Integrating the hospital library with patient care, teaching and research: model and Web 2.0 tools to create a social and collaborative community of clinical research in a hospital setting

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Abstract

Background: Research in hospital settings faces several difficulties. Information technologies and certain Web 2.0 tools may provide new models to tackle these problems, allowing for a collaborative approach and bridging the gap between clinical practice, teaching and research.

Objectives: We aim to gather a community of researchers involved in the development of a network of learning and investigation resources in a hospital setting.

Methods: A multi-disciplinary work group analysed the needs of the research community. We studied the opportunities provided by Web 2.0 tools and finally we defined the spaces that would be developed, describing their elements, members and different access levels.

Model description: WIKINVESTIGACION is a collaborative web space with the aim of integrating the management of all the hospital's teaching and research resources. It is composed of five spaces, with different access privileges. The spaces are: Research Group Space 'wiki for each individual research group', Learning Resources Centre devoted to the Library, News Space, Forum and Repositories.

Conclusions: The Internet, and most notably the Web 2.0 movement, is introducing some overwhelming changes in our society. Research and teaching in the hospital setting will join this current and take advantage of these tools to socialise and improve knowledge management.

Key Messages

Implications for Practice

- Libraries are crucial in a hospital's knowledge management.
- Libraries evolve into 'Learning Resources Centres' (LRC) to carry on with its patient-caring, teaching and research tasks.
- Wikis promote incremental knowledge harvesting.
- Wikinvestigacion is a collaborative web space with the aim of integrating the management of all the hospital's teaching and research resources.

Implications for Policy

- This model within hospital organisation is a meeting point for research and teaching activities.
- Wikinvestigation promoting a web-based manage of knowledge and interconnecting the library with all other collectives.
- To overcome the confidentiality problems, the access should be controlled by the Hospital's Department of Information Systems.

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Background

Research in Spanish hospitals is funded mainly through three mechanisms:

- Public funding (national programs, Health Minister, Science and Technology Minister, Regional Programmes).
- Private, not-for-profit funds (private Foundations).
- Clinical trials, launched and generally controlled by the pharmaceutical industry.

The distribution of these mechanisms varies widely among hospitals, but in general, public funding tends to be concentrated in tertiary and teaching hospitals, while clinical trials are more widespread. Some concerns have been raised not only about the methodology and objectives of these trials, but also about the occasionally fuzzy limits between clinical trials and marketing programmes.

Hospitals are supposed to have three distinct but integrated activities: caring for patients, teaching and doing research. These three limbs, often difficult to harmonise, usually face similar problems:

- Resource limitations, as public funding is increasingly applied to basic sciences while clinical research is expected to be funded by the private industry.[1]
- Time constrains due to ever-growing management and bureaucratic activities[1].
- Difficulties in accessing and selecting meaningful information amongst a wealth of data of very diverse origins and reliability.[2] Optimising physician's search behaviour may be one of the most cost-effective ways to improve healthcare.[3] This probably requires a better categorization of information and its sources.[4]
- Spanish hospitals suffer from the isolated coexistence of the three sub-systems (practising physicians, teachers and researchers) with very few bonds and highly hierarchical structures, which results in an inefficient information flow.[5] Information technologies may be very helpful in bridging these gaps.[6]
- Physicians may have difficulties in maintaining and disseminating their results.

A commitment to excellence (or simply, to meeting standards) makes libraries crucial in a hospital's knowledge management. To carry on with its patient-caring, teaching and research tasks, libraries will have to evolve into 'Learning Resources Centres' or 'Learning Support Services' (LRC/LSS). Besides a library, these centres will have to be a network supporting teaching and research and an agent storing and diffusing its results. Central to these functions stands the duty to improve medical communication[7] and the transference of knowledge.[8] This new concept for the library should help researchers of its hospital, finding solutions[9] and taking advantage of the wealth of opportunities our present information society offers.[10]

Web 2.0 (O'Reilly[9]), also known as social webs, may provide very useful tools to improve teaching and research in the hospital.[10] Its emphasis in bidirectional communication and network building is about to bring a change of paradigm in Internet philosophy. The term Web 2.0 encompasses a set of web pages and applications in which the main architectural characteristic is participation ('users are more important than technology'). These platforms thrive on continuous feedback and the sharing of information, therefore purging and improving its contents, so that the more open and creative a web space is, the more useful (and arguably more visited) it becomes.

Wikis are essential tools of this movement. A wiki is a web application that allows several users to contribute independently in the development of a project,[11] creating or editing contents in a collaborative fashion. Wikis promote incremental knowledge harvesting and are specially suited to small or medium sized research groups. It allows for easy, efficient and low-cost sharing of information, and helps overcoming space and time constraints.

Recent works[12] have shown that when researchers are able to access online biomedical information in an efficient and exhaustive fashion, this becomes their favourite route of information gathering and diffusion.

We intend to provide our research community not only with a wiki that could fulfill these tasks, but also with an online LRC/LSS that can help the researcher in his quest for information, provide him with some helpful instruments and offer him a document repository where he/she can place and share his results, his/her teaching material or his clinical protocols.

Objectives

We aim to gather a community of researchers involved in the development of a network of learning and investigation resources in a hospital setting. Specifically, this would include:

- An area used for sharing data and ideas between members of each research group, stimulating its work and helping in its relation with external groups.
- A space displaying the basic data of each group, including their members, publications, created contents and selected information resources.
- A forum where general issues related with research may be discussed.
- A periodically updated news page with the most relevant information (grants, calls, etc).
- A document repository with three distinct parts: scientific production, teaching material and protocols and guidelines used in daily practice.
- An area where the library may display its collection and propose other evaluated free access web page.

In short, we seek to promote cooperation between the library and researchers, developing new services and contents, improving researcher autonomy and strengthening their informational abilities.

Methodology

This model was started in January 2008 at the library of the Hospital de Mostoles as the result of the work of a multi-disciplinary group composed of librarian, physicians and researchers from the hospital and the University Carlos III.

Several steps were taken in order to develop the first blueprints of the model. We analysed the needs of the research community of our hospital, we studied the opportunities provided by Web 2.0 tools, relating the needs with the opportunities and finally we defined the spaces that would be developed, describing their elements, members and different access levels.

To evaluate what could be the results and usefulness of such an instrument, a small community of researchers created a wiki in Wikispaces (http://medint.wikispaces.com). This wiki was quite successful from the outset, with frequent visits, some members working on it on a daily basis, and arguably acting as a seed for further research projects.

For several months we assessed both the perceived and expressed needs of physicians using our library and/or our wiki. From the diverse Web 2.0 tools available, we chose those that seemed best suited for these needs. Finally, we merged in a common venture the new general web space model with the previous wiki group (wikispaces) and their
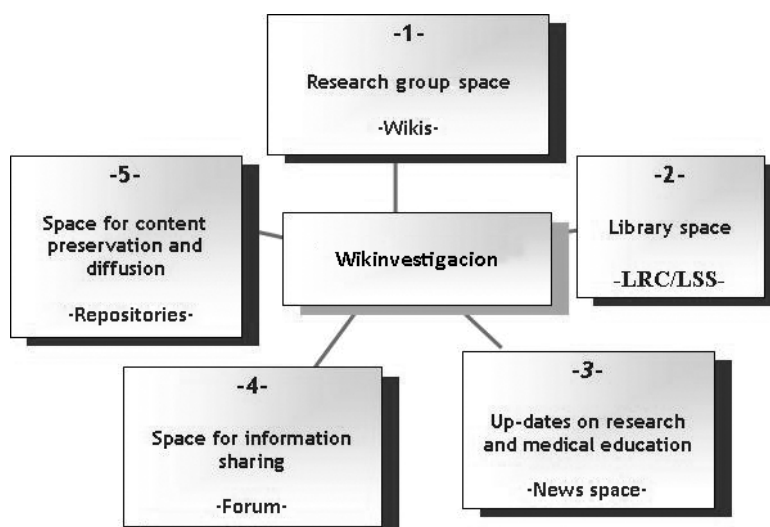

Figure 1 Wikinvestigacion spaces. Model description of social and collaborative community of hospital clinic research

Figure 2 Portal wikinvestigación webspaces

contents, giving rise to the present WIKINVESTI-GACION (http://www.wikinvestigacion.org).

It should be noted that, as for any Web 2.0 tool, Wikinvestigacion will always be a beta version and should be continuously evolving and adapting to the needs of its users and the new tools that become available. We therefore intend to use different longitudinal methods of follow-up,[13] focusing on several issues. Sequential measurements[14,15] will allow a systematic monitoring of the degree of involvement of physicians/researchers and other users. A longitudinal tracking by tendencies and panel analysis will inform us about how this instrument is influencing the areas of research, the resources employed and the results obtained.

Model description

WIKINVESTIGACION is a collaborative web space with the aim of integrating the management of all the hospital's teaching and research resources, providing tools for its development, storage and diffusion. It is composed of five spaces, with different access privileges.

We present each space keeping to the following scheme: Description, elements and contents, members and access privileges.

1. Spaces assigned to research groups: Wikis

Description: This is a space dedicated to each group's collaborative work. Each group has its own space, with the following structure:
- A free-access home page, providing information about the group and displaying their results.
- A private space, restricted to members of the group, where the group may work and share information on a secure basis. This space operates as a wiki, allowing for a user-friendly interaction and collaborative work.

Elements and contents: In each wiki, there is:
- A Home page displaying the basic information on the group: name, members, aims, research scope, published papers and specific resources.
- A web space (the wiki proper) with access restricted to members of each group. The structure and contents will be established by each group. There will be a member in charge,

responsible for admitting new members and up-dating the site.

Both will have content syndication with RSS (Really Simple Syndication).

Participating members: Those interested in having their own wiki space should contact Wikinvestigation's administrators and accept complying with the web's general rules and procedures.

Access levels: The Home page of each group will be free access. Access to the rest of the wiki will be restricted to group members.

2. Library Space: Learning Resource Centre / Learning Support Service (LRC/LSS)

Description: This space offers a unified access to all the information resources and services needed for patient care, teaching and research. These resources will be both those belonging to the library's own electronic resources and free access resources deemed to be especially adequate because of their quality or pertinence.

Elements and contents: The basic elements composing the LRC/LSS (that may eventually be expanded) are:

- Electronic information sources, both free access or purchased by the hospital: e-books, e-journals, bibliographic databases, search and meta-search engines, etc.
- Library catalogues, national and international research repositories and harvester of digital resources.
- Help tools for teaching and research: bibliographic managers, thematic contents, free statistical software, search filters designed by specialised databases.
- 'Frequently asked questions' list. Each question will open its own directory with information concerning the issue and suggested links. The questions raised may include aspects concerning basic research methodology, where to publish a manuscript, impact factors, copyright licences, etc.
- Access to the institutional document repository on research, teaching and patient care.
- Services provided by the library: interlibrary loan, document delivery, literature searching and enquiries, training and e-learning, information services, etc.

Participating members: LRC/LSS will be controlled by the library through its librarians, who will be responsible for updating its contents, managing its services and promoting its use. It will have the backup of a multi-disciplinary workgroup.

Access levels: LRC/LSS is free access to the information of its webpages but not electronic resources with paid subscription (only open to the hospital's staff). Its contents will be only edited by the hospital's librarians.

3. Up-dates on research and medical education: News space

Description: This space will display chronologically all news deemed of relevance for research taking place in the hospital, as well as significant medical education news or relevant information on Web 2.0 developments. Specifically, grant calls, notifications and laws related with research will be gathered from the media and institutional webs, and published in this news space.

Elements and contents: News will be briefly exposed, with a short summary, a link to the original source and eventually a short comment. There will be a content syndication with RSS.

Participating members: News editing will be restricted to members of the news working group. There will be a member in charge, responsible for admitting new members to the group and for assuring the page's up-dating.

Access levels: The news space will be free access.

4. Space for information sharing: Forum

Description: This is a free opinion and discussion forum, where all registered users may comment on issues related to their research, methodological aspects or biomedical general news. It will keep an open, editable file where all the comments may be read and answered.

The forum will have a chronologic, nested structure. Each post will be linked to the initial item, creating discussion threads. It will have content syndication with RSS.

Elements and contents: It will have three separate repositories:

- Scientific production repository: Information created through the research activity: manuscripts, communications, etc.
- Teaching material repository: Lectures, presentations, etc.
- Patient care repository: Clinical guidelines, standards of care, etc. created and approved by the hospital's institutions.

Participating members: To log in to this forum, proposing new topics or answering to previous comments, each member needs to be previously registered. This implies being identified and complying with the forum's rules.

Access levels: Access will be free to read. Posting will be restricted to registered members.

5. Space for content preservation and diffusion: Repositories

Description: This space will backup, preserve and help in diffusing all works of the research groups, both published and unpublished. These repositories will have a pre-defined regulation stating under what terms the information will be stored. These regulations will comply with the Digital Repository Infrastructure Vision for European Research (DRIVER) that regulates knowledge infrastructures in European scientific research. Self-stored material will be under Creative Commons Licenses.

Elements and contents: It will have three separate repositories:

- Scientific production repository: Information created through the research activity: manuscripts, communications, etc.
- Teaching material repository: Classes, presentations, etc.
- Patient care repository: Clinical guidelines, standards of care, etc. created and approved by the hospital's institutions.

Participating members: All registered or applying members will have access to the repositories. Management, organisation and maintenance will be provided by the hospital's library.

Access levels: Access to stored documents will be free, but self-storing and management will be restricted.

The technical part: Programming

Web 2.0 offers several software tools to create communities. The model established in Internet is CMS (Content Management System). This is an application used to manage contents (text, images, files, etc) in order to display them in an organised fashion.

In our case, the model demanded the use of several different software applications.

First we considered which tools would be most useful. We tried to use free software under General Public License (GPL). This has several advantages over commercial software: it can be freely used at any time, for any purpose and in any environment, and masks, templates, tutorials, translations or images can be used with no restriction. Standard publication formats (i.e. *.pdf, *.jpg, etc) were maintained if they did not require the use of commercial software. Furthermore, this allowed us to take advantage of the large community of users and developers who help in maintaining and extending these instruments.

Once we decided to use exclusively free software, we had to choose the specific tools.

The final application was developed with PHP (recursive acronym standing for Hypertext Preprocessor)-based tools and it was meant to run on a web server supporting PHP (i.e. Apache or Lighttpd). Nevertheless, it could also have been written with Python, ASP (Active Server Pages), Ruby or Perl. We chose PHP because one of us (RC) was familiar with its use as a programming language in Web applications, and because of its widespread use in these settings. Of course, a PHP-based application does not exclude the use of other applications written in a different language.

It was essential to define precisely what was needed for each application, in order to select the most convenient tool, and any community willing to develop a model similar to ours should pinpoint its requirement to choose the most appropriate software.

In our previous description of WIKINVESTIGACION, each part was defined as separate component, although integrated in a unified system.

Usually, a CMS (Content Management System) application is developed aiming at a specific

function (a weblog, a wiki, a forum, etc). We tried to find a CMS specifically tailored for each aspect. The criteria we used were rather flexible, based mainly on our own experience, and considering especially how it adapted to our needs, its flexibility, the technical support offered by its community, its friendliness in use and configuration, its security and the extent of its software development. We tried different CMS for each purpose, and finally ended with the following configuration (although obviously, other designs could work equally well):

1. **Webspaces dedicated to specific groups of researchers:** wikis. The most convenient type of software is WIKI, i.e. a content manager (CMS) designed for collaborative work. There are several brands, both as private and free software. We chose to use Dokuwiki, Other wiki we tried but found less useful were MediaWiki, Moin-Moin and TikiWiki.

2. **Learning Resource Center∕Learning Support Service (LRC∕LSS):** Although several other possibilities are equally feasible, we tried to make the edition of new contents as easy as possible, and therefore retained the wiki structure. We selected Dokuwiki, although other alternatives like Drupal, Joomla! And Geeklog were also analysed.

3. **News space:** Weblogs are specially appropriate for this type of contents. In these applications, news is ordered chronologically, the top being the most recent ones with the oldest at the bottom. In our model we have used several Blog CMSs (i.e. Wordpress, Textpattern, Bitweaver, NucleusCMS, Serendipity).

4. **Forum:** Sharing of information is most easily achieved through forum-type software. Among several possible options, we selected PunBB because of its swiftness and simplicity. We also tried SMF and Unclassified Newsboard.

5. **Repositories:** We initially used the same application software that we use to design and integrate the other spaces. The CMS we finally selected was Joomla! because of its power and versatility. Nevertheless, we are considering an alternative solution using free software such as DSpace or E-Prints, which meet international interactivity and access standards.[16]

Obviously Wikinvestigacion should not be just the addition of all these tools, and we therefore unified all the applications in a CMS that could integrate them together. It was not easy to find a CMS able to combine all these parts. Therefore, we turned to a flexible CMS like Drupal or Joomla, which acted as a portal and would allow us to integrate through links all the other spaces. Our present modular development (i.e. a generic CMS to manage contents, a blog, a wiki and a forum) has its own advantages and drawbacks, but we believe it is more flexible than a single monolithic CMS. Integration is assured by the links between different parts and by a stylistic and visual homogenization that warrants that each application is part of a common space.

It should be emphasised that this is just one of several possible options, and that each group interested in developing their own spaces should choose according to their specific requirements. PHP development was chosen because it is a language easy to learn while remaining very flexible, and because most of the free web application software is written in this code. Free software is more economically efficient, and takes advantage of the existing communities for each application.

Integration with the pre-existing information systems

As often happens with any change in organisational culture, the integration of a social web tool like Wikinvestigacion in the hospital's information systems has faced some problems:

- **Problems with confidentiality.** Although Wikinvestigacion was not supposed to have any direct relation with patient's information, hospital managers were concerned about confidentiality and the risk that certain clinical data (images, diagnostic information) may find their way to the wiki. It should however be noted that expert leaders involved in this field underscore the usefulness of these technologies in health research, even when dealing with patients' data. For example, the Institute for Prospective Technological Studies (IPTS), one of seven institutions conforming the European Commission's Joint Research Centre (JRC) has published a paper on the utility of Web 2.0 tools for the research in

the field of rare diseases.[17] To overcome the confidentiality problems we proposed that access to Wikinvestigacion should be controlled by the Hospital's Department of Information Systems, which handles access to the Hospital's Intranet. They could therefore employ the same controls that they use in the access to other clinical data.

- **Managing Repositories** will probably imply a considerable workload, requiring certain technological abilities to grant an easy reuse and dissemination of information. Other requirements would include an in-depth knowledge on copyrights and self-archiving. Furthermore, authors will also have to undergo a considerable cultural change regarding open-access journals and self-archiving publications. However, these problems could be faced through regional, national or thematic cooperation agreements. Several institutional repositories and recollections are being developed at present in Spain (i.e. E-ciencia in Comunidad Autónoma de Madrid and they could arguably help us with the development and diffusion of our repository).

- **Timidity.** The concern of an unrestricted participation of health professionals in creating contents in Wikinvestigación. Although understandable, these fears are contradicted by several facts, such *as the experience of large organisations like WHO*. Marcelo D'Agostino, knowledge management advisor of the Pan American Health Organization (PAHO) (regional office of the World Health Organization) has reported on the use of Web 2.0 tools in his organisation, underscoring the importance of creating a group identity, the idea of promoting participation whilst avoiding over-controlling for the sake of quality control.[18] The issue of quality of contents in wikis has also been addressed by Giles,[19] who compared scientific articles in Wikipedia and Encyclopaedia Britannica. His results favoured Britannica, but the difference was very small. Stern[20] compared the German version of Wikipedia with the Brockhaus commercial encyclopaedia, and their results favoured Wikipedia.

These are the main problems we faced. However, in the 2008 Bridging Worlds conference organised by the National Library Board, Nelly *et al.*[21] pointed out other significant issues, based on United Kingdom Office for Library and Information Networking (UKOLN) work[22] The main risks they identified were sustainability, digital preservation, the human factor and accessibility issues. These authors offer several strategies to minimise these risks, and conclude by indicating that, whatever the threats in the process, a greater risk is failing to engage with a rapidly changing environment.

The hospital managers postponed the decision of lodging Wikinvestigacion in the hospital's net-server until these issues were clarified. Meanwhile, while waiting for the management's final decision, the wiki groups kept on with their work and our group went on developing the project while it remained lodged in the Internet.

We, as others, are convinced of the potential of these instruments, and consider that the main risk is failing to catch up in this rapidly evolving environment. Wikis have already been used as learning devices, with good results, as showed in a survey performed in Darmstad University of Applied Science in 2007–2008.[23]

Conclusions

Hospitals, both in their research role and their role in patient care, need to adapt to the present social demands, and this implies taking advantage of any means of socialising and sharing information.

Web 2.0 tools and distributed knowledge will enrich the hospital's research, teaching and caring activities through more open, dynamic and expansive ways of working.

This kind of web-based organisation will hopefully:
- Provide a meeting point for researchers in the hospital, overcoming space and time constraints. This will lead to a web-based community, actively interacting and collectively creating and editing contents.
- Interconnect different research lines, thus cross-seeding various projects.
- Provide a unified access for all teaching and research resources, facilitating the retrieval of information and its continuous updating.
- Create a virtual community of teachers and researchers, improving their informational abilities and thus providing a continuous feed-back.

- Offer a space where all the research and teaching generated in the hospital can be stored and accessed.
- Provide a space where hospital, guidelines and standards of care, may be uploaded and consulted.
- Improve the diffusion of scientific culture in the hospital, promoting cross-fertilisation of different research lines and projects.
- Promote professional development and visibility of librarians.

Along with some obvious advantages, Web 2.0 tools pose several integration problems, most notably uncertainties about it's interaction with previous IT systems, and about changes on communication philosophy. These are proving to be the major impediments in the development of our project, and represent serious difficulties in the evolution of a research community in hospitals aiming to put in common services and resources of their libraries, perhaps in a regional or even nation-wide web.

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