg.com/>) opens the process to more active *human* intervention. Digg, devoted primarily to technology topics, accepts submissions of stories that users consider worthy of public attention. Users can then vote for, or 'dig and bury', stories they like/dislike, and the site reports the results faithfully.³⁷ This is a good example of community peer reviewing, rating/voting, and collaborative filtering in action.

In 1973, Granovetter⁵¹ argued that weak ties such as the connections between colleagues and acquaintances are more important for personal advancement than the strong ties of family and friendship. This argument proved true in today's Web. For example, in Australia, member forums like Infochoice (<http://www.infochoice.com.au/>) and PhoneChoice (<http://www.phonechoice.com.au/>) already enable consumers to call on 'weak ties' to compare ISP (Internet Service Providers), banking, and telecommunications providers for service, price, and quality. Service developers and managers need to understand the potentially 'disruptive' nature of socially networked consumers and assess their impact on existing and emerging products and services.²

With the growing trends toward patient choice and empowerment in the UK and elsewhere, dedicated social sites are expected to emerge to help patients choose a doctor or health care provider based on a database of advertised clinicians/

providers' profiles and the opinions of other patients.²⁹ In fact, one such service, Patient Opinion (<http://patientopinion.org.uk/>—Fig. 4), already exists in the UK. Patient Opinion was founded by Sheffield GP Paul Hodgkin to feedback patient

views to NHS managers, so that insights and ideas can be put to good use. Patient Opinion enables patients to rate and share their NHS experiences online, and by doing so they can help other patients, and perhaps even improve NHS services.^{52,53}

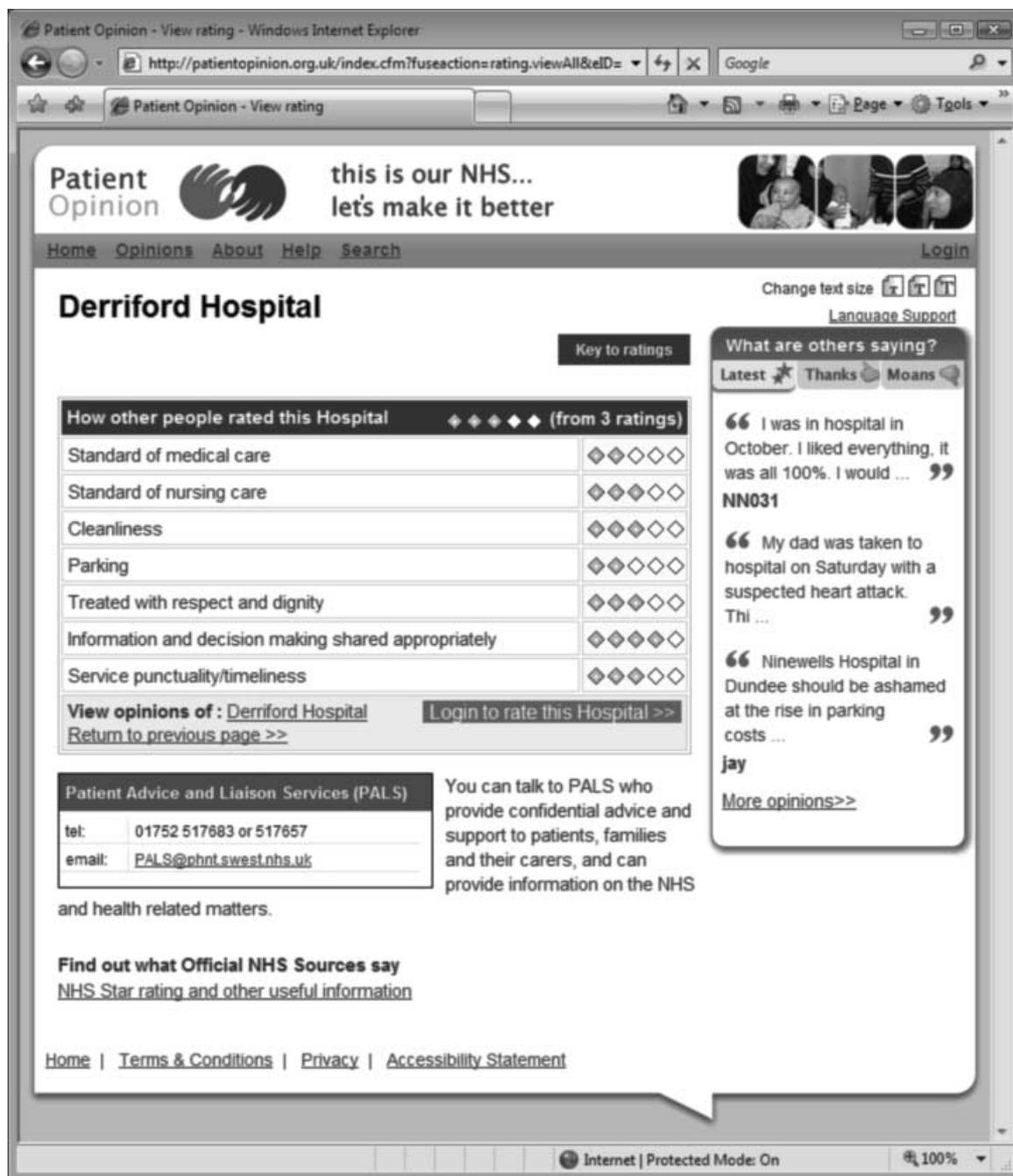


Figure 4 Screenshot of PatientOpinion (<http://patientopinion.org.uk/>) showing the cumulative patient ratings for the level of services at Derriford Hospital, Plymouth, UK

Instant messaging and virtual meetings

Instant messaging (IM) is a form of online real-time interaction between two or more users using networked computers or mobile devices. First-generation IM was mainly focused on one-to-one textual messaging. But today, although typed text remains the primary convention, IM technology also allows users to send images, audio and video files, and other attachments. Users can also combine real-time audio and video conferences/chatting and textual conversations that may involve hundreds of people at the same time. Technologies that enable IM, such as wireless Internet connectivity and mobile devices, are now common, providing the critical mass IM requires to reach near ubiquity.^{2,54,55}

Examples of IM Internet client software include Paltalk (<http://www.paltalk.com/>—starting from version 9, Paltalk also features online multiplayer gaming), Google Talk (<http://www.google.com/talk/>—which is cleverly integrated with Google Mail), Windows Live Messenger (<http://go.microsoft.com/fwlink/?LinkId=68748>), and Yahoo! Messenger (<http://messenger.yahoo.com/>). A Microsoft MSN/Windows Live Messenger network merger with the Yahoo! Messenger network has recently been launched.⁵⁶

Textual IM interaction is closer to spoken conversation than written correspondence, allowing users to communicate beyond e-mail capability. IM users enjoy greater social presence,⁵⁵ yet the technology facilitates the kind of onscreen interaction, with its perceptions of distance and safety, that many find comfortable. IM is also promoting the practice of creating ‘back channels’, secondary conversations that happen at the same time as some primary task or other conversation, such as exchanges between students during a lecture.⁵⁴ People feel more engaged when co-location is simulated, creating a sense of connection and community difficult to establish in conventional Web 1.0 sites and e-mail communications.^{55,57}

IM and virtual meeting software have powerful applications for patient care. Eminovic *et al.*⁵⁸ reported on the first evaluation of a nurse-led web chat triage service for the public. They concluded that ‘the positive reaction from patients and the potential of the service for specific patient groups (the deaf, shy, or socially isolated) encourage us to

continue with piloting such innovative communication methods with the public’.

Moreover, IM and virtual meeting software can be used to support clinicians’ CPD (Continuing Professional Development) and postgraduate e-learning⁵⁵ by allowing clinicians, especially those in isolated remote or rural areas, to connect to peers and tutors and engage in conferences and conversations at a distance in real time. As such they can also be considered a great telemedicine/telehealth and tele-education tool. IM clients are also simple, easy to use and cheap (or free), which adds to their appeal. These tools clearly resonate with the participation ethos of Web 2.0.

Online social gaming

In contemporary computer gaming, the term ‘multiplayer’ usually implies that players simultaneously play by connecting multiple computers via a network.⁵⁹ A Massively Multiplayer Online Role-Playing Game (MMORPG) is an online computer role-playing game in which a large number of players interact with one another in a virtual world.⁶⁰ Virtual worlds are computer-simulated environments where users can ‘inhabit’ and interact via avatars (Internet users’ representations of themselves), e.g. Second Life (<http://slife.com/>). Online social gaming has the potential of promoting stronger communities, online participation, socialization and associated skills, and education through entertainment (edutainment).

A college in Chile recently reported that its students are using a bespoke computer game to learn about team building.⁶¹ Another noteworthy, health-related online game (although non-multiplayer according to the above definition) is the ‘Voices of Youth—What would you do?’ game (http://www.unicef.org/voy/explore/aids/explore_1360.html) which was launched by the United Nations children’s agency Unicef in both English and Swahili (Kiswahili) languages, to combat the spread of HIV and AIDS.⁶²

Schott and Hodgetts⁶³ describe some of the positive health benefits associated with the use of game technologies in relation to surgical training and therapeutic interventions, physical exercise, health education and community participation. Games can provide shared spaces that promote

social interaction through which a sense of belonging and participation can be fostered.

It is increasingly accepted that people engaging in communities with high levels of social capital and mutual support tend to be healthier. The cultivation of shared identities, trust, mutual support, shared interests and public narratives are central to fostering participation in health promotion practices. When it comes to developing ways of working with young people to further enhance their health, we should carefully consider youth sub-cultural practices and work with existing 'communities of practice' within such populations, rather than just engineer traditional support groups or online communities. In this respect, gaming may become a tool for health research and interventions aimed at understanding and promoting organic forms of civic participation and improving population health.⁶³

Internet addiction. Social interaction through games should not replace real-world interaction. As computer and Internet use become more common, the potential for over-use may lead to addiction. Addiction to the Internet shares some of the negative aspects of substance addiction and may lead to failing school, family, and relationship problems.^{64–66} Kim *et al.*⁶⁷ examined the relationship of Internet addiction to depression and suicidal ideation in Korean adolescents and found the levels of depression and suicide ideation to be highest in the Internet-addicts group.

Discussion

Not since the invention of the Web and its subsequent development as a multimedia platform have we seen such an exciting array of emerging technologies, yet to date relatively few health care organizations have taken up the tools and strategic advantages offered by Web 2.0.

These new technologies have created challenges for health care organizations, but have also provided opportunities to make deeper connections with their stakeholders, clients and supporters, including clinicians, patients and laypersons. In a paper published in 2006 about museums and Web 2.0, von Appen³¹ enumerates several resource types that have evolved recently, including online

collections, web casts, interactive exhibits, and virtual tours. He goes on to argue that 'while many of these online experiences are quite engaging, they are for the most part inherently one-way and don't foster user communication or independent participation. By using Web 2.0 tools, museums (and for our purpose health care organizations) can invite a whole new range of interaction focusing on community and social learning'.

Nothing new under the sun?

Web 2.0 social software and its conceptual underpinnings do not indicate a sharp break with the old but, rather, the gradual emergence of a new type of practice³⁷ that is evolution rather than revolution.⁶⁸ For example, the Whole Earth 'Lectronic Link (or The WELL <http://www.well.com/>) has been in existence since 1985 and continues to have an active community more than 20 years after its founding.^{31,69} In a 1995 TV programme about the Internet, virtual communities pioneer Howard Rheingold describes how a parent shared his experience of having a son with leukaemia by posting a new topic about his son's condition on the WELL. Other members of the community offered help within minutes, including nurses, doctors and recovered leukaemia patients (a video recording of this programme is available online at http://www.archive.org/details/ar_cc143_internet).

Dial-in bulletin board systems were also commonly used before the Web. Usenet groups (which were also used for hosting and sharing images), listservs, discussion boards and online forums also existed before the early days of the Web.

The features and qualities of blogs, podcasts, wikis and RSS are thus not all necessarily new, but their ease of use and inexpensive development costs have helped make them worthy of their various neologisms. Furthermore, social bookmarking and folksonomic information discovery have allowed people to connect to each other through their own shared metadata tags, a quite unique feature that was not fully developed in pre-Web 2.0 services.³⁷ Web 2.0 thus provides many useful extensions to Web 1.0 rather than fully replacing it. Both generations of technologies are here to stay and complement each other.

Web 2.0 as supporter and educator

The potential benefits of Web 2.0 technologies as enablers in health and health care education should not be underestimated, particularly for disadvantaged groups such as disabled and elderly people. The same applies to patients and professionals based in isolated and remote areas, where finding or establishing face-to-face support/patient groups and communities of practice might be difficult or impossible.

Results of an online survey of 2624 US adults, aged 18 and older, conducted by Harris Interactive in 2006 for The Wall Street Journal Online (<http://www.wsj.com/health>) showed that few patients use or have access to online services for communicating with their doctors, but most would like to. Over half of all adults in this study said a doctor's use and investment in health information technology would influence their choice of doctor a great deal or to some extent.⁷⁰

Sociable interactive technologies have the potential to augment patients' and older peoples' sense of belonging to a supportive kindred community, thereby reducing their social isolation. Some older people now regularly use web-based video/audio chat applications (e.g. Skype <http://skype.com/>) to converse with their families in other parts of the world. The simplification and decreasing costs of such services and interfaces, coupled with a growing familiarity with computers amongst the elderly, challenge beliefs that such technologies are beyond the grasp of older people. Indeed, information and communication technologies have potential to augment a sense of connectedness with society, something denied to many of those confined to home through destitution, illness or fear.

The potential of these technologies for clinicians is also great in supporting their continuing professional development, and in helping them establish and benefit from virtual communities of practice where advice and expertise, and even multi-media clinical elements, can be easily shared among them, and where they can all learn from each other and keep up to date with the latest advances in their specialities. This is particularly useful for professionally/educationally disadvantaged clinicians who are isolated from the typical urban clinical centres of excellence, in remote and rural areas.

Perhaps the day will soon come when enterprise Web 2.0 application suites like Intel's recently launched SuiteTwo software services bundle (<http://www.suitetwo.com/>) will be regularly used to empower team and group work activities within and between 21st century health care services and research organizations.

Web 2.0 as a social, cultural and pedagogic phenomenon

Sharp² provides a definition of social networking as any set of socio-technical systems and associated activities that enable many-to-many social interactivity to take place via ICTs, whether via the Internet, mobile, PDA (personal digital assistant/handheld computer with wireless Internet connectivity) or any other device. Online social networking is gaining ground globally, advancing new networked models of social interaction that weave in, out, and around to form the new fabric of the Internet. The ease of use and ubiquity of social networking tools have enabled virtually any user to develop or join group-forming networks (GFNs). These GFNs have made possible the creation and maintenance of group affiliations online, allowing small and large groups of network users to coalesce and organize their communications around a common interest, issue, or goal.²

But the radical nature of social networking software lies in its many-to-many duplex communication mode that transcends point-to-point and two-way media like telephone and e-mail, and one-way transmission models such as television, radio and, certainly, Web 1.0. Networks supporting the construction of communicating groups create value that scales exponentially with network size. Individuals connecting to the Internet indirectly benefit other users through 'network effects' or 'collective intelligence'.²

As we have argued, Web 2.0 is primarily about people, the myriad links between them and the folksonomically tagged content chunks they create and mix. Web 2.0 engenders immediacy, online presence, mobility, ubiquity, and location sensitivity.⁷¹ In a potential 'future landscape' of pervasive, mobile, location-sensitive Internet, virtual communities pioneer Howard Rheingold points to the growing army of young mobile phone users as

leading the charge of a new social phenomena he calls 'Smart Mobs': groups of people 'who are able to act in concert even if they don't know each other' in a peer-to-peer (P2P) socially networked world. The growth of 'texting' and next generation mobile phones have created the space for a range of social interactions to occur beyond the place boundedness of the home, office, or school. Through WiFi and Internet-enabled devices like PDAs and 4G mobiles (4th generation mobiles promising much faster wireless data transmission rates allowing, for example, high-quality smooth video transmission), people will 'communicate' and 'cooperate' in ways previously impossible. Many millions of people will carry and wear devices thousands of times more powerful than today's personal computers, linked at speeds higher than present levels. Many of these will create and trade content and applications as well as consume them. People are able to 'swarm'—the spontaneous formation of social networks at any time for a specific purpose.^{2,72}

Hartzog⁷³ discusses the development, cross-fertilization and spread of memes (ideas and experiences) through many-to-many interactions in Web 2.0. The use of the Internet, mobiles and social software has greatly increased the number of conversations occurring at any given moment via chat, newsgroups, discussion forums, and even comment-savvy blogs. Undoubtedly, the survival potential of various memes has grown as these channels have emerged.⁷³

In Web 1.0, the solitary, passive nature of most Internet experiences means that interaction can be limited and lack social exchange. By contrast, the sociable technologies of Web 2.0 have the potential to promote active and engaged learning, where participants themselves construct their own knowledge through social interaction and exploration. Learning becomes an active process, in which peers collaborate equally so none might dominate the interaction.³¹

According to Social Constructivist theory, dialogue offers learners the opportunity to construct and organize knowledge. Immersion in a culture helps learners become increasingly independent in their learning.⁷⁴ Online learners must be active knowledge generators who assume responsibility for constructing and managing their own learning experience.⁷⁵ Bender⁷⁶ argues that 'collaboration

is vital to learning so that students understand questions, develop arguments, and share meaning and conclusions among a community of learners'.

Web 2.0 quality and copyright issues

Potts⁷⁷ holds that 'the "killer application" in e-health will be something that can marry the democratized nature of MySpace or Wikipedia with the safety critical nature (i.e. quality requirements) of health care'.

Collaborative filtering and collective intelligence/wisdom might be the way forward towards finding a remedy for the chronic concerns about online health information quality. Sharp² discusses the example of blogging. As thousands of bloggers exchange ideas and post their daily thoughts and commentaries, they are effectively acting as human (and often expert) filters to the many information overloaded web surfers.²

James Surowiecki⁷⁸ suggests that collective intelligence often trumps that of experts. Collective intelligence invites self-policing and community watchfulness, leading to the 'Darwinism' of Web 2.0 content, where, as a result of the openness and rapidity of Web 2.0 page editing, an evolutionary selection process is imposed. 'Unfit' sentences and sections are ruthlessly culled and voted against, but when considered 'fit' they are developed, resulting in the evolution of higher quality and more relevant content.¹⁸ However, the 'watchfulness of the crowds' and democratic openness of Web 2.0 do not exclude other forms of policing and moderation, by site administrators, and through the creation of 'closed Web 2.0 environments'.¹⁸

A related, but separate, content threat to the Web 2.0 movement is the issue of copyright.^{18,37,79} As the new Web 2.0 services and tools allow users to own, modify, and exchange data, it is perhaps inevitable that intellectual property holders will initiate lawsuits against perceived misappropriation. As tools become simpler to use and practices become more widespread, violation of copyright will become easier.³⁷

From another perspective, Web 2.0 necessitates relinquishing control and ownership of information. In Web 2.0, information becomes meaningless or less useful to others if they cannot remix and repurpose it to make sense of it in their context. It

is for this reason, Boyd⁸⁰ argues, that technology is not enough. There will be political features of Web 2.0 as technological development and cultural desires clash with legislation and political support of traditional information organizations. A better understanding of IP (intellectual property) and copyright issues is thus critical to effective Web 2.0 use.⁸⁰

Web 2.0 addiction and other socially adverse online patterns

It has been argued that the Internet has adverse psychological consequences, causing depression and anxiety symptoms for 'over-users'.³ In a recent study, Campbell *et al.*⁸¹ offered an alternative explanation, suggesting the Internet may be used as a forum for expanding social networks, consequently enhancing the chances of meaningful relationships, self-confidence, social abilities, and social support. They suggest no relationship exists between time spent online and depression, anxiety, or social aversion. Those primarily using the Internet for online chat believe the Internet to be psychologically beneficial, but that frequent Internet users are lonely and for these Internet addiction is possible. It has been argued that socially fearful chat users may use the Internet as a form of low-risk social approach and an opportunity to rehearse social behaviour and communication skills, which may help them improve interaction in face-to-face contexts.⁸¹

Although psychologically balanced adults are expected to be able to protect themselves online amidst adverse social patterns, there is still a critical need to protect vulnerable users, who generally cope less well with these issues. While MySpace allows 14- and 15-year-old users to restrict who can view their page or contact them, most users opt to make their profiles public. The primary concern is that this openness puts youth at risk, making them particularly vulnerable to predators and paedophiles. In the USA, recent federal legislation, the Deleting Online Predators Act of 2006⁸² would require schools and libraries receiving federal aid 'to protect minors from commercial social networking websites and chat rooms'.⁵⁰

Web 2.0 and the Semantic Web

The Semantic Web, also known as Web 3.0, will simplify human-computer interfaces by attaching machine-readable metadata (information about information) to web content to enable computers to 'understand' the actual/intended meanings of this content as they process it.^{83,84} When augmented with business semantics, Web 2.0 technologies such as RSS will enable the user to be in more control over how information is accessed and aggregated to best serve the purpose at hand.⁸⁵ Applied to micro-content chunks and social communication exchanges in Web 2.0, this could also mean better information search and retrieval algorithms that overcome some or most of the limitations of folksonomic metadata, while still benefiting from the strengths of Web 2.0 intelligent community cataloguing of content.

Combining Web 2.0 folksonomies and Web 3.0 formal metadata and ontologies to produce novel social semantic search engines is a strong possibility, but it is more likely that we will see combined Web 2.0/3.0 solutions that are application and community specific, rather than a universal, all-purpose set of health care semantic descriptions. However, we are still far from understanding how Web 2.0 and the Semantic Web will exactly relate to each other. Today, leading edge research is orienting toward Social Semantic Collaboration technologies, which have also become the focus of high profile conference panels. For example, SemSoc2007 (Artificial Intelligence and Social Semantic Collaboration <http://semsoc2007.semanticdesktop.org/>), a Special Track at the 20th International FLAIRS 2007 Conference, Florida, USA <http://www.cise.ufl.edu/~ddd/FLAIRS/flairs2007/>) and the Workshop on Social and Collaborative Construction of Structured Knowledge at the 16th International World Wide Web Conference, Banff, Canada (WWW2007—<http://kmaifb.uni-karlsruhe.de/ws/ckc2007>) were both conceived to exclusively discuss semantic social networks, and a combination of Web 2.0 and Semantic Web strategies and how this can be achieved.

Conclusion

Web 2.0 is here to stay and is an evolutionary enhancement to Web 1.0, rather than a correction

of previous shortcomings. Web 2.0 services will doubtless increase in complexity and scale during the coming years as users continue to creatively adapt new tools to produce knowledge, leverage collective intelligence, and build social capital.² The operation and success of Web 2.0 tools are worthy of study in numerous disciplines, from media studies, sociology and computer science.³⁷

Announcing his new Web Science Research Initiative (<http://www.webscience.org/>), Sir Tim Berners-Lee declared he wished to attract multidisciplinary researchers to study the Web as a technological *and* social phenomenon. The Web Science Research Initiative sets out a research agenda aimed at understanding the scientific, technical and social challenges underlying the growth of the Web. Of particular interest is the growing volume of information that documents cumulative knowledge and human activity. The project will examine how information is accessed and assess its reliability.⁸⁶

In the context of health and health care services and education, there is a need to raise awareness of Web 2.0 tools and the possibilities they offer, and an urgent need to conduct quality research to inform better use of Web 2.0 applications.

Applying Bandelli's⁸⁷ concepts to health and health care settings, one can say that patients and their carers want more than information from providers. They also wish to interact and exchange information with each other. Therefore, health care providers should aim to become social enablers, providing situations that become positively 'addictive' and indispensable, so patients can gather, learn from, and support each other, improving health outcomes. Patients must be empowered to build their needs into any technology on offer. Oliver³⁰ aptly summarizes the current situation: 'Health professionals might not like what's going on in the world of the Internet, but they must get "socially networked" as if their jobs—and their patients' health—depended on it. Because they do!'

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