WAX ActiveLibrary; a tool to manage information overload

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Abstract
WAX ActiveLibrary™ is a knowledge management system that seeks to support doctors’ decision making through the provision of electronic books containing a wide range of clinical knowledge and locally based information. WAX has been piloted in two regions in the United Kingdom. The evaluation of the system has been designed to provide results that could be used for informed future development rather than to measure clinical outcomes.

WAX ActiveLibrary, knowledge management, just-in-time knowledge, information overload

1. Introduction
It is widely recognised that medicine has reached a crisis point. Doctors can no longer memorise or effectively apply the vast amounts of scientific knowledge that are relevant to their clinical practice. The human brain, as a product of evolution, is near to its capability limits and our future evolutionary potential is limited unless we learn to organise knowledge effectively and develop new and efficient methods for knowledge retrieval. Estimates suggest that human knowledge doubles every 33 years1 while the expansion of medical knowledge is currently estimated to double every 19 years2. By contrast, our intellectual capacity doubles every 1.5 to 3 million years and thus has remained practically static over the past hundred thousand years3.

Five hundred years ago Leonardo da Vinci could simultaneously be a painter, engineer, musician and scientist. One hundred years ago a physician could be expected to know all there was to know about medicine at that time, while narrow specialisation only became a common practice early this century and the process continues. Today a typical doctor will face, during his working lifetime, a several-fold enlargement of the body of medical knowledge upon which he should base his practice. As our overall knowledge base increases we have to specialise more and more if we wish to remain near the top of our particular field. As our knowledge increases in depth we are forced to surrender its width and in the extreme it can be said that an expert will eventually know everything about nothing.

Efficient organisation of knowledge is now one of medicine’s biggest challenges; a challenge that also offers exciting opportunities. Information technology (IT) has demonstrated over the years that it too is capable of exponential growth and furthermore has been achieving this while dramatically reducing its costs. An IT user must be enabled to extract almost immediately that information which is relevant to him, and to organise it efficiently. However, simply converting existing information resources into an electronic form and distributing or making them accessible to users is far from adequate and can often exacerbate the problem of information overload. Instead, there is a need for ‘knowledge management’ tools, which are expected to transform the way medicine is practised.

Manufacturing industry has for some time now operated the ‘just-in-time’ methodology that replaces overstocked stores of components with an efficiently organised supply of the right components at the time they are needed and in the required place. More recently, encouraged by the results of the just-in-time methodology, some large companies have introduced a ‘just-in-time staff’ concept in order to manage better their human resources.

In both cases the emphasis has shifted from storage to distribution and delivery. In a similar way we need to develop methodologies for knowledge management that will provide the requisite knowledge as and when it is required. Such ‘just-in-time knowledge’ tools are likely to become essential to many ways of working in the 21st Century. The changing use of computer infrastructure itself supports this development, with the move from mainframes to personal computers and from local storage to Web technology.

In the UK, general practice is a typical example of an activity suffering from information overload3,4. Leaving aside both basic and specialised medical knowledge, a general practitioner (GP; a family doctor)
in Britain is expected to know the contents of numerous health authority policies, referral protocols, governmental circulars, warnings of adverse effects of drugs, and so on. A typical collection of such papers forms a column some 18 inches tall (Fig 1).

This, combined with the general expectation that a GP should also advise patients on matters not necessarily related to their health, results in a massive knowledge and information overload. Recognition of this particular problem combined with the knowledge that computers are good at handling and organising data led to the development of the WAX ActiveLibrary.

2. The WAX ActiveLibrary

WAX ActiveLibrary aims to provide intuitive support for clinical decision-making by putting key clinical knowledge, evidence-based information, details of services provided locally, outcome measures, patient information, etc. at the fingertips of GPs in the form of integrated electronic documents. An important objective of this project was to provide relevant information in the right form, at the right time and in an intuitive, non-intrusive manner.

Specific objectives of the WAX ActiveLibrary are:

- To provide an efficient information management structure to collect, organise and distribute reliable knowledge, evidence and service information that supports local clinical practice.
- To provide a clinician-computer interface, for decision support, that is usable without the need for formal training.
- To assure integrity of information, authenticity of its source and its non-repudiation (in a broad sense).

WAX ActiveLibrary is an IT system that provides users with a library of electronic books having all the searching power, hypertext features and multimedia expected from, say, a CD-ROM product. Furthermore, the library is active in the sense that the user can search across all or selected books in the library, assemble new books on specific topics as a result of searches, update the library by adding new books or updating the existing books, insert notes on the pages of books, author his own books and communicate with authors of books via a feedback facility.

2.1. Interface design

The first priority in designing the WAX interface was to provide a structure for, and means of navigating through, information that is accessible enough to be useful in clinical practice.

We investigated various proprietary hypertext systems, including Web browsers and help engines. Web browsers are optimised for page/note-centred navigation using wide area networks. The educational experience of health care professionals is based around hierarchically classified paper systems such as libraries of books. It is possible to use current Web browsers to create a "book-like" presentation of information but the result is far from optimal. Compiled binary hypertext, such as the help engines of many operating systems, can achieve a more book-like result but plain marked ASCII hypertext, as chosen for WAX, is much more portable. Even though WAX is not directly compatible with standard HTML it is possible to convert WAX books into HTML-based documents (obviously with significant loss of functionality), and vice versa to use HTML sources as the basis for WAX books.

Browsing performance is essential to clinical usefulness; busy clinicians are irritated by anything less than "near instantaneous" hyperlinking. Optimal performance is achieved when hypertext is browsed directly from a local storage device such as a hard disk. WAX books are therefore represented by individual electronic files stored locally on a PC. The files are distributed on diskettes or CD ROMs or attached to e-mail, and can also be downloaded from a central server. Internet and local area networks or other means of distribution are employed to deliver updated hypertext books but these are subsequently read "off line". This approach, established in 1994, improves performance and reduces communications costs even today when most GP surgeries in the UK do not have an Internet connection. However, Internet links to GP surgeries are likely to improve dramatically in the near future and the new version of WAX currently under development anticipates this development and relies on full Internet connectivity. The use of graphics and multimedia files increases the size of the books considerably, but this is overcome by storing multimedia files separately.
The WAX hypertext browsing software was developed to meet a clinical need and has been refined in response to feedback from users. We designed an interface with large icons and "paper-familiar" terms to facilitate intuitive operation that does not depend upon knowledge of a particular operating system (Fig 2).

In the WAX ActiveLibrary information is arranged in chapters of books placed on shelves in a library. Open books can be arranged on a desk area. Each book has an automatically generated 'index' of pages listed alphabetically by title, which the user can scroll through while watching the relevant pages change in real time on screen. The design of the WAX software enables the page-changing to occur at a speed comparable with 'flicking' through pages of a paper book. Users can add their own notes to any page of a WAX book without altering the book's content; these notes are kept in place when the book is updated. Cross-references can be made between books in the library and many books can be open at one time. A single book, a selection of books or the whole library can be searched for words or phrases using the increasingly common notation found in current search systems. A new WAX book addressing a specific need can be created from selected parts of other books using WAX's search and extract function.

Local ownership is an important feature for clinicians and WAX therefore provides a complete text editor that enables users to edit their own books, create hyperlinks to other sources, and insert graphics or multimedia files.

An audit trail records the pattern of system use in routine clinical practice, and the feedback facility provides users with a means of communicating back to the author of a page an assessment of its usefulness and impact on clinical practice, and supporting free-text comments. Audit trails and feedbacks are either uploaded to the central WAX server automatically when the user's computer connects to the server, or copied to a disk and sent manually to editors.

2.2. Retrieval of information in WAX

Success of knowledge tools depends on the efficiency of information retrieval. Barriers to retrieval efficiency are either physical or functional:

- Physical barriers relate to how far the resource is located/retrieved from where the patient care is occurring.
- Functional barriers relate to the organisation of any given knowledge resource once it has been physically accessed. They are resource-specific and include extensiveness, relevance and cost variables including availability.

WAX software is normally installed on PCs held in GPs' consulting rooms, overcoming the physical barrier of distance from the point of care. Sometimes WAX is installed in the reception area for secretarial use, or in a practice library. However, there are many situations where a GP requires access to information outside the
surgery, e.g. on a home visit, and our future plans include a pocket version of WAX running under Windows CE.

Functional barriers predict knowledge resource use better than perceived resource benefits, such as the quality of the knowledge resource. For example, searching MEDLINE frequently yields a low ratio of clinical acceptability-to-retrieval effort and it is thus used infrequently in clinical settings. Time and effort are the major barriers to knowledge access: these barriers have largely blocked the integration of knowledge seeking into the usual workflow and have traditionally limited the usefulness of decision-support applications. WAX ActiveLibrary is therefore designed to balance the requirements of operating within an acceptable time frame and yielding information that is judged to be relevant, with providing a sufficiently extensive knowledge resource. WAX users can then access information they know is in the library, rather than search amorphous sources to find out what information exists in the first place.

Knowledge tools require the capture of coded triggers to activate appropriate information displays. They must have vast stores of data and clinical knowledge available electronically, but also identifiable as relevant to some specific decision tasks. This means that knowledge must be given some structure. Although the text contained within WAX books need not be structured in any systematic manner, each book has a contents page (usually indicating something of the structure of the book), and each page has a title. All page titles are alphabetically listed in the index of a WAX book. The consistent structure of pages making up discrete books allows users to move easily between books compiled by different editors and from different knowledge sources.

The process of simply retrieving passages of unstructured text for visual scanning and interpretation mimics established patterns of patient record use by clinicians who are making decisions about individual patient care. The human mind is good at identifying misspellings, synonyms or related words when looking for something in a text. Sadly this is not the case in a computerised search process where only limited account is taken of misspellings, synonyms and related terms in finding matches to a query. This problem is commonplace when using the WWW, where often several hundreds of hits may be obtained for a particular search, many of which are totally irrelevant.

One solution to the computer search problem is to use some sort of term bank or semantic model that enables the system to match synonyms or related terms. However, these approaches require complex search algorithms and large amounts of storage. At the moment we do not know how detailed a structure is required to support knowledge tools. But, given the vast amounts of patient data and clinical knowledge these tools must use, even minimal structuring could require major effort. A simpler solution adopted for WAX was to define a set of likely misspellings, synonyms, etc. for each book, and use these for searching. However, even a simple approach like this requires some common assumptions and consistency in order to function usefully.

WAX ActiveLibrary can be searched not only by ‘keywords’ that occur in the text, but also by ‘concepts’. By using concept search it is possible to retrieve a block of text that deals with, say, ‘pregnancy’ without the word ‘pregnancy’ itself appearing in that text. Any search can be limited to a particular book, several selected books or use the whole library. New WAX books on specific topics can be created from results of searches. This is a very powerful feature that enables users to personalise their own sources of reference information.

2.3. Creating WAX books

A simple keystroke converts the WAX knowledge viewing interface into an interactive editing interface, in which the book navigation icons at the top of the screen are replaced by a toolbar of basic word processing functions. Text can be cut and pasted in from documents in other word-processing applications and the page titles and hyperlinks are then coded manually using toolbar functions.

Alternatively the editor of a WAX book can bypass the editing interface and directly manipulate the WAX book text files (files with extension *.wtx opened in a plain text editor application such as 'Wordpad') using field codes analogous to HTML codes. This provides a quick method for making global changes to books or ‘chapters’ within books; for example adding the same hyperlink to every page in a chapter, or inserting the same contributing author and update period for a large number of pages. The *.wtx files can also be compiled automatically from source material stored in spreadsheets or databases (for example, waiting times for in- and out-patient clinics) by running a simple program that inserts database information items into appropriate field codes in the *.wtx file.

The use of WAX for locally-owned, primary care-led knowledge distribution, rather than top-down directives from secondary care, is what attracts many GPs to the product. At the same time information managers in secondary care and health authorities see WAX as a tool for disseminating their own protocols and regulations to manage demand for services. Thus there could be competing interests to provide information via WAX
once the distribution system is in place. A degree of co-ordination will be necessary, perhaps implemented at the level of a district WAX server, in order to ensure that paper information overload does not become WAX information overload.

2.4. Integrity and authenticity

Some WAX books are used to deliver ‘mission critical’ information such as drug doses or treatment regimes. The user needs to have both confidence in the information provided and proof that it was supplied by the correct source. The overall level of threat against WAX security is low, certainly much lower than against regimes. The user needs to have both confidence in the critical information such as drug doses or treatment.

1. a WAX book’s content could be altered, whether by accident or malice;
2. an incorrect book source (author or publisher) might be claimed;
3. WAX software could be maliciously altered, whether by a general virus or by a more targeted attack;
4. a party involved in a dispute might deny the content of a previously published book, or challenge the date on which the information was published.

The first three are familiar from the general computer security environment; concern about the fourth arises from a case in which a supplier of surgical implants sought to defeat litigation by claiming that it had published warnings at an earlier date than it in fact had done. Thus in addition to the integrity and authenticity of books and software, we want a non-repudiation service that covers both content and publication dates.

Although the third threat does not introduce a serious risk in our application, it is the main concern with distribution and installation. The issue facing us is where to draw the fine line between prudence and paranoia when it comes to trusted distribution. The main control is that when WAX is first installed a hash of the installed software and of the catalogue of trusted books should be checked against the value printed on the registration form and furthermore can be compared with a value published by the distributor.

Given this check, a reasonable level of trust can be placed in the WAX software, and consequently in the hash of the catalogue of all authenticated books that the distribution software contains. The software checks this hash every time it loads the catalogue of WAX books and the check can also be initialised by the user whenever required. The check can also be manually carried out at any time, and users can compare it with a published value whenever they feel it necessary.

Integrity checks are also performed whenever a book update is received, and whenever a book is opened. The trust model is that the WAX-Root certifies the publisher, and the publisher certifies the book, taking responsibility for its content to the same extent as in the present world of paper.

The effect of the design is to reduce the problem of the trusted distribution of books to the trusted distribution of the WAX software and of the master catalogue. Under the circumstances, we consider that an appropriate level of effort has been expended on trusted distribution; any more effort than this would cross the line into paranoia.

3. WAX pilot projects

Two pilot projects are currently under way, one in Cambridge and one in Oxford. Both pilots use the WAX system to provide local referral guidelines and directories, local and national patient management guidelines, and health service and other government department information to local GPs.

The Health Authority in Cambridge wanted to manage demand for the services of three busy departments at Addenbrooke’s Hospital NHS Trust in Cambridge by providing GPs with referral guidelines and patient management guidelines for common conditions. Meanwhile a Cambridge GP wanted to rationalise the provision of guidelines to local GPs. He had collected some 850 different paper guidelines – defined as any type of material supporting clinical decisions-- used by 22 practices (Fig 1), together with GPs’ views on which were most useful. A selection of these, both local and national, were converted into WAX books, which, along with the three sets of Addenbrooke’s departmental guidelines, form the content for the Cambridge pilot project. The two independent initiatives have to some extent adopted WAX as a representative clinical knowledge management system.

By contrast, while in Oxford a GP and his colleagues also wanted to streamline the provision of information to GPs, they selected WAX specifically as the solution. They have focused more on collecting locally relevant contact and referral information and directories, which were used to create a number of Oxford-specific WAX books.

In practical terms both pilot studies began with seminars for participating GPs in March 1998. These were followed by installation of the WAX software in participating practices (usually on several computers at
each location). Since then, GPs have been taking copies of the audit trail and feedback files pertaining to the WAX books on their computers and sending these to us. These files contain, respectively, an automatic audit trail of WAX pages that have been opened on screen, and feedback in the form of text comments and scores of usefulness appended to specific pages by the user. The data collection will finish in October 1998.

3.1. Evaluation of pilot projects

Despite the fact that information is critical to decision making, the process of delivering clinical knowledge to decision making has received little attention from informatics workers, particularly in the field of evaluation where systems have generally been evaluated by decision outcome, rather than the decision process components. What is needed is evaluation that focuses upon process gains in decision making, such as more efficient information seeking, as opposed to only outcomes.

Therefore the current evaluation of WAX focuses on information seeking and has been designed to provide results that can be used to inform future developments of the system, rather than measure clinical outcomes. Questions addressed in the evaluation include system usage, usefulness of WAX as a tool for delivering information, the information content of the system, and comparison with paper-based equivalents. Several methods are used including audit trail analysis, pre and post study questionnaires, interviews and discussion groups, as described below.

Pre-study Questionnaire:
- this was completed by GPs at the launch meeting (to ensure compliance), and includes questions on:
  - Demographics
  - Computer knowledge, experience and attitudes
  - Use and attitudes towards paper guidelines, do they use them, why not, etc.
  - The role they see for WAX
  - What sort of information would they like to see in WAX

Mid-study Questionnaire
- this was completed three months into the pilot
  - Usefulness of WAX
  - WAX compared with paper guidelines
  - Specific questions about the WAX books supplied

Post-study questionnaire
- to be completed in post-study meeting after six months
  - The WAX interface - ease of use, navigation, use of mouse, etc. Amount and adequacy of training and technical support.
  - WAX compared to paper guidelines - is it easier or quicker to access. Are they more likely to use guidelines in WAX format.
  - Future role of WAX. Will they continue to use it after the pilot? If not, why not? What changes would they like to see? Willingness to pay?
  - Specific questions about the books supplied with WAX. E.g. how useful were individual sections, were they detailed enough, what addition information would they like. (These questions are different, depending upon which regional version of WAX is being evaluated and the objectives of the clinicians involved in the development of the books).

WAX Audit Log
Who uses WAX, when, and for which parts of content, etc.

WAX feedback
Users’ comments about specific books and pages, entered electronically, on a voluntary basis. Feedback comments received from the participants so far can be divided into three categories:
  - General comments on facilities in WAX and the topics covered; e.g. “is there facility to export text into other WP applications?”.
  - Problems encountered in using current layout and structure; e.g. inappropriate hyperlinks within a WAX book.
  - Specific questions, comments or requests for additional information relating to existing pages; e.g. “it was useful to show ENT page on adenoids to patient’s father and reassure him”, or “in Hypercholesterolaemia drug treatment guidelines it might be helpful to indicate use of total cholesterol to HDL ratio as aid to deciding who merits drug treatment”.

As is obvious from the limited examples given above, feedback comments lead to many different actions. Some can be used to improve the presentation of information in the relevant WAX book, some will lead to further improvements in the WAX software and others encourage better provision of information from sources.

Interviews
Semi-structured interviews to explore qualitative issues will take place with a small subset of GPs. The results from the audit log will help identify particular types of user, e.g. high or low levels of use, preference for particular books, etc.
Discussion group

Post-pilot group discussions to gauge support for WAX and determine future software and content development.

The pilots will end in October 1998 and the data from the questionnaires, audit trails and feedback will then be analysed using SPSS statistical software. The results of the analysis will be included in our presentation at HICSS-32 in January 1999.

We are aware that the relatively small number of surgeries that we have been able to include in these two pilots imposes limits on the outcome of the evaluation. When the user base of the WAX system increases, we plan to conduct a more rigorous type of evaluation, with the aim of assessing changes in clinical outcomes. Given that one of the main objectives of the system (in the two pilots to date) is to reduce the level of inappropriate referrals, then a two-group study (intervention and control) could be conducted to examine the rate of inappropriate referrals and the completeness and adequacy of information sent with referrals (e.g. measuring how many times the GP needs to be contacted for additional information and whether the referral would be aided by having more or different data sent with it).

4. Discussion

WAX started out as a research concept four years ago. Since then the project has experienced many difficulties in making the transition from a prototype system towards a fully operational knowledge management tool, including the limited resources available, scalability problems, extension from single-user to multiple-user system, de-bugging and platform dependence. The issue of attracting commercial interest has involved the project group in examining various alternatives between the two extremes of licensing the product to an already established company, to finding suitable venture capital to set up a new company. The project has been greatly assisted by the University of Cambridge, which recognised the potential of the idea and established a company for the further development of WAX.

The design of WAX and its implementation in numerous locations around the UK, and especially in the two current pilot projects in two regional Health Authorities, has highlighted many issues facing the developers of knowledge management tools and the associated information content. The possibility for distributed editing of WAX books according to users’ own needs and resources means that many WAX editors have been experimenting in parallel with different methods for choosing, sourcing, reformatting, checking and testing the knowledge content of their WAX libraries.

4.1. Choice of content

The choice of knowledge content is dependent on the editor’s motivation for adopting WAX: is it a knowledge-sharing system owned by primary care, for example, or a tool for demand management by service providers?

Some editors have decided to censor parts of the information content for quality, for example uploading clinical guidelines only if they are evidence-based. Alternatively the end-user can be handed the responsibility of exercising the same gate-keeping process that is necessary with paper-based information.

4.2. Information sources

Sources for national and local WAX books have included clinicians, administrators and information managers from national, regional and local health service providers, local health authorities and hospital trusts, local GP audit groups, local patient support groups, government departments, charities, and professional medical or scientific organisations.

At the Centre for Clinical Informatics we found that some information providers were reluctant to provide the required information but could be persuaded on seeing a benefit to themselves, for example deciding to adopt WAX as a more efficient distribution system for their own communications.

An important consideration that prevents some information providers from giving access to new knowledge sources is the relative ease of comparisons of information once uploaded onto WAX from diverse sources. While this very point is welcomed by most users, it poses a potential barrier for some information providers because it exposes disparities in practice.

4.3. Re-formatting issues

Re-formatting material for use in WAX is usually necessary because most source documents are provided as Word files, as compiled for linear paper formats; others available only on paper can be captured by digital scanner and text conversion.

In some cases information written for final output on hospital intranet pages or public Internet pages has been provided as Word files.

Various approaches have been taken by different
WAX editors. Some editors constructed WAX pages with a standard proforma style for consistent documentation of local service provision, and completed the separate fields piecemeal by typing from diverse sources including telephone enquiries.

At the Centre for Clinical Informatics, where we are working on transforming large data collections into WAX books, we find we often have to involve information providers in reengineering their use of information technology in order that we can use their data to its maximum potential in the WAX system (for example, collecting clinic waiting times in a database program rather than a spreadsheet so that frequent updates can be compiled automatically into WAX books; or encouraging a charity who maintain a large database of support organisations to use a structured, hierarchical keyword system in order to provide a useful search tool for the WAX version of the material).

If the encounter with WAX is the first time the information provider has had to think about moving into electronic or database formats then this is perceived as a major barrier and difficulty, but identical issues would need to be addressed for other knowledge management systems. If we are first on the scene, we expend time and effort in asking for - and in some cases intervening in and helping with - business process reengineering.

4.4. Translation into hypertext

Most editors use the natural paragraph or section breaks in long texts to divide material across several WAX pages. Once linear documents are split up in this way, and the pages hyperlinked in a branched or networked relationship, the user requires extra navigation aids in order to quickly assimilate the structure of the information content.

The editor can provide a diagram of the branching structure to indicate the depth of information content, while pages consisting of a list of hyperlinks, either alphabetical or by broad subject group, indicate the breadth of topic coverage.

True algorithmic decision paths can be converted into a series of hyperlinked pages.

Editing books 'longhand' via the editing interface is relatively time-consuming, at least when making books from scratch. As more information providers move to sophisticated methods of data capture, storage and distribution, so more WAX books can be produced 'automatically' and updated with minimal editorial input.

4.5. Checking final versions

Some editors have not consulted information providers at all after receiving the material for a new WAX book, and have no established approval system.

The Oxford WAX pilot project editors have inserted a disclaimer for responsibility for accuracy at the front of every WAX book, while an alternative approach used by the Centre for Clinical Informatics is to present the information provider with the WAX version of their material and asked to sign that they are satisfied with the accuracy and format. This process encourages them to think of how better to exploit the new medium, and the editor is freer to experiment with novel structures.

4.6. Testing WAX books

Testing of all these different approaches to providing knowledge content in WAX is now in progress in pilot projects and smaller groups of users around the UK. All WAX users have the opportunity to supply feedback comments to their book editors.

Because most information sources used to compile WAX books were originally written for paper, we are still learning how to translate such formats to exploit the potential of this electronic medium.

However, we expect that the iterative cycling of feedback from user to information provider will help to streamline the information presented in WAX, educating the providers also in exploiting the new media.

5. Conclusions

The future success of WAX and other knowledge management tools depends not only on technical issues being solved, but also on new and innovative professional and organisational infrastructures being put into place in the clinical arena. The contemporary idea that clinicians are independently contracted individuals who must supply their own knowledge storage and retrieval tools is outdated. Clinicians will need to be viewed as production workers with healthcare organisations being pressed to provide the essential production tools to its clinical workers. Berwick stresses that we need to change the whole system, not just make changes within a system, if we are to succeed in making improvements to clinical care. Our experience in trying to implement a new knowledge management system indicates that it is not only in the clinical arena that practices need to change but also in the administrative and backup functions, where inefficient technology and data capture infrastructures hamper a progression to efficient use of clinical knowledge management tools.
Another, perhaps greater, barrier to the widespread use of knowledge management tools is the psychological need of clinicians. A review article by Smith in 1996 which looked at the information needs of General Practitioners made several conclusions, one of which was that doctors are looking for guidance, psychological support, affirmation, commiseration, sympathy, judgement and feedback. Smith argues that this aspect of doctors’ information needs is particularly poorly explored, and yet it may well be the most important need and the biggest stumbling block to a technical solution. Specific feedback comments recorded by GPs using WAX indicate that they appreciate the guidance and affirmation it provides. When users begin to edit their own WAX books and share these with colleagues, WAX may also enhance the personal exchange of information and support that currently takes place verbally.

In summary, the major users of information in the current WAX pilot projects, the GPs, are uniformly enthusiastic about the system. Other local GPs have subsequently asked to join the scheme and have provided their own computer hardware. Enthusiasm for WAX among the major providers of information was varied, primarily because they could not immediately see a benefit to themselves.

The feedback of comments from the users of WAX to the information contributors provides a new level of communication between GPs and hospital consultants. This infrastructure could be used to target specific problems between primary and secondary care such as demand management.

References


