USABILITY TESTING OF

MEDICAL KNOWLEDGE RESOURCES

BY

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A THESIS

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ABSTRACT

Accessed through the computer, medical knowledge resources are increasingly being provided on the Internet. And, it is through the user interface that the user communicates with the computer.(1) As a result, human computer interactions (HCI) associated with the user interface assume a more significant role. Usability testing, a component of human factors engineering (HFE), is an important part of the software development lifecycle and addresses user interface design.

This paper examines usability testing of web resources in the healthcare setting. The method under study is known as Discount Usability Engineering (DUE), which incorporates accepted methods of usability testing but is applied using a relatively small sample of users and experts and employs heuristic evaluation, think aloud sessions, and scenarios to provide results in the form of needed changes. The significance of this approach is that the results provide feedback on what works and what does not, and can be conducted iteratively throughout the development cycle. DUE does not rely on statistical significance, but instead attempts to derive maximum benefit using a limited number of participants. The goal is to maximize the cost/benefit ratio. This study examined two user interfaces to the same information resources. The old interface was a simple listing of resources, while the new interface incorporated design concepts, color, and assumed domain knowledge of the targeted users to organize resources. Heuristic

evaluation was conducted with a web architect and a physician-engineer (domain user), each of whom provided findings that supported and added to the other's assessment. User testing was conducted using simulated tasks which incorporated scenarios requiring the user to navigate through the website to find an acceptable answer. The tasks were the same for both versions of the interface and the goal was to determine if users had better performance in the new version than the old, and to identify any problems in the new version. Both methods tested the effectiveness of DUE. Overall, the new version proved to be a better interface, supported by expert assessment, times for task completion, overall number of tasks completed per version, and users' comments. Further changes reflecting preliminary findings were implemented in the new version before its release. Discount Usability Engineering proved to be a valuable methodology in refining a product and making it more usable for target users.

INTRODUCTION

Medical knowledge resources are quickly becoming more accessible through the Internet/intranet. Using web technologies, clinicians have improved access to scientific journals, publications, guidelines and protocols, and other information resources. However, the Internet (also referred as the World Wide Web (WWW)) is a growing environment where one can get lost, lose track of one's objective, and get inundated with information. The WWW focuses "upon information display and instant retrieval in a multimedia environment,"(2) emphasizing that information retrieval is as fast as a click on a button. For many users of the Internet and related resources, retrieving information is fast but navigating through all the information to find useful content can be difficult.

Along with the dramatic increase in the amount of information accessible through the computer comes the challenge of providing an interface that allows easy and intuitive access to useful information. Discount Usability Engineering (DUE) is a method that focuses on studying ease of use and user satisfaction with a user interface and product. This paper demonstrates the usefulness of DUE in studying and improving a medical information retrieval system.

THE NEED FOR USABILITY TESTING IN MEDICAL INFORMATICS

Despite the many modes of access to information, significant barriers to finding usable information exist. Some of these barriers have been identified by Covell(3), Gorman(4), and Smith(5) and include:

- Poor organization of available resources,

- Ignorance of the availability of relevant resources,
- Lack of time to search for information,
- Lack of up-to-date resources,
- Non-availability of resources,
- Unrecognized information needs.

Resources can be made available but if they are poorly organized or require significant training to use, they probably will not be utilized. Being ignorant of available resources, resource unavailability, and the lack of up-to-date resources are also barriers to accessing useful information. The time required to find needed information is another hurdle to information use. The key to improving information use in the medical setting is to shorten the time required to search and to make the results easy to obtain. Understanding the information needs of clinicians is also important. In a given situation, a clinician may not even be aware of information that would be useful in optimizing care. Automatic reminder systems are one example of systems that potentially overcome this oversight.

Curley et al(6) showed the importance of availability of resources (whether physical, functional or intellectual) and its usefulness to the physician in their everyday practice as another factor affecting access to information. They classified usability of resources as "physical availability", where searchability, understandability and clinical applicability of information were factors affecting the time it took to access useful information. Too much emphasis may be placed on the technological development of resources without sufficient consideration of the organizational and social impacts of the resources. How an organization utilizes a resource and how individual work practices evolve around obtaining information need to be considered during knowledge resource development. Provide a tool that requires users to adapt, and they may use it reluctantly and sub-

optimally. Provide a tool that has been adapted to the users, and they may use it more willingly, and integrate it more fully into their work practice.

Aborg et al(7) introduced a method for usability evaluation of information systems by occupational health care organizations. Aborg's method incorporates observation and interviews at the worksite. They focused on evaluating usability of information systems used by skilled professionals in their daily workday. It was used not during development but in evaluation of the daily running of information systems and how they affect the users. They were addressing issues that may lead to inefficient work procedures, poor performance and low user acceptance.

Gulliksen(8) reviewed designing for usability in the workplace. She affirmed that by incorporating domain knowledge of users early in the development, analysis, design and evaluation processes, and by developing formal representations of this knowledge, user interface design for specific work activities can be enhanced. She emphasized that computers and software are only tools for the job, and that they should aid the work to be done, not hinder it.

Kushniruk et al(9) advocated usability testing in medical informatics. This paper supported the need for developing and applying methodologies that improve upon the assessment of medical systems and their user interfaces. They point out that the conventional methods of evaluation through questionnaires and interviews reflect more of what the users recall and may not accurately represent what they do. Using usability

engineering and cognitive science in a way that studied actual behavior, they proposed an iterative design process and end product testing that would improve the evaluation of medical information systems.

Karlsson et al(10) studied how clinicians used a decision-support system to manage patient cases. Three parameters: relevance, validity and work, were determined to be important in describing how the system was experienced by the users. Physicians have to be able to find relevant information with respect to their own knowledge and experience. They need to know that the information is valid and current. They also find it useful to access patient-specific support information and continuing medical education relevant to their work. All of these were considered important in determining the usability of the system.

Coble et al(11) described usability testing to measure the usability of a clinical workstation and then evaluated the effectiveness of changes that addressed usability problems. Their study sought to determine:

1. If the users understood the system,
2. If changes from usability testing improved usability, and
3. Whether or not new functions increased satisfaction, and whether there were further problems that needed to be addressed.

Their methodology included gathering user requirements, creating usability tasks, testing, analyzing the results and determining problems, making appropriate changes and iterating this cycle. They found that the number of problems that physicians encounter during a given task is one of the most effective measurements determining a function's usability.

Request for assistance during a given task was another good indicator that improvement was needed on a particular feature. They concluded that usability testing is a valuable tool in improving the clinical workstation's usability, increasing the likelihood of success in the "real world".(11)

Gosbee(12) has also written about incorporating human factors engineering (HFE) into the practice of medicine. Despite studies demonstrating the usefulness of usability testing, it is still not a widely practiced technique in the development of systems. Rather, usability testing is often applied near the end of system development, when it is most difficult to change. Gosbee believes in teaching "error-in-medicine"(12) with HFE; that is, by cultivating the awareness of causes and solutions of error in medicine, future clinicians will improve their participation in quality improvement activities. As part of this, future clinicians need to be interested in and be able to effectively communicate with medical software and device companies and to become a better evaluator of such tools.(12) By improving the clinician's appreciation of the requirements of medical software and devices, Gosbee believes these consumers will learn to push the industry to embrace HFE methods in the development cycle, resulting in fewer errors.

In developing software, anything that can prevent the user from using the product to his/her satisfaction can be considered a barrier. Some of these barriers may be beyond the control of the product developer, such as computer speed and monitor effects. However, questions that designers should keep in mind include:

In using the product, is it:

- Easy to learn?
- Efficient to use?
- Easy to recover from errors?
- Easy to recall what to do?
- Fun to use?
- Visually pleasing?
- Satisfying to use?
- Doing what you expect?

This thesis project studies the use of DUE in testing and improving the usability of two web interfaces provided at Kaiser Permanente NorthWest.

WEB BASED KNOWLEDGE SUPPORT AT KAISER PERMANENTE NORTHWEST

Kaiser Permanente Northwest (KPNW) is a large health maintenance organization with about 435,000 members served by over 600 physicians. In 1998, KPNW funded an analysis of their clinical support information.(13) Along with making recommendations for managing KPNW resources, the study included:

- An inventory of the then current capabilities for sharing clinical support materials for clinicians;
- Identification of information stakeholders and relevant project work underway or anticipated;
- Analysis of clinician use of support materials and assessed needs;
- Identification and prioritization of approaches for integration of support materials into their clinical patient information system;
- Development of a strategy for managing clinical support information over time;
- Identification of training requirements;
- A job description for the coordination and management of clinical support materials.

They concluded that KPNW clinicians had access to a rich source of clinical support information but that it was scattered among various delivery formats and systems. KPNW had invested in intranet technology, hoping to realize a strategic advantage through faster and more efficient information access. However, clinical support information was not

stored in a way that allowed easy access, making it difficult for clinicians to use, especially for those with heavy demands on their time. The 1998 study revealed that despite providing valuable clinical information, the lack of coordination and organization of resources impeded clinicians' access to such information. The proposed solution was to provide an online clinical library, organizing what was already provided on the intranet into a more usable format. A new interface known as the KPNW Clinical Library was created and subjected to DUE to help evaluate and improve its usefulness in the KPNW environment.

GOALS OF PROJECT

1. To compare the usability of two versions of the KPNW web interface to access clinical support materials. The "old" version of the web interface is essentially a list of the resources (Figure 1). The "new" interface (the Clinical Library) is a redesign of the resources, organized to improve efficient access to information (Figure 2). Color was used to improve visual cues in navigation and a one-level hierarchy in information resources was added. This study examines whether changes in layout actually improved usability.
2. To determine whether other changes could improve the new interface before its release. This would be the first of many iterative changes that occur during usability testing.
3. Demonstrate the effectiveness of usability testing in development. DUE, employing heuristic evaluation and user testing, is designed to produce a more efficient and

effective product while minimizing costs. This investigation seeks to determine whether these methods actually improve usability at a reasonable cost.

Figure 1. Old Interface

Figure 2. New Interface

USABILITY TESTING

Before 1980, the design of interactive computer systems did not include the role of intended users as an important focus.(14) Since then and most especially in the last few years, the user has become increasingly recognized as an important factor in the development of interactive systems.(14)

WHAT IS USABILITY?

Usability, defined according to the international standard ISO 9241-11, is "the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments."(15). Grudin (14) proposed that usefulness = utility + usability. Utility is the extent to which system functionality supports the user's needs. Usability is the extent to which the user is able to access the functionality. Nielsen(16) built upon this by proposing that:

- Usefulness: relates to work processes - does the system contribute to a good work result?
- Utility: relates to the desired and needed functionality at hand - is this the correct tool for the job?
- Usability: relates to the user - can the user interact efficiently with the system through its user interface?

Usability engineering is a process whereby users become the focus of design activity, i.e., users and their needs are involved in the design process. Specific design requirements involve three techniques:

- Requirements analysis determining what the system should do;
- Task analysis determining how it should be done;
- Usability testing which defines an acceptable performance level for specific user types.(1)

WHY PERFORM USABILITY STUDIES OF BROWSER-BASED KNOWLEDGE RESOURCES?

Medical knowledge resources are increasingly being provided over the Internet and intranets using browser-based interfaces. This involves substantial costs, including creating and maintaining infrastructure, developing and maintaining web sites and links, and purchase and subscription costs for knowledge resources. The cost of determining usability should outweigh the potential waste of providing resources that are not optimally used. If poor usability renders the resources difficult to access, then clinicians are unlikely to take advantage of them.(6)

From a business perspective, usability testing could save millions of dollars. (17),(18) Bay Networks spent $3 million and two years studying the different ways people think about information in the building of a model intranet. Their cost saving for this investment was estimated to be $10 million each year.

Kushner(19) and Boling(20) highlight other aspects of usability testing:

- In development, the earlier a problem is identified, the less it costs to correct;
- System development is expensive but supporting a poorly designed system can be more expensive;
- A usable design requires less documentation;
- A design mistake will eventually require guiding the user around the design flaw;
- Training costs are more expensive if a system is more difficult to use;
- Users will reject or work around systems that do not meet their needs;
- Customer support will be more costly for poorly usable systems;
- Vendor credibility can be lost with a poor product or with poor support;
- Designers cannot accurately represent the users' perspective of the system.

KPNW hoped to improve accessibility of their web site to medical staff to improve patient care, and perhaps, attain a better understanding of information needs of their clinicians.

METHODOLOGIES OF USABILITY TESTING

There are a variety of ways that usability measurements can take place:

a. Measuring user's performance when interacting with the system;
b. Measuring user's attitude towards the system (often based on rating scales);
c. Measuring mental effort required to use the system or stress caused in using it; or
d. Formally analyzing the system itself to assess the operational complexity of using it.

As part of user performance, ease of use can be measured by how quickly a task is performed, how many mistakes are made, how quickly the tool is learned and how satisfied people are with the tool in performing the task. Usability can also include factors such as safety, usefulness, and cost-effectiveness. Mehlenbacher,(21) in assessing online systems concluded that a system is usable if it is:

- accessible,
- maintainable,
- visually consistent,
- comprehensive,
- accurate, and
- task-oriented.

The different methodologies for conducting usability testing each have its own advantages and disadvantages. Table 1 summarizes the characteristics of these methods.

Methodology	Evaluators	Evaluation tools	Guidelines	Other Participants
Heuristic evaluation	Expert/trained	No tools	Established heuristics.	No
Heuristic estimation	Expert	No tools	Expected user performance.	No
Observational or direct testing	Trained/limited training	Notes, video recording	Users go through series of tasks.	Yes
Cognitive Walkthrough	Experts who role play the anticipated users	Task scenarios	Tasks constructed from specification or early prototype.	No
Formal usability inspection	Trained	Software inspection methodology	Inspect codes to detect defects or bugs, providing quantitative measurements that can be tracked using statistical process control methods.	Yes, inspectors who are specialized in their role of inspection of the code.
Pluralistic walkthrough	Experts, developers and users	Task scenario	Discuss and evaluate each element of interaction.	Yes, users, developers and usability professionals
Feature inspections	Experts/trained	Examine sequences required to complete a task	Determine whether sequence is too long, cumbersome, unnatural for users to try or requires more knowledge than may be expected.	Yes, targeted users or participants who know what users would want to do.
Consistency inspection	Expert/trained	Inspection of a group of products that should look and work the same way.	Common functions should be implemented the same way (e.g. saving to disk should entail the same steps whether the application is a word processor, spreadsheet or presentation.)	Yes, an evaluation team consisting of designers from different projects who will test to see if the subject software works and looks like their project software.
Standards inspection	Expert	Inspection for compliance.	Industry standards.	No
Guidelines checklist	Novice, trained or expert	Inspection for compliance.	Institutional standards	No

Table 1. Summary of Testing Methodologies

The table lists several methodologies. Evaluators refer to those people used to assess usability and their qualifications (novice, trained or expert). Evaluation tools refer to anything that may be used in the assessment of usability. Guidelines refer to protocols that may be consulted during the test. Other participants indicate the presence of people other than the evaluators.

The following describes each method from Table 1 in some detail.(22),(2).

Heuristic evaluation

Conducted by trained evaluators, heuristic evaluations are independent evaluations. The evaluators follow established heuristics such as the 10 formulated by Nielsen.

Heuristic estimation

Rather than following established heuristics, inspectors estimate the relative usability of two or more designs in quantitative terms (usually expected user performance by computing the mean of the individual estimates).

Observational evaluation/direct testing

Users are observed during task execution with the evaluator taking notes on user performance and timing the task to completion. Video recording can be used as well, for future review and analysis.

Cognitive walkthrough

Expert evaluators construct task scenarios from a specification or early prototype, and then role-play the part of a user --"walking through" the interface.

Formal usability inspection

Employs software inspection methodology and adapts it to usability evaluation. This includes code inspections to detect defects or bugs, and provides quantitative measurements that can be tracked using statistical process control methods

Pluralistic Walkthrough

Uses group meetings where users, developers, and usability professionals go through a task scenario, discussing and evaluating each element of interaction.

Feature Inspection

Lists sequences of features used to accomplish typical tasks, checks for long or cumbersome steps, steps that would not be natural for users to try, and steps that require extensive knowledge/experience in order to assess a proposed feature set.

Consistency Inspection

Have designers who represent multiple other projects inspect an interface to see whether it does things in the same way as their own designs.

Standards Inspection

Has an expert on an interface standard inspect the interface for compliance with the industry standard.

Guidelines checklists

Uses checklists in combination with a usability inspection method -- the checklist gives the inspectors a basis for comparing the product.

DISCOUNT USABILITY ENGINEERING USING HEURISTIC EVALUATION AND USER TESTING

Discount Usability Engineering described by Nielsen(23) and employed in this study, is based on three techniques:

- Scenarios
- Simplified thinking aloud
- Heuristic evaluation

Scenarios are a form of prototyping that examines only part of the system, keeping the interface to a functionally reduced level. By reducing the number of features, this method allows one to receive quick and frequent feedback from users. Think aloud sessions provide insight into user experience of the system, having the users voice their thoughts as they perform a series of tasks using the system. Heuristic evaluation employs an expert who evaluates the interface based on commonly accepted guidelines known as heuristics. The evaluators in Nielsen's approach are experts in software engineering, usability or human factors. Muller et al(24) extended the list of experts to work-domain experts (users) because they are experts in their own right. In heuristic evaluation and in user testing, usability problems in a user interface design are determined through an iterative process.

We chose these methods,

1. Task analysis with think aloud sessions of a small number of users,
2. Scenario implementation,
3. And heuristic evaluation by two experts,

to maximize usability improvements while minimizing costs. Nielsen conducted a study in 1995 that looked at measuring usability.(25) The study results indicate that heuristic

evaluation and user testing rate the highest in overall usefulness among the methods offered.

Nielsen also validated DUE.(23) In the redesign of a set of account statements, he tested one user on the old version and seven newer versions, employing simplified think aloud experiments. To validate the final redesign, Nielsen then used traditional statistical measurements. With 152 subjects, and both experimenters and subjects not knowing which was the original account statement and which was the new, the study showed significant improvement in the understandability of information with the new version.

Because DUE allows for quick implementation of changes and reiteration of testing in a shorter turn-around time, it can be considered more cost effective and time efficient than other methodologies. This methodology is easy to apply from the stage of early conception and provides useful results at reasonable costs and tight timelines. One of the greatest benefits of DUE is that the rapidly generated results identify flaws before expensive investment in development and deployment.

METHODOLOGY (MATERIALS AND METHODS)

OVERVIEW

We undertook both a structured and systematic format for this study. Heuristic evaluators (hereby referred to as expert reviewers) followed Nielsen's 10 heuristics to guide their assessment of the interface. In user testing, users were given a list of tasks and their progress navigating through the knowledge resources was recorded. They were also asked to voice their thoughts or "think aloud" as they performed these tasks.

HEURISTIC EVALUATION

SELECTION OF SUBJECTS

Two expert reviewers examined and evaluated the interfaces.

- Andrea Drury, M.S. in Library Science, works as a consulting website architect to various organizations; she will be referred to as the web architect.
- Dr. Tom Stibolt, B.S. in Electrical Engineering, MD, Board Certified Internist and Pulmonologist on staff at KPNW, is actively involved with a number of Internet technology projects at Kaiser, including the design and development of clinical guideline web information; he will be referred to as the physician-engineer.

Each expert was given a list and description of Nielsen's 10 heuristics to perform the evaluation. The responsibility of the experts was to generate a list of usability problems found with the interfaces, and categorize them according to the 10 heuristics.

SELECTED CRITERIA FOR EVALUATION

The criteria (Table 2) for the expert reviews was taken from Nielsen.(26). Based on a factor analysis of 249 usability problems(27), these 10 criteria are derived from a refinement of previous heuristics determined by Nielsen(28) and Molich,(29) which Nielsen later revised for maximum explanatory power.(26).

1. Visibility of system status	The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. Match between system and the real world	The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. User control and freedom	Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. Consistency and standards	Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5. Error prevention	Even better than good error messages is a careful design which prevents a problem from occurring in the first place.
6. Recognition rather than recall	Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7. Flexibility and efficiency of use	Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8. Aesthetic and minimalist design	Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9. Help users recognize, diagnose, and recover from errors	Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10. Help and documentation	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Table 2. Nielsen's 10 Heuristics

Data Collection

The web architect provided a written report of her evaluation, conducted independently of the investigator for this study. The physician-engineer's session was videotaped, reviewed and reported by the investigator.

User Testing

Selection of Subjects

Physicians were randomly selected from a list of clinicians at KPNW. Physicians based at a location requiring more than 45 minutes of travel time one way were excluded, as were physicians who participated on the KPNW Clinical Information System committee. The physician list was randomized using JMP-IN Version 3.4.1, random number assignment function and then reordered sequentially. The physicians were then called by phone and invited to participate in this study. 30 minutes of their time was requested. 18 participants agreed to participate from 160 who were contacted. Although the physicians were given the option to be scheduled out of clinic and to participate on company time, all physicians chose to take the test either before clinic time, during lunch, or during a break between patients. Appointments were made with each participant at their clinical office.

Selection of Tasks

The clinical librarian was the web designer for the KPNW clinical library, and will be referred to as the librarian/designer. Her goals in designing the clinical library website were the basis for scenarios and task selection. For example, one scenario focused on "Physician Availability", a function physicians use to locate other clinicians, find who is on call for a certain specialty and clinic location, etc. Another task looked at consumer resources because it was felt that physicians should be able to refer their patients to

Internet resources available to them. Each task had a specific goal, whether it was the ability to navigate through the interface, to locate a colleague, specialist or object, to determine whether organization was appropriate, or if the resources provided met physicans' needs. The tasks and scenarios were devised by the investigator and reviewed during pilot testing with the librarian/designer. Tasks for the project may be found in Appendix E.

DATA COLLECTION

Each physician was sent a survey form before their test, to assess their computer background. This survey is found in Appendix F. During the actual testing session, users were informed that the test was a test of the interface and not of their performance. Users were given 135 seconds to read and complete the task. Besides note taking and real time recording with a stopwatch, a Sony CCD/TRV65 videocamera with Hi8 cassette tapes was set up to record the computer screen and voice. Following the test session, an evaluation survey was given to the user to assess the two versions of the web page and gather information on their satisfaction levels (Appendix G). General comments gathered from the satisfaction survey are found in Appendix H.

RESULTS

HEURISTIC EVALUATION

The expert reviews as provided by the web architect and the physician-engineer are provided in Appendices A, B, C & D. Briefly, the experts found that the old interface was not informative enough, lacked in system status and user control, lacked consistency in delivery format, and provided poor flexibility and poor efficiency. Although the experts agreed the new interface had improved upon information organization, providing better system status, user control, consistency, flexibility and efficiency, there were still problems with broken links, terminology agreement between the system and the real world, and acronyms needing to be explained. Otherwise, the overall look and feel of the new interface was judged to be better than the old interface.

USER TESTING

Based on the computer background of users (Appendix F), the following demographic information was obtained. There was almost an equal proportion of male and female physicians used in the final count of users for this test (5 males and 6 females). The age of these users ranged from 29 to 56 years, the average age being 42 years. Subjects were asked in the surveys to evaluate themselves as computer users. Most rated themselves as neither sophisticated nor unsophisticated in computer skill level. (Figure 3)

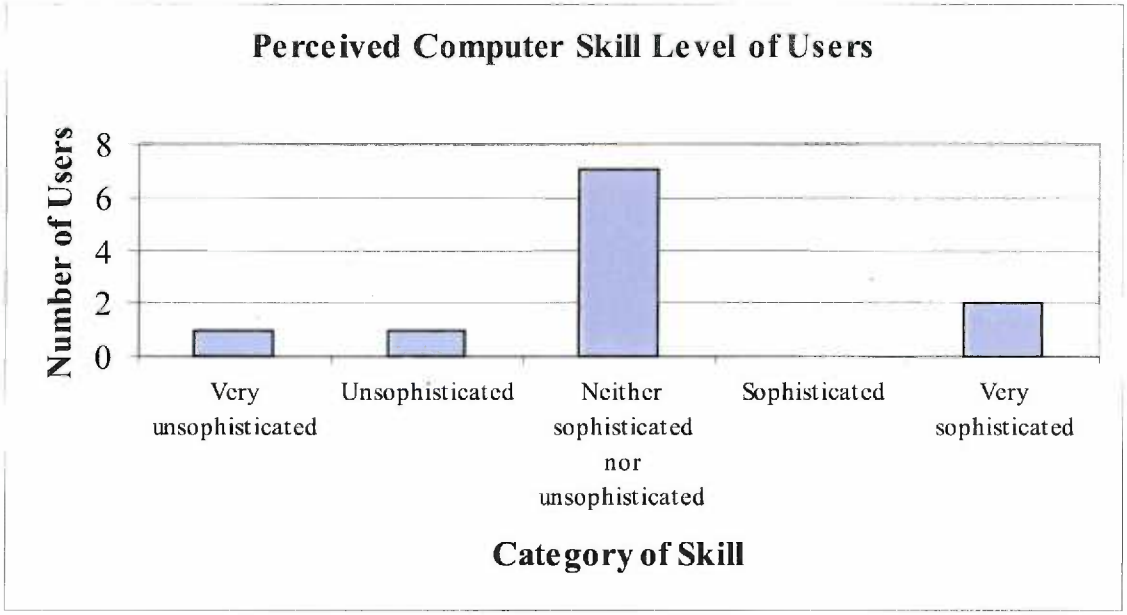

Figure 3. Perceived Computer Skill Level of Users

Users were asked to evaluate themselves within a certain category of computer skill level. The response indicates that most subjects felt they were neither sophisticated nor unsophisticated. Three other subjects classified themselves as very unsophisticated, unsophisticated and very sophisticated.

They were also given an objective test question of their web skill, based on a number of tasks with which they had experience. (Appendix F, Part IV) Most users were classified as novices. (Figure 4)

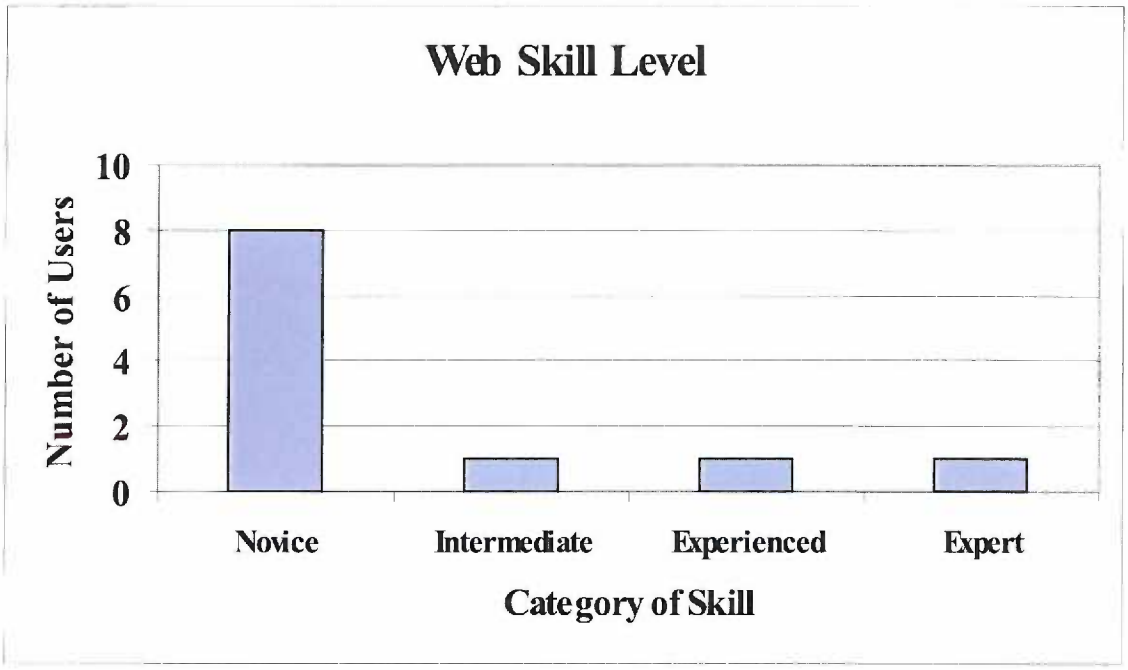

Figure 4. Objective Evaluation of Web Skill Level

Subject users were evaluated on their web skill with 12 questions. (Appendix F, Part IV). Based on the results, eight of the subjects were classified as novices, and the other three were categorized into intermediate, experienced and expert levels.

PERFORMANCE ON USABILITY TEST

Summaries of user performance from the usability tests are shown in Tables 3 and 4.

Tasks	Number of Users Successful in Both Versions	Old Interface		New Interface		Difference of Mean Time
		Mean Time (sec)	Range	Mean Time (sec)	Range	Time (sec)
1. Literature search	7	32	16-54	54	19-85	-22
2. Rheumatology resources	4	59	17-120	33	14-60	26
3. Search for colleague	9	40	18-120	33	7-130	7
4. Locate urologist	8	34	15-56	48	24-84	-14
5. Find drug interaction	7	69	13-135	50	8-89	19
6. Find info on CME	7	44	21-83	26	13-49	18
7. Find CPG	9	39	16-84	26	7-58	13
8. Find translator	1	73	73	30	30	43
9. Recommend online patient resources	3	30	17-45	23	10-36	7
10. Find available chairs	0	0	0	0	0	0
11. Latest healthcare news	3	12	6-17	23	16-30	-11
Average for all tasks	5	39		31		

Table 3. Time for Successful Completion of Tasks, Comparing Old & New Interface

The task column represents the various tasks given to the user during the test. Shaded values indicate the better performance between the two interfaces. The number of users successful in both versions represents those users who successfully completed the task in question, in both versions of the interface (old and new). Success is defined as finding an acceptable answer within the time limit of 135 seconds. The mean times for the old and new interface represent the average of all the times taken for the successful users, and the range of times represent the low and high times it took users to successfully complete the tasks. The difference of mean time indicates the difference between the average times of the old and new interface for each task. The average for all tasks summarizes the column values.

Table 3 describes the results from those users who successfully navigated through each task. Here, success is defined as the completion of a task within the time limit of 135 seconds. Completion is the state where the physician found a satisfactory answer that resolved the task. The table shows the mean time for a group of physicians to complete the task in each version, the range of time that the group took to complete the task in each

version, and the difference between the mean time to completion between the two versions. The shaded values depict the better performance. The negative values in the last column indicate that the old version had the better performance, and the positive values indicate that the new version had the better performance, for the respective tasks. Column values are summarized by the averages calculated in the last row. Although for some tasks mean times were better in the old interface, in general users took less time to complete tasks in the new interface (an average 31 seconds in the new interface versus an average 39 seconds in the old interface).

Tasks	Number of Users Completing Task	Old Interface Successes	Success Rate	New Interface Successes	Success Rate	Percentage Difference
1. Literature search	11	9	82%	8	73%	-9%
2. Rheumatology resources	10	4	40%	9	90%	50%
3. Search for colleague	11	9	82%	11	100%	18%
4. Locate urologist	9	8	89%	8	89%	0%
5. Find drug interaction	10	9	90%	7	70%	-20%
6. Find info on CME	11	9	82%	8	73%	-9%
7. Find CPG	11	9	82%	11	100%	18%
8. Find translator	9	2	22%	4	44%	22%
9. Recommend online patient resources	10	3	30%	10	100%	70%
10. Find available chairs	8	1	13%	1	13%	0%
11. Latest healthcare news	10	3	30%	9	90%	60%
Average for all tasks	10	6	58%	8	77%	

Table 4. Success Rates Comparing Old and New Interface

This table depicts the success rate of users for each task and interface. The number of users completing task indicates the total number of users evaluated for each task. Old interface successes and new interface successes indicate the number of users who successfully completed the task for the respective interface. Success rate represents the proportion of successful users over the total number of users who attempted the task. Shaded values indicate the higher success rate for the task. Average for all tasks summarizes the column values. Percentage difference represents the difference between the old and new interface success rates. Negative values indicate that the old interface had a higher success rate. Positive values indicate that the new interface had a higher success rate.

Table 4 describes the success rate for users who completed each task for each interface. Completion is defined as finding an appropriate answer to the task and success is defined as completing the task within the time limit of 135 seconds. Shaded values depict the better success rate between the two versions. The negative values in the last column indicate that the old version had a higher success rate among users, while the positive values indicate that the new version had the higher success rate, for each task. The column values are summarized in the last row with an average value. Overall, performance with the new interface was better. For some tasks, performance with the old interface was better but in general, users were more often successful at completing tasks within the time limit using the new interface (an average 77% success rate with the new interface versus an average 58% success rate with the old interface). Based on comments from the satisfaction survey, users also felt that the new version of the interface had improved in layout and was easier to navigate. (Appendix G)

DISCUSSION

There is strong evidence based on this study, that overall, the new version of the interface is an improved and more usable version. However, the study also showed that the new interface could be improved.

HEURISTIC EVALUATION IN REVIEW

The expert reviewers identified flaws in web design that user testing would not necessarily recognize. For example, whether or not the user could identify his location on the website or relative to the initial homepage, and layout of the web pages at the same level was an issue that heuristics assessed. A user would not necessarily look for these features but it is extremely relevant in the user's navigational abilities.

The experts did not dispute findings with the old interface:

a. It was not informative enough;
b. It did not provide enough cues in matching with the real world;
c. It lacked user control and consistency;
d. It provided little flexibility and poor efficiency of use;
e. It provided little in helping users to recover from errors;
f. Broken links and use of obtuse acronyms were used.

The two experts agreed on the good parts of the new version:

a. User control and freedom was good in the new version;
b. Layout was mostly consistent in new version;
c. New version was flexible and efficient to use;
d. Users were provided ways to recover from errors on the most part;
e. Help resources were available.

The experts agreed on the bad parts of the new version:

a. Broken links had to be corrected;

b. The system and the real world need to agree on terminology and organization appropriate to the population of physicians;
c. Consistency must be maintained;
d. Acronyms need to be spelled out or referenced.

The two expert reviewers were in general agreement for both interface versions but did provide some unique findings. The physician-engineer was more critical of organization and technical issues; for example, he detected the error in not including orthopedics as a surgery, and identified issues related to updated and new information affecting links. The web architect provided a more architectural design viewpoint, identifying discrepancies between link labels and destination title pages, and noting how standard fonts and colors were implemented to avoid web browser difficulties.

The decision of whether or not two experts were sufficient in meeting the needs for evaluation might be questioned. Nielsen and Landauer (23) derived a mathematical model for expected cost/benefits based on a number of evaluators, as depicted in Figure 5. The curve represents the average of six case studies using heuristic evaluation. As depicted in the graph, this evaluation used only two experts and it was expected that they would detect approximately 50 percent of the problems. (23)

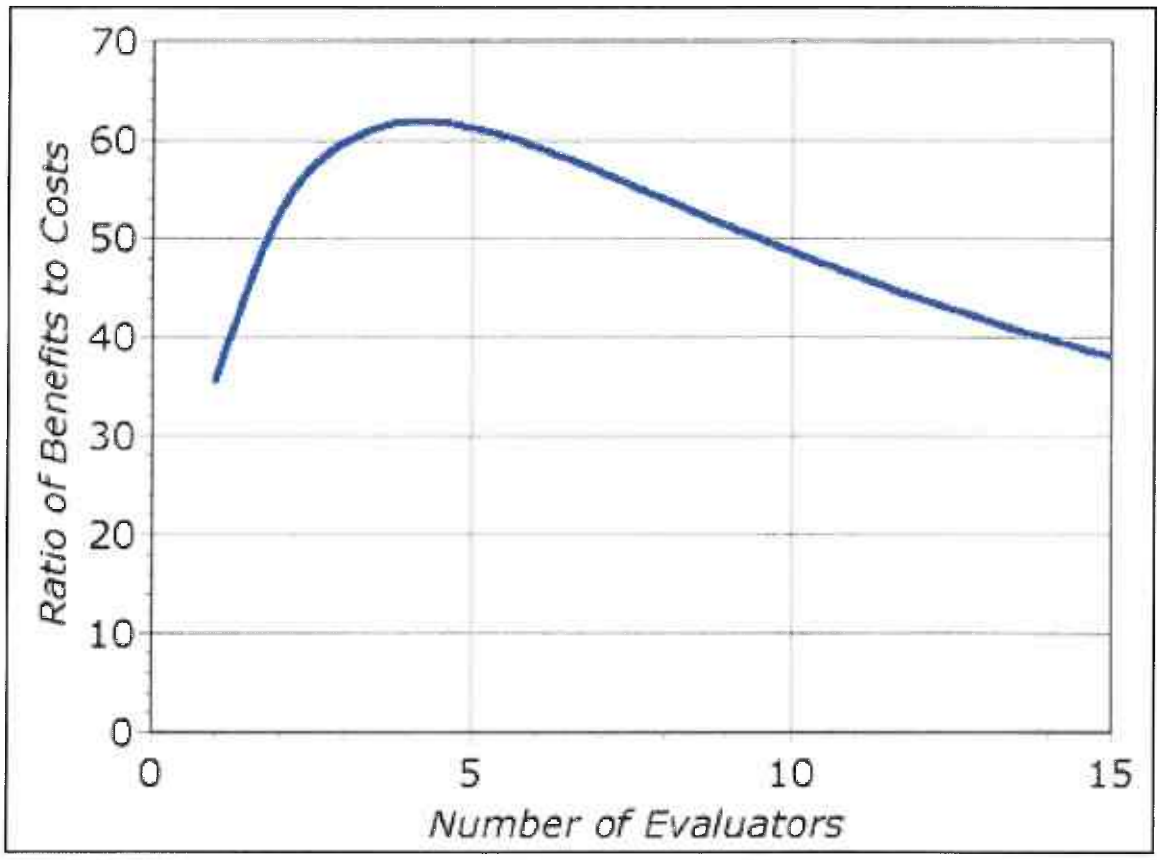

Figure 5. Cost/Benefit Analysis of Discount Usability Engineering

The cost/benefit of discount usability engineering based on a number of evaluators. (23) Here, three to five evaluators generate benefits 62 times greater than the costs.

USER TESTING IN REVIEW

Performance in user testing provided a different perspective into the usability of the interfaces. During the test, it was discovered that users were not aware that a button was a link to more resources, or that colored text, e.g. "etc" were links to more extensive information. Information such as "Interpretative Services" and "Ergonomics Checklist" was not felt to be important and could be moved from the top to a deeper level. Acronyms used in the interface were not clear to physicians and was an indication that they needed to be explained or spelled out. Results depicted in Tables 2 and 3 show that overall performance was improved in the new version. In general, time to complete tasks was lower in the new version, more tasks were completed in the new version, and comments from users (Appendix G) were more positive towards the new version. The effectiveness of user testing was exemplified when features (buttons, textual links, screen layout, etc.) were found to be problematic for the users.

Although the study had initially recruited 18 volunteers for the study, due to difficulties with the video camera not taping, some recordings providing a fuzzy picture, incomplete taping sessions as a result of lack of time, and a few dropouts, the total number of users included in this study dropped to 11. This exceeds the recommended number of three to five users, shown by Nielsen and Landauer (30) to provide maximal cost/benefit of testing. (Figure 6) Deluxe user testing employs a larger number of users at no greater benefit and at greater cost. (Note that in Figure 6, the number of users are the same but it is the cost

is the cost benefit ratio that changes with deluxe and discount user testing. In both cases, the benefits achieved are highest when three to five users are tested).

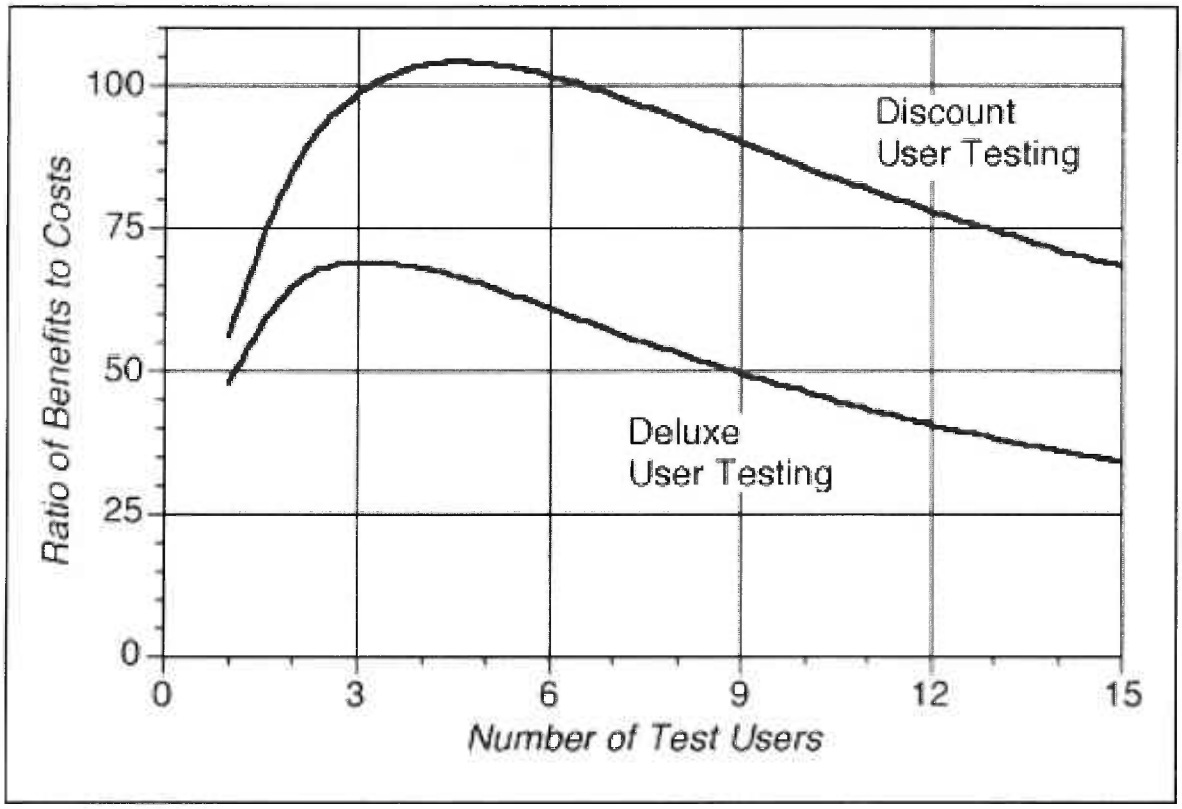

Figure 6. Discount User Testing vs. Deluxe User Testing

Nielsen and Landauer.(23) The curve depicts the ratio between the benefits of user testing and the cost for medium sized development projects. The curves show that the benefits are greater than costs, no matter how many subjects are used. 3-5 subjects achieve the maximum cost/benefit ratio.

ADDITIONAL FINDINGS

This study produced some other interesting information. Some physicians, once their time was committed to usability testing, were eager to display their method and tools for searching for information on the Internet. Despite the fact that the physician was required to complete a task within a specified timeframe, a few interrupted the task session by diverting to what they believed was a better method for completing the task but did not

involve the interface in use. The "noise" from the extra time taken for these interruptions was eliminated in the time recordings. In these cases, the physician was redirected to focus on the task at hand, and not to use other methods of searching not provided by the interface.

A few users were not content in just finding an acceptable answer to the task. Instead, they continued to search through the resources to determine if there was yet a better information resource for the task, or to verify that their first answer was the best one available. This additional time from continued searching when an acceptable answer had been found complicated time recordings. In these cases, the longer search time was used in the analysis because the physician had not been satisfied with the initial response. This exemplifies the need to validate information resources. Physicians need to know that their resources are valid and up-to-date, especially when the care of patients is at stake.

Figure 5 suggests that most problems can be identified with the first five users. In this study, beyond five users, it was easy to predict what difficulties the users would encounter.

The new version was clearly easier to navigate than the old. To correct for any biases, the test alternated between giving the old and new interface first to users. In both cases, the new interface proved to be more usable, both in overall time completion of tasks and success rate.

The number of views a user was determined not to be relevant to task success after studying the taped sessions. Many of the users would click on the screen searching for an answer to the task but when they were stumped, it was more of a reaction while they were voicing their thoughts on what to do next. Too often, especially in the old interface, users were just viewing screens back and forth because they could not find an answer to their task.

Attitude towards the task - whether or not the user felt there was an answer worth searching, seemed to affect task success rate more than the time taken for task completion. Some physicians refused to work on a task either because they felt it had no relevance in their work practice, or they had absolutely no idea on how to begin to search for the answer. Other physicians refused to quit searching even after having found an acceptable answer because there was still time to look for a possible better answer.

Users who were more comfortable or facile with the Internet may have suffered "tunnel vision" due to what they were used to using. These users had developed their own method of accessing information and often, bypassed KPNW resources by having organized their own web page. This contributed to a longer time in their task performance because they often tried to use their own method first, rather than looking for what was available through the interface.

Some users voiced skepticism in performing some of the tasks. A specialist in oncology found that the KPNW resources were not specialized enough to provide any valuable

resource to his practice. As a result, he approached many of the tasks as something he would not normally perform. In the end, he did look at some resources that were organized under oncology and found them to be better than what was previously provided or expected.

CHANGES BASED ON USABILITY FINDINGS

After completing this study, preliminary results were given to the librarian/designer. Problems such as too much information and misinterpreting graphical cues (buttons were not recognized as graphical links) were consistently encountered by most users during the test. As a result, modifications focused on creating a more usable interface: button links were changed to textual links, the volume of information provided on the first page was reduced, and "Information Technologies, Clinical" and "Internet Guides to Medical Info" categories were added. Resources were also slightly reorganized. (e.g. Micromedex, being a pharmaceutical reference, belongs under "Handbooks, Manuals and Forms" because it provides similar information to other paper-based manauls, under "Database" because on the computer it is organized in a database, and under "Drug Information" because it provides drug information.). DUE dictates iterative testing and although this was not possible due to time constraints, it was felt that users would benefit from the changes implemented. (Appendix I shows what the revised KPNW Clinical Library looked like at its release).

Certain tasks used in the test also showed what was useful (task questions #1, 3, 5, 6, 7, 9), useless (task questions # 4, 8, 10), or needed improvement (task question #2) in the

new interface. For example, "Physician Availability" as discussed in Task Selection, is often accessed and was reflected in the ease with which physicians completed this task. Other tasks showed that some unimportant information was inappropriately provided at the top level. One task required physicians to find an ergonomic chair, and another to find an interpreter. In both cases, most physicians failed in the task, gave up, or stated that they would have their nurse find the resource. It was evident from their reaction that this task was not of high priority and not one in which they would dedicate much time.

Work in Progress

More extensive potential modifications to the site include providing a site-wide search engine and creating a Continued Medical Education (CME) course to educate physicians. Several physicians commented that a search engine for the entire site would greatly increase the efficiency of the interface. The CME would target efficient use of the clinical library as many of the users lacked awareness of the richness of the available resources provided by KPNW.

Future Work

Finding out what the physicians want and use would be helpful in developing a knowledge resource. Among those physicians who do make use of Internet resources, it would be informative to assess what resources were actually being accessed and why.

Highlights of Discount Usability Engineering

The effectiveness of DUE in the development of the new interface was evidenced through the following:

- Expert reviews and usability testing proved to be a useful and relatively inexpensive way of improving the first iteration of the web interface design before it was implemented;

- Users actively engaged in carrying out the tasks they were assigned. They were able to navigate through the new interface with little difficulty. The easy navigation indicated that the interface was easy to understand and follow;

- It provided the opportunity for feedback from the users about their information needs and practices;

- DUE provided other perspectives from both users and experts.

DUE is based on the premise of efficiency and effectiveness. In the study, both the expert reviews and user testing took place over a period of three weeks. Preliminary results were provided to the librarian/designer in the fourth week to allow for design modifications before the clinical library release. The process permitted quick analysis, highlighting problems that could be corrected to meet a pressured work environment where results are crucial. The expert reviews and user testing worked well together because they introduced different perspectives and identified strengths and weaknesses of the interfaces.

Nielsen states that in using DUE, a first time test of a website could take 39 hours, which includes planning the test, defining test tasks, recruiting test users, conducting a test with five users, analyzing the results, and writing the report.(31) He also added that with experience, web user tests could be completed within two days. Before this, it had been generally perceived that usability testing was costly. Bellotti (32), Mantei(33), and Nielsen(34) have recounted how many developers do not use usability engineering because HCI methods are considered too time consuming and expensive, and because the techniques seem intimidating in their complexity. This paper confirms that DUE can be

applied efficiently and effectively to study and improve the usability of a site for medical information access in a cost/effective manner.

The heuristic evaluation done in this study involved recruiting two experts, getting their evaluation of the interfaces and analyzing their reports. This took about 24 hours. The heuristic evaluation may be more expensive because one is paying for expert time. However, the findings identified significant gaps and inconsistencies that should be addressed to make the final product more usable.

User testing required planning the test, defining the tasks, studying the interface and looking at functionality (8 hours); and recruitment (8 hours). Each user test required approximately 30 minutes. Analysis of each user's taped session required about two hours. There were 11 questions and 11 users who had usable data. Therefore, task creation, testing and individual analysis took a total of about 43.5 hours. It took approximately another 24-48 hours to review the data, and analyze the results for possible conclusions. In total, one could say the whole process for this study took 80 hours in total.

If this study were repeated a second time, perhaps only one expert would be used for the heuristic evaluation and three to five users would be recruited for the user testing. This would require only three to four days to conduct a usability test, agreeing with Nielsen's estimation.

CONCLUSION

It is somewhat thought provoking that a test with so few participants could generate compelling evidence for change. Yet two expert reviews provided insights into how layout, colors, inconsistencies and organization affect the user interface. User testing identified poor link design, irrelevant information and needed resources. The benefit from testing during development is obvious:

1. Usability of two interfaces was compared. We found that layout and design had a significant impact on improving usability.
2. Problems and potential enhancements were identified. We found that although the new interface had increased usability compared to the old, there was still much room for improvement.
3. The value of discount usability engineering in website development and evaluation was examined. We found that with DUE, we were able to achieve substantial and meaningful improvements in a short time and at reasonable expense.

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APPENDIX A

HEURISTIC EVALUATION REPORT
FOR THE
KPNW CLINICAL LIBRARY INTRANET WEB INTERFACE

(NEW INTERFACE)

ANDREA DRURY
(WEB ARCHITECT)

Heuristic Evaluation Report
for the
KPNW Clinical Library Intranet Web Interface

Evaluator: Andrea Drury, MLS, Web Site Architect

Introduction

In this heuristic evaluation, the KPNW Clinical Library intranet web interface was examined and judged as to its compliance with the ten usability principles developed by Jakob Nielsen[1] and further described in Keith Instone's article, "Usability Heuristics for the Web."[2]:

1. **Visibility of system status**
2. **Match between system and the real world**
3. **User control and freedom**
4. **Consistency and standards**
5. **Error prevention**
6. **Recognition rather than recall**
7. **Flexibility and efficiency of use**
8. **Aesthetic and minimalist design**
9. **Help users recognize, diagnose, and recover from errors**
10. **Help and documentation**

Level-one and all level-two homepages were examined. A single level-three page, *Resources by Specialty*, also was examined.

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[1] Nielsen, Jakob, "Ten Usability Heuristics."
<http://www.useit.com/papers/heuristic/heuristic_list.html>
[2] Instone, Keith. "Usability Heuristics for the Web." 1997.
<http://webreview.com/97/10/10/usability/sidebar.html>

1. Visibility of system status

This principle deals with how well the interface answers the questions *"Where am I?"* and *"Where can I go next?"*

This web interface clearly shows the user where he is and where he can go next. Effective use of color, the presence of common page headers and footers, and text links rather than graphic buttons make the interface very approachable and the site easy to navigate.

Where am I?

Each page is "branded" with a common header and a common footer, so the user always knows where he is in the site.

A different soft pastel color characterizes each section.

Where can I go next?

All section headings on the level-one homepage are visible without scrolling. This makes it easy to scan and select a level-two topic quickly.

Each section heading is followed by a list of linked topics that allow the user to click straight to level three in the hierarchy if desired. Key content topics are in bold to draw the user's attention.

Text links are easy to spot. This user appreciates that no graphic "buttons" are used as links.

The header of each page gives the user a way to return to the main homepage, suggest a site, or get help.

The footer on each page includes links to the KPNW Clinical Library / KPNW Intranet / PKC and instructions to contact the Clinical Information Systems Librarian for content issues and the webmaster for technical issues.

A pull-down menu in the upper right corner of the examined pages allows the user to select and Go! to another homepage or topic at the same level without returning to the main homepage.

Note: On the Consumer Health Information homepage an entry appears outside the table for no apparent reason: "Factsheets for Evaluating Patient Educational Materials."

2. Match between system and the real world

This principle deals with how well the interface uses the intended audience's language and matches their sense of organization.

Language:

The words, phrases, and concepts used in this interface would seem to be familiar to its users. An exception might be the acronym "PKC" (Permanente Knowledge Connection). PKC isn't defined until the user follows the link.

Organization of information:

The main homepage presents an alphabetized list of section headings in a two-column table. The wording used for the section headings indicates the site's content has been organized in a natural and logical way. Some headings reflect the format of the information in the section (e.g., *Directories*); some headings reflect the content (e.g., *Drug Information*).

Level-two homepages generally group the links on the page by internal (links that go to Kaiser Permanente resources) or external (links that go to external web resources). Exceptions are found on these pages: *Databases, Journals & Research* and *Directories*. A sub-heading on these pages, *"WWW Guides to Medical Information,"* leads the user to expect links to external web resources to be listed there, when actually some such links are included under the other sub-headings on the page.

3. User control and freedom

This principle deals with how well the interface accommodates user control of page appearance and navigation, and how easy it is to get out of problem situations.

Page appearance and navigation:

The web interface is built using text in standard fonts and colors, which the browser displays with no problems. Pages have been designed to fit the screen size of KP monitors without excessive scrolling.

The simple text links are always visible and never "broken" button images.

Getting out of problem situations:

The browser's back button allows the user to leave a page he has entered by mistake.

Also, a link on all examined pages takes the user back to the *KPNW Clinical Library* homepage.

The "Feedback/Help" link on all examined pages lets users give feedback or request help by filling out a form, or by speed-dialing right away to the Clinical Information Systems Librarian.

4. Consistency and standards

This principle deals with whether the interface is consistent in its use of headings, link labels and titles, structure, etc.

Headings:

Headings and subheadings are easy to read and consistent from page-to-page.

The section headings found in the pull-down menus on level-two homepages match those presented on the level-one homepage. The topics in the pull-down menus within the *Resources by Specialty* section match those on the corresponding level-three portal page, too.

Link labels and titles:

Quite a few link labels don't match the titles of destination pages, leaving the user confused as to whether he or she is in the right place after the "click." Some examples, taken from the *Clinical Practice Guidelines* homepage, illustrate this potential problem:

Link Label	Destination Page Title
Titles A-Z	All Guidelines
Search	Basic Search
Immunization Standards	Clinical Guidelines and Resources Immunization Standards

Structure:

The level-one homepage and most of the level-two homepages are laid out as a two-column table. Headings on the level-two homepages appear at the top of each column on color-coordinated backgrounds. Four sections[3] do not follow this format and the inconsistency could cause some disorientation and confusion as the user tries to understand why the format is different. This evaluator recommends implementing the two-column table format and color coding in all level-two sections.

5. Error prevention

This principle deals with how well the interface has been designed to prevent problems from occurring in the first place.

This interface has been designed to avoid errors. It's a straight forward, text-based interface to an informational web site.

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[3] Clinical Practice Guidelines; Drug Information; Handbooks, Manuals & Forms; Resources by Specialty

As there are automated tools available to verify links, this evaluator only spot-checked the external and internal links. (There are several broken internal links on the *Consumer Health Information* homepage.)

6. Recognition rather than recall

This principle is closely related to Principle 1, Visibility of system status. It deals with how the interface cues the user as to where he is in the site and how to use features of the site.

The interface does an excellent job of keeping users from feeling lost in the site.

- Page headers and footers are consistent.
- Page layouts are similar and color is used effectively.
- Pages have good labels and descriptive links.

Pull-down menus are an efficient navigation tool and are easy to identify and use.

7. Flexibility and efficiency of use

This principle deals with whether the interface allows users, as they become more experienced, to tailor frequent actions. Some of the best accelerators are provided by the browser; for example, bookmarks.

Pages at level-one and level-two are all easily bookmarked, which allows the user to return to a particular page within the site rather than always having to start at the main homepage.

- The interface doesn't use frames, which can interfere with bookmarking.
- Page URLs all appear to be permanent, which supports bookmarking.

8. Aesthetic and minimalist design

This principle deals with how well the interface has minimized "information noise."

This interface was created with the principles of aesthetic and minimalist design in mind.

- Information is broken into chunks and linked appropriately.
- Extraneous text is rare. (A few paragraphs could benefit from proofreading and minor editing.)
- The interface uses no "gratuitous graphics."
- Color adds interest and continuity, and is pleasing to the eye.

The interface makes good use of progressive levels of detail on all the examined pages. Users drill down to get from general topics of information to more detailed information. At the same time, as noted under Principle 1, the interface provides a way to go "up" to get the bigger picture, in case users jump into the middle of the site.

9. Help users recognize, diagnose, and recover from errors

This principle is about how well the interface handles error messages: are they expressed in plain language (no codes), do they clearly indicate the problem, and do they suggest an appropriate solution.

This interface provides a very efficient way for users to find the information they seek and does not tend to generate error situations.

A few exceptions to be noted:

- As pointed out in Principle 4, link labels don't always match the titles of destination pages.
- Several broken internal links give a system error message:

  "Not found. The requested object does not exist on this server. The link you followed is either outdated, inaccurate, or the server has been instructed not to let you have it."

  The standard system message has been rewritten to exclude its code number, but the words "object" and "server" still aren't plain language to most people.

  A bigger problem is that the error message does not say what to do next. Clicking the browser's back button just causes the error message to reappear. The user is on his own to check the browser's GO menu or to reconnect using a bookmark.

10. Help and documentation

This principle is about how well the interface provides help and documentation when necessary.

The interface is very easy to use without documentation. Nevertheless, a link to help appears at the top of every page and contact information is at the bottom of every page.

APPENDIX B

HEURISTIC EVALUATION REPORT
FOR THE
KPNW MEDICAL/DENTAL RESOURCES INTRANET WEB INTERFACE

(OLD INTERFACE)

ANDREA DRURY
(WEB ARCHITECT)

Heuristic Evaluation Report
for the
KPNW Medical/Dental Resources Intranet Web Interface

Evaluator: Andrea Drury, MLS, Web Site Architect

Introduction

In this heuristic evaluation, the *Medical/Dental Resources* intranet web interface was examined and judged as to its compliance with the ten usability principles developed by Jakob Nielsen[4] and further described in Keith Instone's article, "Usability Heuristics for the Web."[5]

11. **Visibility of system status**
12. **Match between system and the real world**
13. **User control and freedom**
14. **Consistency and standards**
15. **Error prevention**
16. **Recognition rather than recall**
17. **Flexibility and efficiency of use**
18. **Aesthetic and minimalist design**
19. **Help users recognize, diagnose, and recover from errors**
20. **Help and documentation**

Level-one, the page labeled *Medical/Dental Resources,* and the following level-two pages were examined:

- Ambulatory Care Policies and Procedures
- Appointment Making Protocols
- Guidelines
- KSMC Health Sciences Library
- RAN

[4] Nielsen, Jakob, "Ten Usability Heuristics." <http://www.useit.com/papers/heuristic/heuristic_list.html>
[5] Instone, Keith. "Usability Heuristics for the Web." 1997. <http://webreview.com/97/10/10/usability/sidebar.html>

1. Visibility of system status

This principle deals with how well the interface answers the questions *"Where am I?"* and *"Where can I go next?"*

The interface does a poor job of indicating where the user is in the site and only a fair job of indicating where the user can go next.

Where am I?

Level-one page: A graphic navigation bar appears at the left of the page. The *Medical/Dental Resources* entry on this navigation bar is a different color from the other entries, so the user can see where he is with respect to other topics at that level.

Level-two pages: The examined pages provide no context to tell the user where he is within the site. There is no continuity from one page to another--each page has a different look.

Where can I go next?

The level-one *Medical/Dental Resources* page presents a pseudo-alphabetized list of 31 linked topics. These topics make up the level-two choices in the interface.

The navigation bar topics are repeated as text links at the bottom of the *Medical/Dental Resources* page and at the bottom of three examined level-two pages. However, these topics are all peers to the level-one *Medical/Dental Resources* page. There's no ability to go horizontally within level two. The user must return to level one in order to see other level two choices.

2. Match between system and the real world

This principle deals with how well the interface uses the intended audience's language and matches their sense of organization.

Language:

The words, phrases, and concepts used in this interface would seem to be familiar to its users.

Organization of information:

There appears to be no master plan--no subdivisions or logical groupings--just a hodge-podge of more-or-less alphabetized topics.

Many of the topics are repeated in other lists at the same level, e.g., under *Policies & Procedures* and *Administrative Resources*.

3. User control and freedom

This principle deals with how well the interface accommodates user control of page appearance and navigation, and how easy it is to get out of problem situations by backing up.

Page appearance and navigation:

The examined pages bear no resemblance to one another. It's obvious that no attempt has been made to give the interface a common look and feel. Different colors, graphics, and fonts are used from page to page.

The Kaiser Permanente logo sits in the upper right corner of each examined page, but with no link. This is likely to frustrate those users who are accustomed to clicking on a logo to go to the home page.

A navigation bar appears only on the level-one page, and only three of the five examined level-two pages repeat the navigation links found at the bottom of the level-one page.

Emergency exits:

The browser's back button allows the user to leave a page he has entered by mistake.

There is no way to get back to the home page without relying on the browser's "back" button or clicking on one of the text links at the bottom of the page. And then users must remember that they are in the *Medical/Dental Resources* section in order to return to that home page.

4. Consistency and standards

This principle deals with whether the interface is consistent in its use of headings, link labels and titles, structure, etc.

Headings:

The interface has made little or no attempt to use section headings. Most of the examined pages are just lists of topics.

Link labels and titles:

Quite a few link labels don't match the titles of destination pages, leaving the user confused as to whether he or she is in the right place after the "click." For example:

Link Label	Destination Page Title
Appointment Making Protocols (Medical)	Medical Appointment Protocols
Availability (Clinician)	Availability: Main
Personal Computing News	Personal Computing Services News
RAN	Regional Advice Page

Structure:

Each examined page has a different look. There is no sense of structure to the interface.

5. Error prevention

This principle deals with how well the interface has been designed to prevent problems from occurring in the first place.

The interface for this site hasn't been designed.

If a user were looking for a subtopic it would be difficult to know which of the 31 headings is the one to start with. This introduces the likelihood of a user making the wrong choice and taking the wrong path.

The pages are largely text, which does display properly. This evaluator saw no broken images.

6. Recognition rather than recall

This principle is closely related to Principle 1, Visibility of system status. It deals with how the interface cues the user as to where he is in the site and how to use features of the site.

The interface offers no cues to tell the user where he is in the site. This interface forces the user to remember how he got to where he is, and which section or subsection of the site he is in.

7. Flexibility and efficiency of use

This principle deals with whether the interface allows users, as they become more experienced, to tailor frequent actions. Some of the best accelerators are provided by the browser; for example, bookmarks.

Pages at level-one and level-two are all easily bookmarked, which allows the user to return to a particular page within the site rather than always having to start at the main homepage.

- Examined pages don't use frames, which can interfere with bookmarking.
- Page URLs all appear to be permanent, which supports bookmarking.

8. Aesthetic and minimalist design

This principle deals with how well the interface has minimized "information noise."

Although one could say that this interface is minimalist in its design, there is also lots of "noise." Because each page is different the user has to re-think the situation at each step of the way. There is no explanatory text and no consistency in design from one page of the interface to another.

9. Help users recognize, diagnose, and recover from errors

This principle is about how well the interface handles error messages: are they expressed in plain language (no codes), do they clearly indicate the problem, and do they suggest an appropriate solution.

This error message occurs five times when linking to topics listed on *the Ambulatory Care Policies and Procedures* page:

> **"404 Not found. The Web server cannot find the file or script you asked for. Please check the URL to ensure that the path is correct. Please contact the server's administrator if this problem persists."**

This is the standard system message, which uses a code number and language that is quite technical for most people. Although the error message says what to do next, these instructions are next to useless for the typical user.

10. Help and documentation

This principle is about how well the interface provides help and documentation when necessary.

There is no help or documentation provided. Some pages provide an email link to the webmaster.

APPENDIX C

HEURISTIC EVALUATION REPORT
FOR THE
CLINICAL LIBRARY INTRANET WEB INTERFACE

(NEW INTERFACE)

DR. T. STIBOLT
(PHYSICIAN/ENGINEER)

Heuristic Evaluation
for the
KPNW Clinical Library Intranet Web Interface

by Dr. T. Stibolt

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1. **Visibility of system status**
   - Page informs user where they are, scroll bar is present that signifies more information available.
   - Headings clearly marked.
   - Feedback help is not specific help information - might be good to add.
   - Color is good for system status.

2. **Match between system and the real world**
   - System in real world - most of this works well, the groups are soft (not limited to one category), micromedix belongs under handbooks, manual and forms but could also fall under maybe under database,journals and research.
   - Kaiser external is highlighted with color (indicating difference between internal and external)
   - Match between system and real world…layout does seem appropriate, items are categorized under various areas.

3. **User control and freedom**
   - Free to move around.
   - User control and freedom - clearly marked exit and can always use back button.- Problem with autoforwarding and users get stuck… once link is fixed, not a problem but until then, users could get frustrated

4. **Consistency and standards**
   - Getting back to additional homepages is easy -
   - Likes consistency among levels and between levels
   - Kaiser resources may be highlighted to maintain consistency, not always followed after the first level.
   - Resources for specialty… ok…different format.
   - Handsbooks, manuals & forms - not consistent with other layouts…
   - Health & safety… kept with standard format.
   - Good information provided.
   - Color status and buttons are consistent between pages.
   - Consistency and standards seem to be appropriate… whether words seem to be what they mean can be ambiguous at times.

5. **Error prevention**
   - Make a mistake, mostly hit back button.
   - KP online - requires log-on… must be remembered & can make it difficult to get on.

- Error prevention is pretty straight forward.

6. **Recognition rather than recall**
   - Error prevention.... Basically everything is straightforward.
   - Information about navigation once beyond Kaiser site might prove to be helpful.

7. **Flexibility and efficiency of use**
   - Accelerators may not be obvious to novice users.
   - MD consult... can use directly and not have to go through PKC logon. This would not be evident to the user unless used previously.
   - Flexible until logons required.

8. **Aesthetic and minimalist design**
   - Cannot fit all information on page even after trying to resize font indicating a lot of information.
   - Organization is good... local is left, national stuff is the right hand side.
   - "etc" didn't seem to work too well during evaluation although does convey more information available.
   - Clinical practice guidelines is nicely laid out.
   - Immunology/allergy.... Extend link to end of line.
   - Cconsumer health information, databases, journals and research - Kaiser vs non Kaiser resources is not broken down.
   - Consistent with buttons and moving around groups at top - color indicates where user is at and supposedly won't get confused.
   - Goes back and forth on amount of text... journal section - locating databases - go to this section and it doesn't work... extra information.
   - Drug information - text colors not consistent.

9. **Help users recognize, diagnose, and recover from errors**
   - Back button does not work all the time. Autoforward is a dead end.
   - Emergency exit is pretty good since available on almost all pages.
   - All up-to-date urls should be used... ensure that this is so and not the older version (kp phonebook).
   - Own error messages not present on Kaiser server.... Error message given when hitting a non-existent site is ok for system users but for casual users... not good.

10. **Help and documentation**
    - Good.

General comments
- Rather than referring to another site, provide a link directly to that site.
- Must provide updatedness to resources and somehow indicate that.
- Etc. may not be useful as homepage button and not as obvious.
- Only recall is when pk online required - once you get there, you have to navigate to where you want to go. May be using cookies.

- Surgery… see neurosurgery… orthopedics is also surgery. Surgery may need pointer to more than just neurosurgery, must consider all.
- Third level… specialties are is color coded, pointers to different sections of guidelines,
- Know where we are… back to top and sub-menus
- Straightforward.. choose where you want to go and back almost always works.
- Guidelines have no way from page to pointer….
- Web resources look good… feedback suggest site is good .
- Server side had some problems thereby causing some sytem problems.
- Resource location… how does one know where they were?
- Guideslines get updated weekly…. This could cause some issues with links on clinical library page.
- PKC login is required - as has been discussed, been difficult to take people directly to wherever when a log-on required.
- Many sites other than Kaiser are provided.

APPENDIX D

HEURISTIC EVALUATION
FOR THE
MEDICAL/DENTAL RESOURCES PAGE

(OLD INTERFACE)

DR. T. STIBOLT
(PHYSICIAN/ENGINEER)

Heuristic Evaluation
of the
Medical/Dental Resources Page

by Dr. T. Stibolt

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1. **Visibility of system status**
   - Users told where there are, sidebar allows user to go to other resources.

2. **Match between system and the real world**
   - CIS might be unknown to most physicians.
   - CST unknown - leads to customer support technology?
   - Subcategories provided but ambiguous.
   - No organization - ad hoc list in alphabetical order but falls out of order in some places.
   - Confusing.
   - Links to other pages and webmaster comment good.

3. **User control and freedom**
   - No link to main page - problem.
   - Second levels show no consistency in providing resources.
   - Difficult to navigate because some internal resources do not link back to original site.

4. **Consistency and standards**
   - No consistency, no clarity with acronyms.
   - No apparent standards followed in format of delivery.
   - Not clear what medical and dental resources are provided.

5. **Error prevention**
   - Adequate.
   - Can get lost if link to another page because there may be no direction to main page.
   - No flexibility, linear design.

6. **Recognition rather than recall**
   - Not supported.

7. **Flexibility and efficiency of use**
   - Not supported.

8. **Aesthetic and minimalist design**
   - Very minimal to the point of being uninformative, not very aesthetic.

9. Help users recognize, diagnose, and recover from errors

- Poor.
- No help or guidance in recovery.
- Must have bookmarked site to get back.

10. Help and documentation

- Not available.

General comments

- Disorganized and or only partial organization.
- Many resources obviously missing.
- Not comprehensive.

APPENDIX E

TASKS (SCENARIOS)

Task	OLD INTERFACE
1. You have been given a grant by the National Library of Medicine to conduct research on the usefulness of computers in medicine. Please go to any resource where you would begin your literature search. (Do they go to the databases, journals and research homepage?)	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
Task	OLD INTERFACE
2. What resources are available to physicians specializing in Rheumatology? (Determine whether they can access resources by specialty)	Number of views Time
	Number of attempts
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments

Task	OLD INTERFACE
3. You need to speak with Dr. Michael Krall. Please find his location and phone number. (Tests their ability to locate a physician)	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments

Task	OLD INTERFACE
4. You have a patient that requests to see an urologist within the KP network. Please find one for your patient. (Tests the ability to find a specialist using the new interface and whether it is useful?) (If the physician is a urologist, make the scenario such that he is referring for a second opinion.)	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:

Task	OLD INTERFACE
5. You see a patient for the first time who is taking Coumadin (Warfarin) because he has an artificial heart valve. The patient is also taking 325mg of acetaminophen almost every day for stress headaches. Is there a problem with this? (Can they find their way to the pharmaceutical information?) (Tests whether grouping of information makes sense to the physicians).	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:
	NEW INTERFACE
.	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:

Task	OLD INTERFACE
6. You have realized that you need to take a CME course but you don't have time to travel. What options do you have? (Awareness of training and CME homepage)	Number of views
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
Task	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments

Task	OLD INTERFACE
7. You get a 24 year old female patient with complaints of dysuria, the urgency and frequency increasing over the past 3 days. Is there a clinical guideline to determine treatment?	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:

Task	OLD INTERFACE
8. You receive a referral letter telling you of a future patient who understands only japanese. What resources inform you of your options? (Tests whether Interpretive Services under Handbook, Manuals and Forms is logical)	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments

Task	OLD INTERFACE
9. You have a patient who is asking for background reading material related to their medical condition? What online resources can you recommend?	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments

Task	OLD INTERFACE
10. You have found that your chair is contributing to aching neck and shoulders... and you are aware that Kaiser will pay for furniture if it helps you feel more comfortable. Where can you look to find a chair or more information on chair options?	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations
	Clinician's comments

Task	OLD INTERFACE
11. **You have a break in your schedule and you are curious about the latest healthcare news… is this available online?**	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:
	NEW INTERFACE
	Number of views Time
	Number of attempts (starting from first page)
	Problem encountered: Catastrophic Major Cosmetic
	Additional observations:
	Clinician's comments:

APPENDIX F

COMPUTERS IN MEDICAL CARE SURVEY

Computers in Medical Care Survey

I. Demographics

a. Your age:_____

b. Your gender: ☐ Female ☐ Male

c. In which are of medicine do you currently specialize (check only one)?

☐ Cardiology	☐ Gen. internal medicine	☐ Ophthalmology	☐ Surgery, general
☐ Cardiothoracic surgery	☐ Infectious disease	☐ Orthopedics	☐ Urology
☐ Critical Care	☐ Nephrology	☐ Otolaryngology	☐ Vascular surgery
☐ Emergency medicine	☐ Neurology	☐ Pulmonary medicine	☐ Other _____
☐ Endocrinology	☐ Neurosurgery	☐ Radiology	
☐ Family Practice	☐ OB/GYN	☐ Radiation Oncology	
☐ Gastroenterology	☐ Oncology	☐ Rheumatology	

d. Over the course of an academic year, what percent time do you spend in the following activities?

Clinical care and clinical teaching	%
Didactic teaching	%
Research	%
Administration	%
Other Specify:_____ _____)	%
TOTAL	100%

II) Computer Experience

1) In a typical week, how many hours do you personally use a computer hands-on? _____

If you answered zero, go to question 3.

2) What kind(s) of computer(s) do you use? (Check all that apply)
- ☐ Macintosh
- ☐ IBM PC or compatible
- ☐ Terminal connected to a remote mainframe computer (e.g., hospital information system)
- ☐ High-performance scientific workstation
- ☐ Other (explain) _____

3) To what extent do you personally use a computer for each of the following professional tasks? Please circle your answer.

1. Never perform this task
2. Perform this task but never use a computer
3. Sometimes use a computer
4. Often use a computer
5. Always use a computer

Documenting patient information (e.g., history & physicals, progress notes	1	2	3	4	5
Accessing clinical data (e.g., laboratory data, EKGs, radiology reports)	1	2	3	4	5
Communicating with colleagues	1	2	3	4	5
Obtaining advice on a specific patient's diagnosis or therapy	1	2	3	4	5
Scheduling patient appointments	1	2	3	4	5
Writing (e.g., grants, research papers, teaching material)	1	2	3	4	5
Preparing presentation slides or overheads	1	2	3	4	5
Performing statistical analysis on clinical or research data	1	2	3	4	5
Searching the medical literature (e.g.,MEDLINE)	1	2	3	4	5
Teaching students and residents	1	2	3	4	5

4) What kind(s) of computer(s) do you routinely use? (Check all that apply)
- ☐ Desktop computer at your office
- ☐ Desktop computer at home
- ☐ Portable or notebook computer
- ☐ Other (please specify:_____)

5) What training or experience with computers have you had? (check all that apply)
- ☐ Formal course(s) in computer science or related field
- ☐ Formal medical school training in computers
- ☐ Formal residency or fellowship training in computers
- ☐ Workshops or conferences on computers for which I received CME credit
- ☐ Worshops or conferences on computers for which I did *not* receive CME credit
- ☐ Self-guided learning about computers
- ☐ None

6) On the whole, how sophisticated a computer user do you consider yourself?
- ☐ Very sophisticated
- ☐ Sophisticated
- ☐ Neither sophisticated nor unsophisticated
- ☐ Unsophisticated
- ☐ Very unsophisticated

III) Computer Experience

Below are a set of paired terms that relate to computers in medicine. Please score your knowledge of the distinction between the terms in each pair, using the following scale:

1. I don't understand the distinction at all.
2. I have a general appreciation of the distinction but couldn't define it.
3. I can define the distinction precisely.

Hardware ↔ Software	1	2	3
Images ↔ Graphics	1	2	3
Forward chaining ↔ Backward chaining	1	2	3
Free text ↔ Coded data	1	2	3
Field ↔ Record	1	2	3
Relational database ↔ Flat-file database	1	2	3
Data in memory ↔ Data on disk	1	2	3
Sensitivity ↔ Positive predictive value	1	2	3
ICD9-CM ↔ SNOMED	1	2	3
Entities ↔ Relationships	1	2	3
Floppy disk ↔ Hard disk	1	2	3
Full-text database ↔ Bibliographic database	1	2	3
Interpreter ↔ Compiler	1	2	3
Mainframe computer ↔ Personal computer	1	2	3
Electronic mail ↔ Electronic bulletin board	1	2	3
Client ↔ Server	1	2	3
Digital ↔ Analog	1	2	3
Database ↔ Knowledge base	1	2	3

IV) SKILL Test

Which of the following have you done?
Please check all that apply.

- ☐ ordered a product/service from a business, government or educational entity by filling out a form on the web
- ☐ made a purchase online for more than $100
- ☐ created a web page
- ☐ customized a web page for yourself (e.g. MyYahoo, CNN Custom News)
- ☐ changed your browser's "startup" or "home" page
- ☐ changed your "cookie" preferences
- ☐ participated in an online chat or discussion (not including email)
- ☐ listened to a radio broadcast online
- ☐ made a telephone call online
- ☐ used a nationwide online directory to find an address or telephone number
- ☐ taken a seminar or class about the Web or Internet
- ☐ bought a book to learn more about the Web or Internet

APPENDIX G

SATISFACTION SURVEY

Satisfaction Survey

Which of the following best describe you when you use Kaiser Permanente's web sites?

❑ Leisure (browser)
❑ Work (searching for information)
❑ Media (searching for news)
❑ Education (searching for information for patient)
❑ Do not use

How important to you are each of the following reasons for using the Kaiser Web sites?

	Unsure	Unimportant	Somewhat important	Important	Crucial
Get facts: news, data, addresses, schedules or other info.	❑	❑	❑	❑	❑
Get opinions: reviews, referrals, analyses, forecasts, explanations, recommendations or guidelines:	❑	❑	❑	❑	❑
Fix a problem: find help, get instructions, file complaint, or arrange repairs	❑	❑	❑	❑	❑
Conduct transactions: trade, place orders, reserve, subscribe, enroll, download	❑	❑	❑	❑	❑
Give an opinion: respond, comment, share ideas, speak out or discuss something	❑	❑	❑	❑	❑
Just exploring: curiosity, read or heard about something or saw something new	❑	❑	❑	❑	❑

How would you rate:

the current Medical/Dental Resources page

	Poor	Fair	Good	Excellent
Key content resources	❑	❑	❑	❑
Wide range of content	❑	❑	❑	❑
Fun	❑	❑	❑	❑
Navigation	❑	❑	❑	❑
Speed	❑	❑	❑	❑
Look and feel	❑	❑	❑	❑
Community	❑	❑	❑	❑

vs.

the future KPNW Clinical Library

	Poor	Fair	Good	Excellent
Key content resources	❑	❑	❑	❑
Wide range of content	❑	❑	❑	❑
Fun	❑	❑	❑	❑
Navigation	❑	❑	❑	❑
Speed	❑	❑	❑	❑
Look and feel	❑	❑	❑	❑
Community	❑	❑	❑	❑

For an ideal web-based medical library, how would you rate the importance of each of the attributes below?

	Unsure	Important	Somewhat important	Important	Crucial
Key content resources	❑	❑	❑	❑	❑
Wide range of Content	❑	❑	❑	❑	❑
Fun	❑	❑	❑	❑	❑
Navigation	❑	❑	❑	❑	❑
Speed	❑	❑	❑	❑	❑
Look and feel	❑	❑	❑	❑	❑
Community	❑	❑	❑	❑	❑

How important to you are the following features for a web-based medical library?

	Unsure	Important	Somewhat Important	Important	Crucial
More information	❑	❑	❑	❑	❑
More pictures/graphs	❑	❑	❑	❑	❑
More timely information	❑	❑	❑	❑	❑
More third-party information on site	❑	❑	❑	❑	❑
More links to other sites	❑	❑	❑	❑	❑
Faster download time	❑	❑	❑	❑	❑

How important to you are the following navigational features for a web-based medical library?

	Unsure	Important	Somewhat Important	Important	Crucial
More useful welcome page	❑	❑	❑	❑	❑
More detailed table of contents, site map or site index	❑	❑	❑	❑	❑
More internal links within the site	❑	❑	❑	❑	❑
Better search capability	❑	❑	❑	❑	❑
The same navigational tool on every page	❑	❑	❑	❑	❑

How often have you used the KPNW Intranet Resources (not the future KPNW Clinical Library)?

❑ This is my first visit.
❑ I visited once before.
❑ I have visited a few times.
❑ I am a frequent visitor.

When compared to other sites, how satisfied are you with the current KPNW Medical/Dental Resources (not the future KPNW Clinical Library)?

❑ Not satisfied
❑ Somewhat satisfied
❑ Satisfied
❑ Very satisfied

Where are you now (or when you typically visit this site?)

❑ Work
❑ Home
❑ Library/Community Center
❑ Other (please specify)_____

Would you like to make any additional comments about either the current KP Medical/Dental Resources or the future KPNW Clinical Library?

APPENDIX H

COMMENTS BY USERS

COMMENTS ON OLD INTERFACE

1. **You have been given a grant by the National Library of Medicine to conduct research on the usefulness of computers in medicine. Please go to any resource where you would begin your literature search.**
   - Would have nurse do it, had no idea where to start.
   - Does not often use Medline.

2. **What resources are available to physicians specializing in Rheumatology?**
   - Does not drive from this page, therefore does not know of resources available.
   - Does not know.
   - No idea.
   - Wouldn't keep looking.

3. **You need to speak with Dr. Michael Krall. Please find his location and phone number.**
   - Old version is very difficult to use after new version.

4. **You have a patient that requests to see an urologist within the KP network. Please find one for your patient.**
   - Would use phone to get specialist.
   - This question is not applicable because docs mandated to use urophone and not computer.
   - Would use phone.

5. **You see a patient for the first time who is taking Coumadin (Warfarin) because he has an artificial heart valve. The patient is also taking 325mg of acetaminophen almost every day for stress headaches. Is there a problem with this?**
   - Not sure if the pharmacy online resource is the best thing available... might just phone directly.
   - Would send question to pharmacy through mail-in.
   - Prefer drug therapy and formulary.
   - Selected mail-in.
   - Would call pharmacist usually. would use micromedix but can be cumbersome to log in.

6. **You have realized that you need to take a CME course but you don't have time to travel. What options do you have?**
   - Since current listings not specialized, he said he preferred doing this through the mailings that he receives (more specialized)

7. **You get a 24 year old female patient with complaints of dysuria, the urgency and frequency increasing over the past 3 days. Is there a clinical guideline to determine treatment?**
   - Software exists to search internal sites... kaiser could implement that... and save physician time in searching.
   - Not easy to find dysuria or uti.

8. **You receive a referral letter telling you of a future patient who understands only Japanese. What resources inform you of your options?**
   - Would not do this.
   - Could not see anything related so stated would call instead (usual procedure).
   - Would ask nurse, does not know where to begin.
   - Could not find anything from first page, would order interpreter.
   - Would go to hard copy to find information.

9. **You have a patient who is asking for background reading material related to their medical condition? What online resources can you recommend?**
   - Uses Netscape or would suggest patient use favorite search engine to find information with a disclaimer to beware of who is providing information. Kaiser should also focus on using information that is out there and not try to repeat information efforts.
   - Quit because did not "see" page.
   - Does not know.
   - Would use KP online but otherwise, site has nothing relevant to specialty of satisfaction.
   - Dould not find kp online so does not know how to get there.
   - Unaware of resources... only heard of a few things.
   - Question was not relevant.

10. **You have found that your chair is contributing to aching neck and shoulders... and you are aware that Kaiser will pay for furniture if it helps you feel more comfortable. Where can you look to find a chair or more information on chair options?**
    - Would call resource management, on ergonomics checklist, did not find anything important.
    - No clue, would go to ergonomic people at Kaiser.
    - Would use service manager.
    - Job for administration.

11. **You have a break in your schedule and you are curious about the latest healthcare news... is this available online?**
    - Had no idea where to begin.
    - Could not find clear link from page.
    - Would go to Yahoo.

General Comments

- This interface is not that good.
- I never use the old interface.

2. **What resources are available to physicians specializing in Rheumatology?**
   - Category buttons should be bigger, and text below should be smaller.
   - Looking for old stuff in new design can be time consuming and requires adjustment.

3. **You need to speak with Dr. Michael Krall. Please find his location and phone number.**
   - Comfortable using this.

4. **You have a patient that requests to see an urologist within the KP network. Please find one for your patient.**
   - Would use phone.

5. **You see a patient for the first time who is taking Coumadin (Warfarin) because he has an artificial heart valve. The patient is also taking 325mg of acetaminophen almost every day for stress headaches. Is there a problem with this?**
   - Thought it was here but couldn't find it exactly.
   - Would use Micromedix.
   - If not urgent, would use Micromedix, otherwise, send note to pharmacy.

6. **You have realized that you need to take a CME course but you don't have time to travel. What options do you have?**
   - Don't know where it is.
   - Would call using KP phonebook.

7. **You get a 24 year old female patient with complaints of dysuria, the urgency and frequency increasing over the past 3 days. Is there a clinical guideline to determine treatment?**
   - Was ok searching.

8. **You receive a referral letter telling you of a future patient who understands only Japanese. What resources inform you of your options?**
   - Do not know where that is.
   - Blanking on this one.
   - Would use phone and call.
   - Does not know where to go.

10. **You have found that your chair is contributing to aching neck and shoulders... and you are aware that Kaiser will pay for furniture if it helps you feel more comfortable. Where can you look to find a chair or more information on chair options?**
    - Could not figure out what to look under after ergonomic checklist.
    - Will not look.
    - Would call 3M.

General Comments:

- Change font color of homepage bars to blue so users know that they can click on them.
- Move Permanente Journal to ":Databases, Journals & Research".
- Place directions at top left.
- Change "Handbooks, Manuals & Forms" to "Manuals and Outside Resources".
- Make room for Knowledge Finder under "Databases, Journals & Research" on the homepage.
- Put the most used items at the top rather than organize alphabetically.
- The new Clinical Library is a huge improvement!
- This is much better and easier to use that the old screen.

APPENDIX I

KPNW CLINICAL LIBRARY AFTER USABILITY TESTING

KPNW Clinical Library

Weekly Feature **Bloodborne Pathogen Exposure Management**

New | Americal Academy of Pediatrics | Go

Contact: **Clinical Information Systems Librarian** Rosemary.Burris@kp.org
Feedack/Help Form or Phone: (503) 813-4323; 49-4323 for KPNW Clinical Library content issues;

Webmaster *on internal mail for technical issues; webmaster@kpnw.org over the Internet*