Journal of Biomedical Informatics 42 (2009) 334–346

Contents lists available at ScienceDirect

Journal of Biomedical Informatics

journal homepage: www.elsevier.com/locate/yjbin

Creating and sharing clinical decision support content with Web 2.0: Issues and examples

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ARTICLE INFO

Article history:
Received 8 May 2008
Available online 8 October 2008

Keywords:
Decision support systems, clinical
Decision making, computer-assisted
Decision support techniques
Hospital information systems
Medical records systems, Computerized
Cooperative behavior

ABSTRACT

Clinical decision support is a powerful tool for improving healthcare quality and patient safety. However, developing a comprehensive package of decision support interventions is costly and difficult. If used well, Web 2.0 methods may make it easier and less costly to develop decision support. Web 2.0 is characterized by online communities, open sharing, interactivity and collaboration. Although most previous attempts at sharing clinical decision support content have worked outside of the Web 2.0 framework, several initiatives are beginning to use Web 2.0 to share and collaborate on decision support content. We present case studies of three efforts: the Clinfowiki, a world-accessible wiki for developing decision support content; Partners HealthCare eRooms, web-based tools for developing decision support within a single organization; and Epic Systems Corporation's Community Library, a repository for sharing decision support content for customers of a single clinical system vendor. We evaluate the potential of Web 2.0 technologies to enable collaborative development and sharing of clinical decision support systems through the lens of three case studies; analyzing technical, legal and organizational issues for developers, consumers and organizers of clinical decision support content in Web 2.0. We believe the case for Web 2.0 as a tool for collaborating on clinical decision support content appears strong, particularly for collaborative content development within an organization.

1. Introduction

Clinical decision support systems are tools designed to help humans make better clinical decisions. The most familiar types of decision support, such as drug–drug interaction alerts and preventive care reminders are targeted at physicians, but clinical decision support systems can also be designed to influence the clinical decision making of nurses, pharmacists, ancillary care providers, patients and others involved in the process of decision making in clinical care. Substantial evidence suggests that clinical decision support can improve the quality and safety of healthcare [1–15]. Systematic reviews of the past two decades by Grimshaw in 2006 [16], Johnston in 1994 [10], Hunt in 1998 [9], Garg in 2005 [8] and Kawamoto in 2005 [11] have shown generally favorable results, in the areas of diagnosis, therapy and prevention.

Although the cumulative evidence that clinical decision support is beneficial is compelling, many specific interventions have had no impact, and adoption of advanced clinical decision support systems has been limited to date. A number of factors have limited adoption, including challenges with integrating decision support into workflow, uncertainty about medical knowledge, organizational and socio-political challenges and limited adoption of those clinical information systems, such as Computerized Provider Order Entry (CPOE) and Electronic Health Records (EHRs) which are used as a vehicle for the delivery of clinical decision support interventions. But one of (and perhaps) the largest inhibitors of adoption is that translating text-based medical knowledge into actionable, real-time clinical decision support is a Herculean task for any but the largest hospitals, health systems and provider organizations to take on alone. In fact, a recent systematic review [17] suggests that just four of the nation's largest academic medical centers and integrated delivery networks have carried out the lion's share

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doi:10.1016/j.jbi.2008.09.003

of studies in this area. The overall magnitude of the decision support knowledge management problem is enormous—in the aggregate, it has been estimated the costs of knowledge management for EHRs alone in the United States is approximately $25 billion [18].

It seems plausible that the best approach for handling this huge task is for people and entities to share and collaborate on the development of clinical decision support content [19]. Geographic distance and competitive pressures have, to date, made such collaboration difficult on a large scale. In this paper, we evaluate the potential of Web 2.0 technologies to enable collaborative development of clinical decision support systems through the lens of three case studies; analyzing technical, legal and organizational issues for developers, consumers and organizers of clinical decision support content in Web 2.0.

2. Background

2.1. Earlier decision support sharing efforts

There have been a number of non-Web 2.0 efforts at sharing decision support content to date. One of the earliest efforts at sharing clinical decision support content was the Arden Syntax Medical Logic Module (MLM) repository. Arden Syntax is a standard for encoding event-driven rule based clinical knowledge for use in clinical information systems [20,21]. Knowledge modules encoded in Arden Syntax are known as MLMs. An MLM library, hosted at Columbia University, exists to facilitate the sharing of MLMs. The repository can be accessed at http://www.dmi.columbia.edu/resources/arden/mlm/cpmc-mlm-index.html, and currently contains 240 Arden-formatted MLMs.

Another significant knowledge sharing initiative was InterMed, a collaboration between Stanford, Harvard and Columbia [22,23]. InterMed encoded clinical knowledge in a knowledge representation formalism known as the Guideline Interchange Format (GLIF) [24–26] and piloted sharing these guidelines amongst the three participating sites. Likewise, the SAGE project [27], which included clinical partners Intermountain Healthcare, Stanford University, the Mayo Clinic and the University of Nebraska as well as technology partners GE Healthcare and Apelon terminology services has piloted the development and sharing of guidelines, including ones relating to immunizations, diabetes and community-acquired pneumonia.

A particularly ambitious knowledge sharing initiative was the Institute for Medical Knowledge Implementation (IMKI) [28]. IMKI was a non-profit organization founded by Eclipsys, Epic, Siemens and GE, and was designed as a clearinghouse and repository for sharing a variety of clinical decision support content. Although IMKI was extremely promising, it encountered funding and technical issues as well as issues with participants' willingness to share decision support content they had developed, and it dissolved in 2003.

At the time of their conception, each of these knowledge sharing efforts was greeted with significant enthusiasm, and it is clear that great effort was expended in each of them. That said, none has gained significant traction. Arden Syntax is implemented in only three commercially available clinical information systems [29,30], and portability of Arden-formatted MLMs has been limited because of challenges relating to mapping concepts to the local vocabulary (referred to the in the literature as the "curly braces problem") [31]. And, although InterMed was successful insofar as the participating sites exchanged clinical guidelines, it did not lead to wide-spread sharing of clinical guidelines, or significant adoption of GLIF in commercially available clinical systems. And, as previously mentioned, although IMKI was initially greeted with much fanfare, it was relatively short-lived and did not result in significant sharing of decision support content.

It is worth noting that efforts to share decision support content need not be (and have not been) necessarily restricted to sharing executable forms of content. For example, sharing a human readable description of an alert or reminder (such as its inclusion and exclusion criteria, the interventions it suggests and the logic it uses) may, in many cases, be as useful as sharing a machine-readable form, particularly since there are very few clinical information systems that can natively import and interpret machine-readable decision support in any of the proposed standard formats. On the other hand, not all expressions of clinical knowledge qualify as decision support. For the purposes of this paper, we limit clinical decision support to knowledge artifacts which are designed to deliver some sort of real-time, point-of-care, clinical intervention (including an informational intervention) within a computerized clinical information system. By this definition, a textual description of an alert, reminder or order set would, for example, qualify; however, a raw clinical practice guideline would not. Although such guidelines contain specific clinical recommendations, they are not generally designed to be implemented directly as interventions inside of a clinical information system. That said, rules derived from a guideline (or even a rule that displays portions of the guideline in specific clinical contexts) would certainly qualify.

2.2. Introducing Web 2.0

The previously described efforts were mostly limited to a small number of pre-approved participants and were not fully interactive. Web 2.0, by contrast, is characterized by online communities, open sharing, interactivity and collaboration [32]. Although Web 2.0 is more of a movement or a philosophy than a precise technology, Web 2.0 applications share some common principles and policies, namely:

1. Using the web as an application and content deployment platform. Flickr (http://www.flickr.com), an online photo site with many Web 2.0 features, is an example of this characteristic. Long before Flickr, there were offline photo organizing and editing applications. However, Flickr moved these tools to the web while keeping much of the richness of the offline application experience. By moving the tools to the web, Flickr was also able to provide capabilities such as online sharing and community discussion that weren't possible in offline applications.
2. Leveraging the web as a participatory and not merely as a publishing platform. Some innovative web sites that exemplify this practice are: (a) Wikipedia, where any user can add an entry to the encyclopedia (http://www.wikipedia.org); (b) Del.icio.us (http://del.icio.us/) and Flickr, where users can automatically create tags, annotate content and create folksonomies (ad hoc taxonomies that emerge from members of an online community applying tags to content) as opposed to centrally defined taxonomies; (c) Collaborative spam filtering products that aggregate individual decisions of users related to what is and what is not spam [33].
3. Providing valuable content in addition to simply offering useful tools. This content does not necessarily have to be developed by the same party that develops the tools themselves—instead, the community plays a key role.
4. Treating users as co-developers. Real-time monitoring of user behavior to see which new features are used, and how they are used, thus becomes another required core competency. Websites like Flickr, deploy new builds every half hour [32] and features that are not used are removed, just as new features are added.
5. Supporting syndication of services and content, as opposed to central control. An example of this is Really Simple Syndication (RSS), which is a tool for syndicating content (such as news stories or blog entries) so that it can appear on sites beyond the content author's own (http://www.rssboard.org/rss-specifica-