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An Investigation into the usability of Europe PubMed Central Database.

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An Investigation into the usability of Europe PubMed Central Database.

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Abstracts

Healthcare professionals and lay people are challenged by the availability and plethora of health information particularly web based which has become increasingly important when diagnosing, advising of preventive measures and in prescribing future care. Access to accurate, reliable and current information in a useable format is becoming essential particularly at the point of care and if patients are to be part of that process.

Method: *Three volunteers were observed carrying out three separate queries to better evaluate the search engine. Ease of access, user experience, relevance of results and an analysis of the usability method were evaluated. (Appendix 1 Blank Observation Sheet). Participants were questioned after the task and asked to grade the usability of the database, its layout and help facilities. (Appendix 3 Questionnaire Sheet).*

Results: *Volunteers experienced a wide range of difficulties in accessing relevant information reflecting their medical and IT background. The professional clinician accessed results more quickly, but accessed other databases when information on a particular query was difficult to find and then use this information to return to PubMed.*

Conclusions: *PubMed is a specialised medical database that is particularly suitable for medical professionals as all articles are peer reviewed whereas other search engines for example, Google have a wider search base, but their relevance and authenticity is more questionable. It is suggested that lay users should explore multiple search engines to search different types of health information and medical knowledge for their own needs as articles containing less specialised vocabulary can be accessed.*

1. Introduction

An investigation was carried out into the large and easy to find database Europe PubMed Central, which until November 2012 was known as UK PMC. The database is free to use with access to 30 million abstracts including over 24 million from PubMed itself. Europe PMC is based on PubMed Central (PMC) developed on the NCBI (National Centre for Biotechnology Information) in the USA and is part of a network of PMC International repositories that also includes PMC Canada. Europe PMC is developed and managed by three institutions, which include European Bioinformatics Institute, The University of Manchester and the British Library. It accesses primarily MEDLINE database of references and abstracts on life sciences, biomedical topics, health research articles and publicly funded research.

Health IT evaluation is complex as it intends to serve various function. Evaluation involves hardware and information processes in a given environments. Many health IT usability studies have been conducted to explore usability requirements, usability problems and design solution, these studies includes; Georgsson et al (2014); Hulda et al (2014); Jorritsma et al (2013); Lin and Wilbur (2008); Sim and Read (2015); Vincent and Blandford (2014) and Bell, S (2014).

There are different methods of evaluation today, and one of the most recent, Bell (2014) postulate that academic library user experience should be centred on totality and not just usability of the interface. Jorritsma (2013) state that a task based usability evaluation methodology is better with subjective preference and objectives performance. In 2014, Ramkumar argued that, instead of evaluating the system as a

whole, we should evaluate the systems individual components to determine the performance and easy use of those individual component. This research has adopted cognitive walkthrough to determine the positive and negative effects of Europe PubMed central.

1. 2 Aim and Objectives

Objective: To carry out a usability test via a cognitive walkthrough of Europe PubMed Central to collect data in order to ascertain the positives and negatives effects of accessing medical and health information.

1. To review related literature on usability study on medical databases
2. To explore the importance of specialise database
3. To explore recent usability methods
4. To assess the users cognitive walkthrough behaviour.
5. To make recommendations.

2. 1 Literature Review

In 2014, Bell proposed a new methodology in accessing user experience design in academic libraries. He argues that user experience should not just be about the interface and usability. So, he maintained that academic library experience should be shifting from usability to totality, Bell S (2014). According to him user experience go beyond interface design and transcends to a whole experience of users in a particular community. He suggest that users experience should come to bear when designing the interface. Recent studies have shown that there are different methods of evaluating user friendly interface. Some of these studies highlight issues of components of a system, method of evaluation and web design.

2. 2 Brinkman et al (2008) Component Specific Usability Testing Method

Conducted an empirical meta-analysis to examine the effectiveness of components – specifics versus overall usability measures in 12 component tests that were carried out as part of six usability experiments tests that looked into the compositionality of usability. He submits that individual parts of a system cannot provides the whole usability of a system. However, they give understanding of usability of individual parts of a whole system. The findings indicate that the component-specific measures were, or average statistically more powerful than their overall counterparts when comparing component versions. Whole examination found that this was the case for the subjective-satisfaction measures. Although failing to reach a significant level, the component-specific subjectively ease of use measure also points in the direction of improved statistical power.

2. 3 Cassino et al (2015) Empirical Validation of an Automatic Usability Evaluation Method.

In 2015, Cassino et al conducted a research to verify whether evaluation with a medium level of expertise could reliably adopt usherlock to evaluate usability of given artefacts with an acceptable error coverage. 24 students were recruited for the experiments. The 24 students taking part in the experiments were initially informed on the purpose of the study and were instructed on the set of usability indicators considered relevant for the evaluation. They were then given instruction to perform one task for each of the analysed pages/screen, with a total of 40 units of analysis.

The findings suggest an improvements in terms of effectiveness is indeed achieved using usherlock, with obvious advantages in terms of time and cost with respect to the canonical manual test.

2. 4 Lin and Wilbur (2008) Modeling actions of PubMed users with n-gram Language Models.

This work demonstrate that simple n-gram models can capture regularities in user's activities, based only on a rough characterisation of their actions. These techniques, are able to identify activity, collocates and characterize interesting patterns of behaviour. Overall, the models are able to correctly predict the user's action about half the time. In this regards, log-mining technique that are able to extract are information from impoverished datasets are particularly valuable, since they alleviate these concerns, for academic researchers, it is more likely that such datasets can be shared. They researchers maintain that while user Modeling may be interesting in itself, our ultimate goal is to export such models to improve the search experience. The work represent an enabler for such transaction logs help us better understand how PubMed

users search for information and provides a value resource for building computational models of users activities.

2. 5 Ramkumar et al (2014) Comparison of Heuristic Evaluation and think aloud

Method: A study in Radiotherapy Contouring Software.

This study captures the radiotherapy planning process patients medical images are used to determine the optimum configuration of radiation dose to the patient's tumour while sparing their normal tissues. Clinically, tumour delineation is performed by physicians, either manually or using semi-automatic and automatic software. He maintained that, the usability of the software also plays a role in the tumour delineation process. Three methods of evaluation were used, first, contouring software was evaluated, two, evaluators assessed the software according to heuristic evaluation method, and lastly, physicians evaluated the same system using the think aloud method.

The research was rewarding as the experiments revealed different insights of the systems. The think aloud method was easier to identify end user's preference regarding both software interface input tools. While on the other hand, the heuristic evaluation method uncovered more specific issues with the interface. Besides, this method was able to explore more details regarding individual functionalities on the interface. Based on the comparison of the outcomes of both methods, it is suggested that in the process of improving usability of the contouring interface and the think aloud methods can be applied to explore preferences of the user. The heuristic evaluation can be applied in designing the details of the interface.

3. 1 Methodology

The cognitive walkthrough method was particularly suitable for evaluating the design of the PubMed user interface. Observations by the researchers of how well the interface supported the users' exploratory learning i.e. first time use without any formal training drew attention to problems first hand this was the case in Users 2 and 3. In addition all users were asked questions to test understanding of user experience and progress made to the outlined tasks.

Successful results for all users did not come first time so repeated steps were taken to achieve a series of stages that made up the complete task. The walkthrough method examined each of the correct actions needed to accomplish the task, and evaluate whether the cognitive steps would accurately lead to a relevant conclusion. In the experiment observation sheets were completed while the users carried out each query (20 minutes was allocated to each query totalling 1 hour) with a questionnaire/interview being conducted afterwards. A heuristic evaluation may have highlighted any setbacks when designing the experiment and allowed for any improvements, but this was not possible due to time constraints. It was considered that observation of users and the completion of questionnaires would provide sufficient data. The advantage of using this method was that it was quick and inexpensive to carry out which was particularly suitable for the group and part-time researchers.

A disadvantage of the method chosen was the limited knowledge of two of the users and the limited skills and knowledge of the evaluators in observing and assessing the process and quality of results at each stage of the experiment. All users had limited knowledge of the content of the queries and varying degrees of skill in accessing

databases, but the specialised knowledge of the content of the experiment made evaluation of results and the method itself more difficult to assess. Although labour and time intensive, cognitive walkthrough method could have been carried out with users completing their own assessment sheets at each stage of the process without the pressure of observers being present.

To improve the cognitive walkthrough for this investigation a number of variables could be changed in order to yield more accurate and substantial results. Less or more time could have been allocated to each query with users indicating problems at each stage – comments could be recorded for future reference. It was useful to compare the users' different skills and knowledge and the effect this had on the user experience of the cognitive walkthrough method. User 1 was familiar with the database and was able to navigate more efficiently and quickly whereas Users 2 and 3 were turgid and would have benefitted from a pre mini tutorial. Perhaps the experiment could have been carried out with two groups – one with IT skills plus medical knowledge and the other with only IT skills.

None of the users searched for articles using the Bio Entries, Related articles or the External links tabs to widen the search, but preferred to use the references at the conclusion of the article. The functionality of the database was not fully tested by the users.

The investigation involved a study of users' interaction carrying out specific tasks with a specific user face i.e. PubMed. This usability test involved a cognitive walkthrough that focuses on the simplicity of learning, especially through exploratory learning as opposed to an analytical method which uses theoretical models. One advantage of using the usability method is that it can identify important usability problems easily, quickly and cheaply when resources for performing other usability tests are limited. A

disadvantage is that it focuses mainly on ease of learning; that is, it assesses whether the equipment/database is simple to use without taking into account any previous knowledge of the participant.

- **User/volunteer one** – 37 year-old female healthcare clinician who accesses PubMed frequently as part of her professional occupation.
- **User/volunteer two** – 58 year-old female who has an IT background, but not one in medical science although has knowledge of balanced translocations.
- **User/volunteer three** – 67 year-old male has a science background, is a frequent internet user, but no medical background.

The users/volunteers were informed of the purpose of the research and were asked to find relevant information on three different medical areas:

- The effects of teenage pregnancy;
- The link between anti-depressants and the onset of early dementia;
- And the effect of an unbalanced translocation.

Volunteers were given twenty minutes per task - an hour to carry out the three tasks.

Users/volunteers were asked to score the usefulness of the search engine for each of the three queries scoring from 0 (useless) to 10 (the most helpful). They were also asked to give scores for each of the following:

- Layout
- Advanced search facility
- And the help menus.

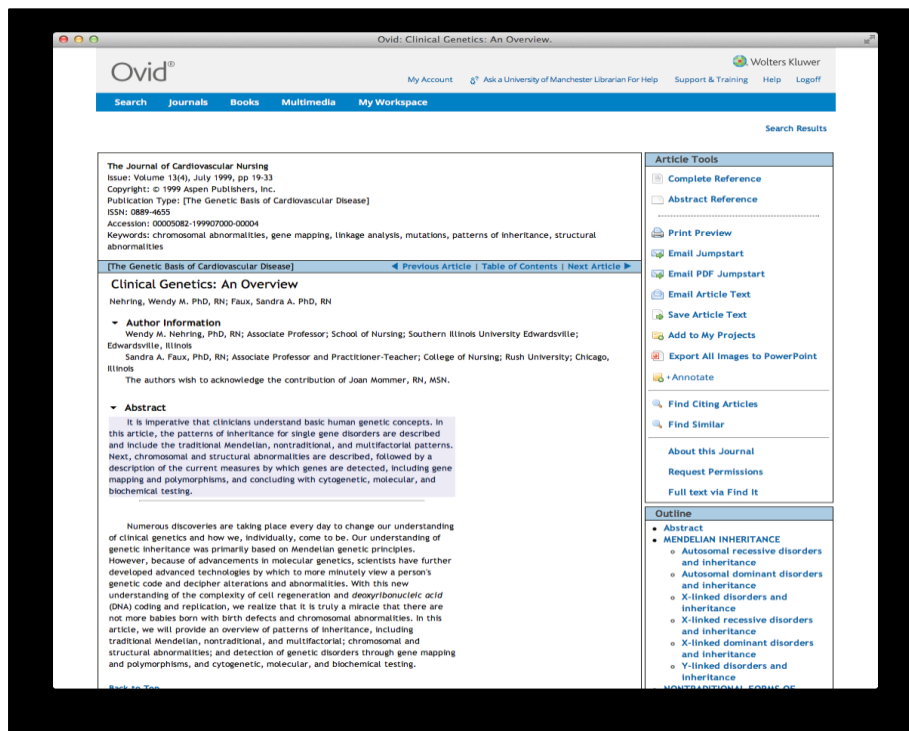
The investigation was carried out independently and in the home environment, but on different dates. Screen shots were taken to evaluate the stages of navigation across the search engine and to display results. On conclusion users were asked verbally a series of questions about the user experience.

4.1 Data Analysis

User/volunteer 1 – Medical Clinician obtained relevant articles quickly e.g.

“Differential Social Evaluation of Pregnant Teens, Teen Mothers and Teen Fathers by University Students,” by Keri Wood and Jody S. Nicholson. This article was found in the first few minutes of the 20-minute time limit and demonstrates the familiarity of the user with the database. There was a lack of external links on some of the articles, but the user was more confident on the references at the end of articles rather than on the citation tabs or the Bio Entities tab. The layout was limited and the word colouring with the white background tiring. The Advanced Search facility was not required.

User 1, found it is more difficult to access relevant articles on anti-depressants and the onset of early dementia. After reading the articles listed on the first page she goes offsite to use Google Scholar, and uses the results to type into the query search box



of the search engine PubMed.

The Advanced Search was not used as this requires specific knowledge of

Journal titles and their contributors.

The third query on chromosomal

translocation produced very specific results on balanced and unbalanced translocation of specific chromosomes so the user looked through the related articles tab. As this

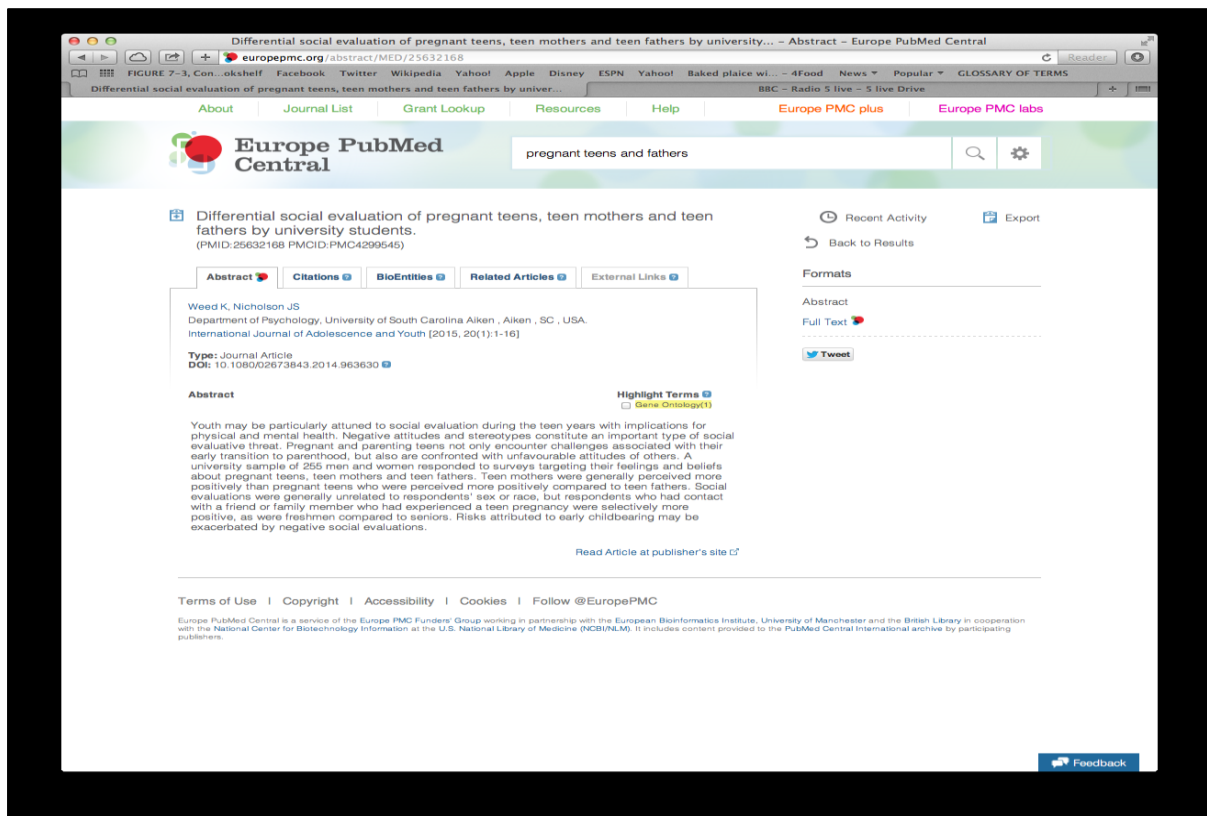
did not produce a general overall definition of the topic the user again referred to Google Scholar and to the references that were cited. From this, she signed into Ovid: Clinical Genetics. The National Library of Medicine through Medline leases **User/volunteer 2** – found difficulty in finding relevant articles relating to British experience so she rephrase the query to include social and medical problems. The search engine was unfamiliar to her, but an article that was slightly relevant – ‘The impact of Social Media on the Sexual and Social Wellness of Adolescents’ by Lisa M. Cookingham was accessed. The PDF option was found, but a number of articles had to be purchased through Science Direct. It was noted that a number of articles did not display abstracts.

The first results on query 2 were not relevant as they related to Aids so the wording of the query was rephrased. This produced some relevant articles, but user 2 was disappointed because recent research reported in national newspapers in March 2015 could not be identified. She commented that it was difficult to identify the separate articles as the lettering colouring of pale blue and grey and the lack of boxed in results blended together. The PDF option could be missed, but the red dots indicating full text articles could be easily seen.

A general definition of a balanced or unbalanced translocation could not be found, so user 2 changed query to an unbalanced translocation of 1 and 16. Results were unsatisfactory so a new query of unbalanced chromosome translocation of 10 and 19 was created, but very specific results given – no general overview.

User/volunteer 3 - a simple query search produced quickly the same article as user 1. He was very vocal about the user experience, but often made contradictory statements depending on his particular user experience. Was able to find PDF option

and use the citation tabs once he became more familiar with the layout. The back option could not be found nor the citation tab.



User 3 changed the query wording several times and read abstracts of results to find relevant articles. He spoke aloud as he searched, and stated 'Google pages are clearer and less stressful on the eye'. The advanced search button had to be indicated, but specific knowledge prevented use of this.

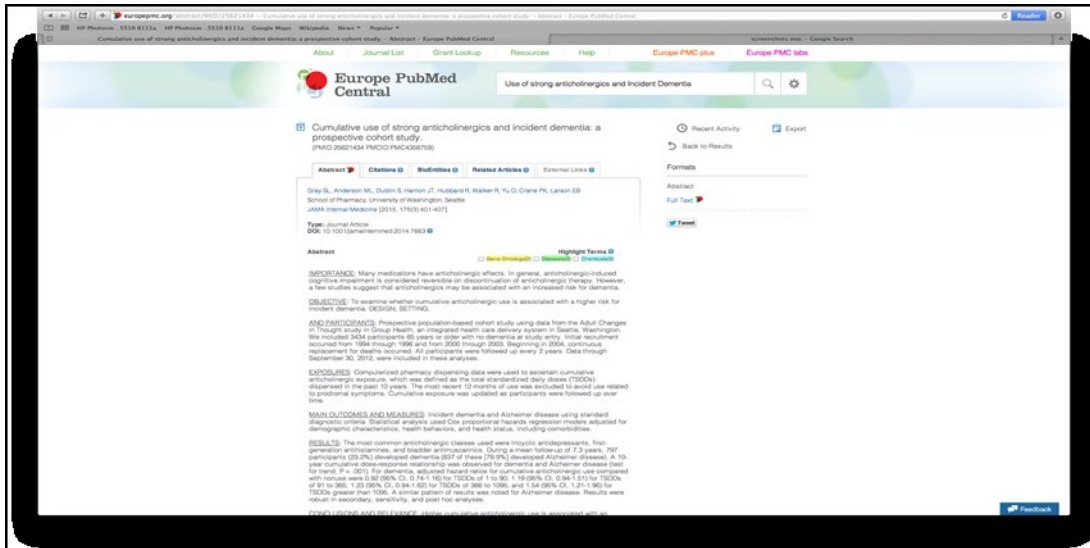
User 3 experiences similar problems to user 2, he was unable to produce results on specific translocations. Eventually he finds an article entitled – 'Long Term Follow-up of Females with Unbalanced X, Y translocations Reproductive and non-reproductive Consequences.' The user starts again to have a fresh query search with similar

queries to user 2 – more specific chromosome translocation 1 and 12, but with little success.

4. 2 Result Analysis

Accessing PubMed was the first hurdle to overcome. User 2 accessed the American version. It is necessary to enter the correct website title 'Europe PubMed Central'. On the opening page of the database a tab opens to give the full list of Journals that PubMed has access to. This is useful if an article is found on an alternative site but payment is required whereas free on PubMed.

User/volunteer 1 was able to bypass the usability investigation by first accessing Google Scholar to find relevant Journal articles on queries 2 and 3 when she was unable to find immediately material on PubMed. The article for query 2 was accessed first through Google and then via JAMA Internal Medicine March 2015, but access to the full article required payment or to be a subscriber. The advanced search facility on PubMed was used to type the specific Journal name and title before the article was displayed giving access to the full article free. PubMed was unable to produce the article from the query 'anti-depressants and dementia' because the query was too general despite the results of the research being publicised widely in the national press and the possible side-effects of the anti-depressant drug amitriptyline.



The full title of the research paper “Cumulative Use of Strong Anticholinergics and Incident Dementia” was not able to access from the simple query. The component Anticholinergic blocks the neurotransmitter in the central and peripheral nervous systems, which is used for a wide range of conditions and is contained in a number of drugs other than in some anti-depressants. But if the Citation tab had been used (screen print below) then a number of articles on this specific topic were available. If the Bio Entities tab has been pressed then the sub heading Diseases would have shown 55 articles on dementia and 6 articles on depression.

Users 2 and 3 had similar problems accessing relevant information, but did not have the experience to access other search engines. PubMed was unable to deal with layman’s vocabulary as the titles of research papers use specialised medical vocabulary and the algorithm only allows a narrow window of access.

Europe PubMed Central

Cumulative use of strong anticholinergics and incident dementia

Cumulative use of strong anticholinergics and incident dementia: a prospective cohort study.
(PMID:25621434 PMID:PMC4358759)

Abstract Citations BioEntities Related Articles External Links

Cited By - displaying 1 of 1 citations

Adverse cognitive effects of medications: turning attention to reversibility.
(PMID:25622111)
Campbell NL, Boustani MA.
JAMA Intern Med [2015]

Cites the following - displaying 41 citations

Anticholinergic drug use and risk for dementia: target for dementia prevention.
(PMID:20960005)
Jessen F, Kaduszkiewicz H, Daerr M, Bickel H, Pentzek M, et al.
Eur Arch Psychiatry Clin Neurosci [2010]

Non-degenerative mild cognitive impairment in elderly people and use of anticholinergic drugs: longitudinal cohort study.
(PMID:16452102)
Ancelin ML, Artero S, Portet F, Dupuy AM, Touchon J, et al.
BMJ [2006]

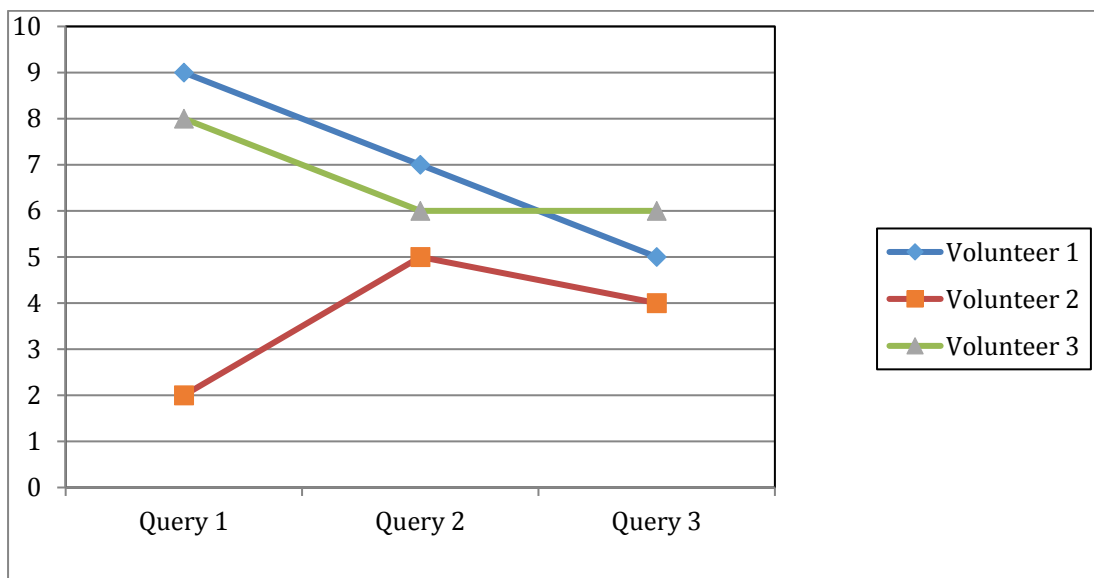
Drugs with anticholinergic properties and cognitive performance in the elderly:

Show all items

Feedback

Note the results listed in the citations tab were boxed and less tiring to the eye.

A Graph to illustrate the scores on the Usability of PubMed

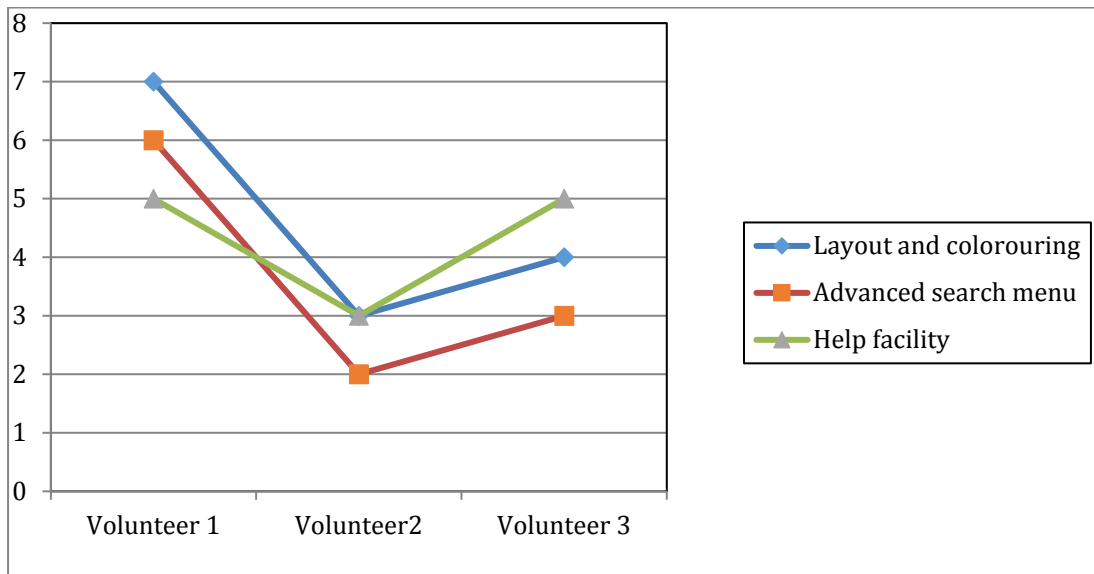


Similar problems arose with query 3 when a definition of chromosomal translocation could not be found or explanatory diagrams illustrating these problems. It is recognised that PubMed is a specialist medical search engine, but many health clinicians are not familiar with the conditions contained in query 2 and 3. PubMed provides accurate, reliable and current information, but does not always provide this in an easy useable format. But the anomaly of the above was the results produced in Query 1 by user 1 and 3. In this case a general search query on teenagers and pregnancy provided a quick and relevant result for both users. This is probably because the query does not contain any medical terms or conditions, but appears to be a more sociological query. The above accounts for the high scores for query 1 by volunteers 1 and 3 on the Usability Graph, but followed by the lower scores on queries 2 and 3. Volunteer 2 had the most difficulty accessing information and navigating around the database.

4. 3 Layout

All volunteers complained that the layout and colouring of the web pages were tiring and harsh on the eyes particularly user 1. The bright red dot in the title detracts from the results that are displayed on a white background with titles of the research papers in pale blue and with a slightly bigger font. It is easy to miss the opportunity to sort results by relevance, date or the number of times the article has been cited as the instruction is in a pale grey which is a pity as the date order is changed frequently if the term appears in the document. None of the tabs, instructions or results is boxed to give an emphasis. Despite this user 2 attempted to sort the dementia query by date as the snippets of the research had been published in a newspaper a few weeks before, but without success.

A Graph to show scoring for Layout, Advanced search facility and Help menus



The red, green and blue dot placed at the side of each article indicates the full free text is available and is easy to identify and speeds the process. None of the users chose to use the text mining technology which highlights Gene Ontology words with yellow, Gene Proteins with pale pink and Chemicals with blue in the Abstract of an article, but these options are not available in PDF format. This indicates that all of the users did not have sufficient background knowledge of the biochemical make-up to use this facility. The PDF format indicator is clear and easy to use.

The citations tab on the abstract page gives the option to view other referenced articles, which were boxed and gave some definition outline to the page, but user 1 preferred to consider the references given at the end of an article. A comprehensive list indicated at least seven further articles on the specific query all available on PubMed. The Bio Entries tab indicates terms used in the article to perform further searches of that term i.e. across referencing of bio-scientific terms e.g. Gene Proteins,

Gene Ontology, and Diseases. When questioned all users knew the purpose of the citation tab, but only used by users 1 and 3.

Although the layout is bland and unexciting, but cross referencing of information is very comprehensive and clear, and presents what is essentially an academic search engine.

4. 5 Help Facility

The Advanced Search symbol on the browser adjacent to the query sign, is not well sign posted and can be easily overlooked. User 1 used the Advanced Search facility to gain access to articles, but only when the name of the Journal and article was known. Although the advanced search page is superfluous for the novice the thorough cross referencing within the search engine itself overcomes this problem. The Advanced search is clear in terms of information required, but if this is not known is of no help.

5. 1 Conclusion

A limited sample size with diverse ages, backgrounds and medical knowledge was a limiting factor in drawing conclusive results. Time constraints set on both users and assessors was another problem as all participants were given the same amount of time to complete each query.

To achieve a comprehensive and optimal search in PubMed it is necessary to have a thorough understanding of medical vocabulary, knowledge of the areas to be investigated and knowledge of the institutions and personnel who carry out medical research. Two of the users did not use fully the facilities provided by PubMed. Despite this PubMed is a comprehensive medical search engine providing peer reviewed articles ensuring quality and legitimacy of information.

The first fifteen results on chromosomal translocation did not include any research from Manchester University despite it being one of the universities assisting in PubMed development and is one of the centres in the country with a genetics department and a reference for people with genetic problems. The graphs do not strictly correlate with the results of the interview questionnaire.

5. 2 Recommendations

To produce an online tutorial similar to the American version as this would aid both the healthcare practitioner and the inexperienced user of PubMed to facilitate a quicker response accessing medical information and leading to a constant flow of user experience.

1. The algorithm of PubMed could be more finely tuned so that general queries in lay man's terms lead to relevant articles. The Advanced Search facility should then follow on from this.
2. The advanced search symbol on the browser page should be more prominent and redesigned for general medical use.
3. A change of colours and emphasis of the wording of the results and the inclusion of diagrams or illustrations could be included if appropriate and a tab indicating these.
4. To ensure that the graphs reflect accurately the results of the questionnaire and not the verbal responses.

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Websites

Europe PubMed Central – www.europepmc.org

PubMed America – www.ncbi.nlm.nih.gov

Google Scholar – www.scholar.google.co.uk

Appendix one

Action Observations			
Landmarks and layout out			
Users thoughts and intentions			
User feelings			

Appendix Two

Screen Print of the Advanced Search on Europe PubMed Central requiring specific information.

The screenshot displays the 'Advanced Search' page on the Europe PubMed Central website. The browser's address bar shows 'europepmc.org/advancesearch'. The page is titled 'Advanced Search' and includes a search query builder at the top with a 'Search' button and an 'Edit Query' link. Below this, the 'Bibliographic Fields' section contains input fields for 'Journal', 'Author', 'Published' (with a dropdown menu set to 'First published'), 'From' (dd/mm/yyyy), 'To' (dd/mm/yyyy), 'Volume', 'Issue', 'First Page', and 'Title'. There is also a dropdown for 'All Bibliographic Fields' set to 'Choose one bibliographic field'. The 'Funding Attribution' section has fields for 'Funder' and 'Grant No.'. The 'Filters' section includes a 'Synonym query expansion' toggle (set to 'On'), a 'Sources' list with checkboxes for 'Agrisola (USDA/NAL)', 'Chinese biological abstracts', 'CiteXplore records', 'Patents', and 'PubMed/MEDLINE (NLM)'. It also features 'Special Collections' (All BMJ, All manuscripts, EuroFIR, Europe PMC manuscripts) and 'Full Text Availability' (In Europe PubMed Central, Open Access). At the bottom, there are fields for 'Publication Type' and 'Language', and a 'Feedback' button.

Appendix Three

Below are sample Questions asked of Users in order to gauge a well-rounded usability experiment:

Interview/Questionnaire

1. Was the use of design and colour satisfactory so as not to distract and confuse from the main task in hand?
2. On a scale how did you rate the help menus where they sufficient to meet your user needs?
3. To follow on from the previous question, did you find the layout of the Advanced Search page easy to Navigate?
4. How did you find access to full articles? And did you think that they were easy to find?
5. When you searched and retrieved a full text article how did you find the PDF options to view the article? Were they clear and easy to use?
6. How did you find the layout for the abstract, citations, Bio Entities, Related Articles page on a scale of 0-5?
7. How did you rate the Related Articles section – did it provide sufficient content to establish a flow for the user experience?
8. Did you find the Bio Entities Tab useful in the pre viewing stage of the article?
9. Do you know what a citation is?
10. Did you find the citations tab with the 'cites the following' and 'cited in by' options useful? On a scale of 0 – 5 rate this usefulness.

Appendix Four

Interview Questionnaire – User 1

1. Yes, although the white background (no contrast) because harsh on the eyes. Search results were not as easy to read.
 2. Did not use them – didn't see link at the top of the page.
 3. Advanced Search is clear in terms of information required. Unfortunately you need to know quite specific information in order to use it – none of which I did now as these search areas were unfamiliar.
 4. Full article access was good and very useful. Could login to some using institution login – okay as I know it
 5. Yes
 6. Five - tabs make it easy to navigate and provide some definition outline to page
 7. Yes – I use this feature along with references from articles.
 8. No didn't use it, wouldn't know how to use effectively
 9. Yes – when an article has been referred to in another article
- 10.3 - 4

Appendix Five

Interview/Questionnaire answers – User 2

1. Satisfactory – fairly bland – pale blue and grey not blocked in – tend to merge into one red dots stand out next to full text article.
2. 3 – being average
3. Unless knew the journal title – No – otherwise layout fine.
4. Yes, especially with an indicated red dot
5. Yes because on the right hand you could miss PDF element.
6. Satisfactory mainly easy to use.
7. Average – found to be ok when in the flow of a user experience.
8. No – did not know what they were
9. Yes but had to be reminded about that
10. I did not use them

Appendix Six

Interview Questionnaire Answers – User/Volunteer 3

1. Yes the use and the design of colour was not distracting
2. Did not use them – do not stand out
3. Yes – easy to navigate with specific queries
4. Yes – finding full articles was relatively simple
5. Yes used PDF articles
6. Good – easy to use and find
7. Yes – looked at related articles and did eventually find a flow especially on the first question
8. Looked in Bio – Entities tab and found it a useful contribution to the flow user experience
9. Yes – a reference on a reference list
10. Yes – found it useful links to other websites useful.