

[Type here]

# Health Informatics Journal

<http://jhi.sagepub.com>

---

## Lessons learned from evaluation of the use of the National electronic Library of Infection

Gemma Madle, Patty Kostkova, Jane Mani-Saada and Anjana Roy

*HEALTH INFORMATICS J* 2006; 12; 137

DOI: 10.1177/1460458206063809

The online version of this article can be found at:  
<http://jhi.sagepub.com/cgi/content/abstract/12/2/137>

---

Published by:

 SAGE Publications

<http://www.sagepublications.com>

**Additional services and information for *Health Informatics Journal* can be found at:**

**Email Alerts:** <http://jhi.sagepub.com/cgi/alerts>

**Subscriptions:** <http://jhi.sagepub.com/subscriptions>

**Reprints:** <http://www.sagepub.com/journalsReprints.nav>

**Permissions:** <http://www.sagepub.com/journalsPermissions.nav>

**Citations** (this article cites 7 articles hosted on the SAGE Journals Online and HighWire Press platforms):  
<http://jhi.sagepub.com/cgi/content/refs/12/2/137>

[Type here]



---

## **Lessons learned from evaluation of the use of the National electronic Library of Infection**

*Gemma Madle, Patty Kostkova, Jane Mani-Saada and Anjana Roy*

The National electronic Library of Infection (NeLI: <http://www.neli.org.uk>) in the UK is a freely available portal to key evidence and guidelines in the infectious disease field. This paper discusses 5 years of evaluation of the pilot library and how this evaluation informed design of the new library website. The importance of combining qualitative and quantitative evaluation is highlighted and the results of web access logs analysis, free text search query analysis and an online user survey are compared. The paper concludes with a discussion of lessons learned for future development and evaluation of this Internet digital library.

### **Keywords**

digital library evaluation, Internet digital libraries, National electronic Library of Infection, user evaluation

### **Introduction**

This section introduces the National electronic Library of Infection, provides information about its background and navigation structure, and discusses the priority that has been placed on evaluation throughout the project duration.

#### *The National electronic Library of Infection*

Medical digital libraries are essentially life critical applications enabling professionals to stay up to date. They have the potential to change working culture, creating new types of professional relationships and communities based across distances, hierarchy and other traditional barriers. Recent research indicated that some senior clinicians are reluctant to

provide access to evidence-based information to junior staff, one clinician even suggesting that they should learn on the job instead [1]. Evidence-based medicine is an increasingly popular practice with much public money being spent on projects such as the National Library for Health (NLH: [www.nlh.nhs.uk](http://www.nlh.nhs.uk)) and IT infrastructure to make the evidence available to clinicians at the point of care, such as the National Programme for IT in the NHS (National Health Service), NHS Connecting for Health in the UK ([www.connectingforhealth.nhs.uk](http://www.connectingforhealth.nhs.uk)).

The National electronic Library of Infection (NeLI: [www.neli.org.uk](http://www.neli.org.uk)) is a specialist library of the NLH [2]. The NeLI is a freely available Internet gateway to the best available evidence around investigation, prevention, treatment and management of infectious diseases. The key value of the library lies in the quality appraisal of documents by expert reviewers. The library has been operating as a pilot version developed in HTML and using CGI search scripts since 2000 and has recently been relaunched as an enhanced integrated database, the design of which was based on the results from this multimethod evaluation. The new library includes discussion forums and development of an online community of professionals in communicable disease to provide and seamlessly maintain the quality appraisals of documents [3]. Figure 1 shows the home page of the new NeLI.

### *NeLI navigation and document quality appraisal*

NeLI can be navigated by browsing or searching. The original browse menu of the pilot site was a two-level menu with two initial options: syndromes or pathogens. Each of these options led to an alphabetical list from which users could select a topic page. In January 2004 this menu was restructured as a result of the growing site and informal feedback. The syndromes and pathogens options were removed and the following options added:

- A to Z showed all topic pages in alphabetical order.

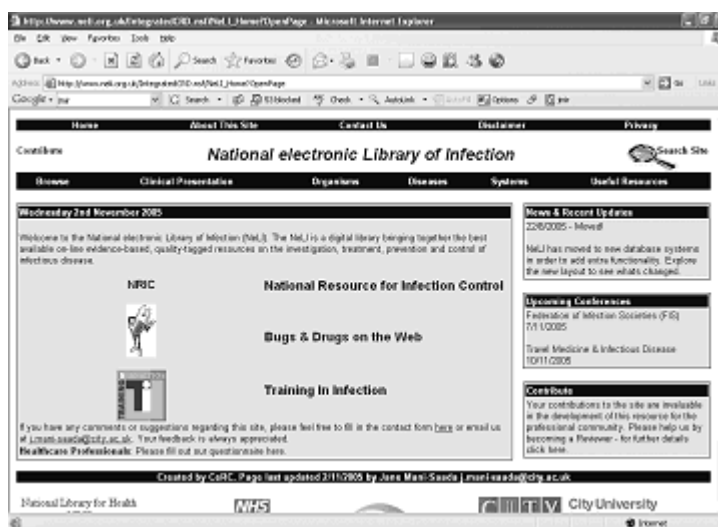


Figure 1 Home page of the NeLI

[Type here]

- Antimicrobial Resistance was added in response to growing political and medical interest in this issue.
- Factsheets listed those available on NeLI in alphabetical order.
- Guidelines listed those available on NeLI in alphabetical order.
- New Pages listed topic pages recently added to the library.
- Societies listed all the professional societies that support NeLI and also others in the infectious disease domain.
- Top Ten showed the 10 most frequently accessed topic pages as shown by the web access log analysis.

The search page consisted of a choice of dropdown boxes from which the user would select a keyword to be taken to the appropriate topic page. In June 2003 an external free text search box was added allowing users to enter their own keywords in order to retrieve topic pages.

A key feature of the NeLI are the reviewer's assessments (RAs). They provide the quality appraisal for documents that is lacking in so many other portals and information repositories. RAs are short reviews of the documents held in the library, written by professionals in the field. They allow the library user to understand what the document is about, its evidence base, whether any studies confirm or contradict it, and whether it is appropriate for their needs at the time without having to read the document itself. It therefore reduces the amount of time the user spends reading documents only to decide they are inappropriate or not relevant.

### *Evaluation of NeLI*

Evaluation of the use of the NeLI was identified early in the project as essential for developing the library in line with user needs and wants. Reasons identified for evaluating NeLI use were:

- to identify navigation patterns to improve the structure of the NeLI;
- to determine user satisfaction with the quality and content of information on NeLI and the value placed on RAs to help promote their development;
- to identify gaps in content;
- to find out information about users such as clinical interests and demographic information.

Initially an information needs survey was done to assess the information needs of public health professionals. This survey was used as a reference when developing the pilot site [4]. Funding for NeLI has so far been limited and irregular and therefore evaluation has been constrained, as in any real-world project, both financially and practically in terms of time and resources. However, evaluation has remained a key objective of the team involved. The NeLI Advisory Board provided the required feedback until the project was of a suitable size to include public users. The initial pilot to demonstrate site features was developed around meningitis and became available in March 2000; and the site based on information around the PHLS-identified OVCD diseases [5] was launched in April 2001, when the First Annual Advisory Board meeting took place. From June 2002 web access

[Type here]

logs were collected and analysed. Web log analysis provides information about the path a user takes through a website [6]. It is a cheap method of data collection as the log data are often freely available to website administrators. We can find general patterns in use, e.g. most commonly visited pages, search terms used, time spent on a page etc. We can also employ a technique known as microanalysis, analysing use of the library by a small number of individual users. This provides a clearer picture of individual user behaviour when in the library, rather than general trends [7]. Previous research has evaluated the impact of the NeLI on user knowledge and attitude [8, 9]. Analysing the web logs of the library allowed us to evaluate current user behaviour, in particular that of the target group for the online community, health professionals. This helped ensure that development of the new website is in line with user preferences. In June 2003 a new free text search facility was added to the site and keyword data were collected and analysed. As this search was external to the NeLI website the keyword data were not collected in the NeLI logs and so had to be analysed separately. Following this, in August 2004 an online questionnaire was developed to evaluate use of the NeLI by asking users for their feedback [10]. The objectives of the survey were to determine navigation, to investigate quality and tagging of data and user information, and to gain information about the group of respondents. We requested the users to think of a specific infectious disease-related question (clinical or non-clinical) and to try to answer their question using the NeLI site; we then matched the log data to the questionnaire data to compare reported behaviour with actual library navigation.

In this paper we will discuss the analysis of the web logs of the pilot NeLI for the period January 2002 to July 2005, analysis of the free text search queries from August 2003 to January 2004, and the results of the online questionnaire. The next section outlines the methods used and details of the data collected. This is followed by a comparison of the results between each method of collection, a discussion of the application of these results to future development of the NeLI, and general lessons learned for future evaluation of medical Internet digital libraries as a result of this study. This is followed by a brief conclusion.

## Methods

This section discusses the qualitative and quantitative methods used for data collection, the type of data collected, and their advantages and disadvantages, and explains the way in which data will be compared. The three methods used are outlined below.

### *Web access logs*

#### **What data do we get?**

Initially web access logs were collected between January 2002 and July 2005. The access logs provide quantitative data about users in the following fields: (1) the IP or host name of the origin of the request, (2) the date and time of the request, (3) the type of request, (4) the page requested, (5) the returned status of the page and (6) the number of bytes transferred. These raw data were cleaned, e.g. a request from one user for one page can result in a number of hits as each picture file on the page is recorded as a hit. We also adjusted the time and date format to separate these and, because we were only interested in 'real'

[Type here]

user behaviour, we removed hits from identifiable robots. The data were imported into Microsoft Excel, month by month, and analysed accordingly. IPs and hostnames were looked up for more specific details of the user, e.g. domain name and country of registration.

### **Advantages of these data**

- They enable the identification of users accessing the NeLI from hospitals and other medical centres and organizations as these health professionals are the target community of the NeLI.
- They provide us with information on how the users actually navigate through the site while using the library, providing invaluable quantitative information on user actual online behaviour, often unconscious and not logically reflected.

### **Problems associated with web access log data**

- It is not possible to resolve IP addresses to individual users as one IP address can represent many users, e.g. gateway IPs and computer sharing, as is the case for many NHS connections.
- It is not possible to identify all non-human users, e.g. spiders and crawlers.
- We cannot know exactly what a person is doing in their session. For example, when there is a pause in their online activity, are they still using the information on the website or have they left their computer? This is particularly relevant for use in clinical settings where users may be distracted by other matters but return to resume their session. In this study, if there was a period of inactivity in the web logs for longer than 30 minutes the session was recorded as ended.
- We have no information about where they go when they leave the website, e.g. whether they are they using links on NeLI to external documents during or at the end of their session.
- More importantly, web logs do not provide any insight into why users did what they did on the site and whether they were or were not dissatisfied with the results. For example, did they leave the site because they found what they were looking for, or they did not find what they were looking for and went somewhere else, or give up?

### *Free text search keyword data*

#### **What data do we get?**

In August 2003 a free text external search box was added to the NeLI. The providers ([www.freefind.com](http://www.freefind.com)) of the free text search send the query data to the NeLI team on a weekly basis. The query data include keywords used and the time the search was performed. This is collated in a spreadsheet and keywords are grouped into categories for analysis to prioritize the development of NeLI content accordingly and identify any knowledge gaps. In addition, the quantitative data collected from the free text search enabled us to see what users were searching for, how they structured their search query, when they searched, and how use of the free text search compared with use of the structured search and browse facility.

[Type here]

### **Advantages of these data**

- It is possible to identify gaps in the library content if users are frequently searching for content that is not available.
- We can see how users search for information, i.e. whether they use different terms to those available in the controlled vocabulary of the dropdown search boxes or browse menus.
- Are users using Boolean operators when searching to identify overlapping topics such as TB and HIV or to narrow down topics, e.g. TB and immigrants?

### **Problems associated with this type of externally collected data**

These issues were a problem due to the use of an external freetext search engine; by implementing an internal one the following issues were overcome.

- Because this search facility is not integrated in NeLI, the query data are separate from the web access logs so it is difficult to know whether users are finding what they want.
- It is also difficult to link queries to log data as this has to be done manually with the two separate data sets.
- Free text search requires the user to know what they are looking for in advance and spell it correctly, something that is often difficult with Latin-based medical terms. Added to this there can be differences between UK and US spellings.

### *Online user questionnaire*

#### **What data do we get?**

An online questionnaire was developed as part of an MSc project in August 2004 [10] to evaluate users' perception of navigation of the NeLI and the quality tagging that is a key feature of the library, as well as to gain some information about the users themselves. This questionnaire provided qualitative results that showed users' perceptions of how they behave in the library and how they viewed the library. Questions were asked about how users navigated the library, which clinical areas they worked in and were interested in, whether they found the RAs useful, and the barriers they may face in using the NeLI or contributing.

#### **Advantages of these data**

- Qualitative data show what the users think of the library and whether they are understanding the navigation structure and terminology.
- They also provide some demographic information about the library users.
- They provide in-depth user feedback about other aspects of the project, e.g. involvement in producing RAs, time and social constraints.

#### **Problems associated with these data**

- This is an opportunistic self-selecting sample as we are relying on users to choose to fill out the questionnaire, and therefore the data set is likely to be small and

not statistically significant. These data were compared with the web access logs to see how users actually behave in terms of navigation.

- Many discrepancies were identified, showing differences in user perceived and actual behaviour, and user satisfaction was not always linked to finding the correct results [10].

### *Combining the three methods*

Bearing these problems in mind, it is important not to take each data set as a standalone evaluation. A recent evaluation of a patient information system identified the problems of using log data or questionnaire data without linking them together. Eight GPs claimed to have used the system but the web logs indicated that only seven had logged in. In this instance the authors suggested the GP had logged into a patient's computer rather their own [11]. Similar results were identified in the NeLI survey where users reported they were satisfied with the results but never visited the page containing the answer to their clinical question [10]. However, the advantages of each data set are complementary and when combined they provide a useful insight and a more accurate picture of how the library is used. The two areas of investigation for comparison are:

- The navigation methods of users, i.e. are they browsing or searching and how are they doing this? The web log and free text search data will show how users are navigating the site, whilst the questionnaire will show how users think they are navigating. The online questionnaire study already identified discrepancies in user perceived and actual behaviour [10].
- The reviewer's assessments, i.e. are they valued by users and are they accessed? The web log data will show how often these resources are accessed whilst the questionnaire data will show what users think of them.

## **Results**

A standard web log report was produced showing general access statistics and use of the website, including most popular pages, browsing and searching behaviour and geographical distribution of users [12]. Also the free text search query data analysis and the results of the online questionnaire have been reported elsewhere [10]. For the purposes of this paper we will not be discussing general access statistics but focusing on the most interesting data by a comparison of the three methods in order to describe the lessons we've learned from 5 years of NeLI evaluation.

### *Browsing and searching*

The web access log data indicated that searching was performed more than twice as often as browsing. In contrast, the online questionnaire results suggested that browsing was more popular than searching (52 per cent browsed, 37 per cent searched and 11 per cent used a combination of the two). The browsing options were altered in January 2004 and for the original site two options were given: syndromes and pathogens. Web access logs indicated that syndromes was a more popular menu choice than pathogens (ratio 1.46:1). This was supported by the freetext search keyword data where search queries about



syndromes were more common than those about pathogens (ratio 1.3:1). The online questionnaire respondents tended to have more clinical interests than microbiological. If this reflects the general users of the library then this could explain the preference for syndromes over pathogens. However, the online sample was rather small and opportunistic: user registration and profile gathering could provide detailed information about user professional backgrounds but this was not available with the NeLI pilot version.

Table 1 shows the relative popularity of each browsing menu option following the browsing menu restructure in January 2004. These populations are different and so cannot be compared directly, but it is nonetheless useful to see how the data differ. The web access logs showed that the most popular browse option was the top 10 option, followed by the A to Z index, guidelines, infectious disease societies list, factsheets, antimicrobial resistance and at the bottom new pages on NeLI. The key differences with the online questionnaire data are the common use of the factsheets option and the less common use of the top 10 option.

Figure 2 shows that over half of free text searches consisted of a single keyword search and 30 per cent of a phrase, with only 3.5 per cent of searches using Boolean search queries. Eighty-two per cent of free text searches were performed between 9 a.m. and 6 p.m. compared to 55 per cent of website access being during this period. The online survey indicated that none of the users questioned used the free text search; however the query data and web access log data show that free text search queries make up 25 per cent of the searches performed during the period August 2003 to May 2004.

### *Reviewer's assessments*

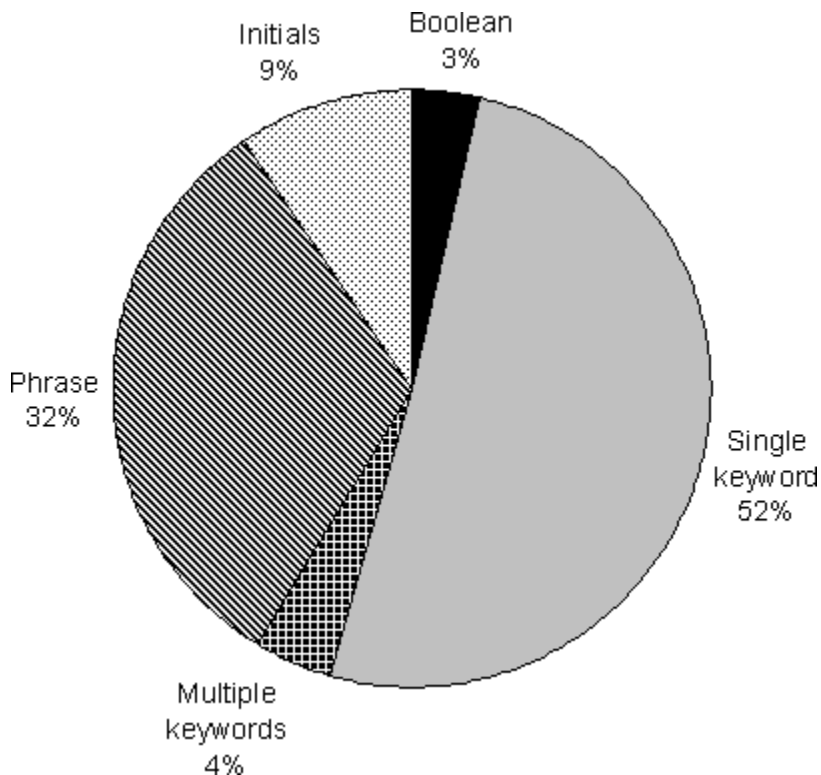
Eighty-six per cent of online questionnaire respondents thought that the reviewer's assessments were useful or very useful. However 75 per cent said they would not be prepared to contribute due mainly to lack of time. Access to the assessments online has increased since the library started but is still low as a proportion of access to the library as a whole (see Table 2).

Until 2005 there had been an increase in the number of RAs available and accessed, both as individual pages and as a proportion of access to the site as a whole. In 2005 there was a slight increase in the number of assessments accessed but a drop in the

**Table 1** Use of browsing options (as described in section 1.2) following menu restructure in January 2004

<i>Options listed in the order they were listed on the website</i>	<i>Web log data January 2004 to July 2005</i>	<i>Online questionnaire data August 2004 to September 2004</i>
A to Z index	21.80%	33.3%
Antimicrobial Resistance	3.57%	0%
Factsheets	5.75%	33.3%
Guidelines	13.41%	11.1%
New Pages	2.35%	0%
Societies	12.58%	11.1%
Top Ten	40.53%	11.1%

[Type here]



**Figure 2** Structure of free text search queries from August 2003 to January 2004

number of hits to all assessments. However access to RAs as a percentage of total hits is still very low considering the endorsement of RAs by the online questionnaire participants. The free text search was not a popular way to find these assessments, with only 15 searches for 'reviewer's assessment' or 'review' (the latter of which could equally be searching for a publication type 'review') during the period August 2003 to May 2004.

**Table 2** Web log access to the Reviewer's Assessments

	<i>January 2002 to March 2002</i>	<i>January 2003 to March 2003</i>	<i>January 2004 to March 2004</i>	<i>January 2005 to March 2005</i>
Average no. RAs accessed per month	0	11	32	34
Total hits to RAs per quarter	0	82	777	326
Percentage of total hits to library	0	0.65%	2.7%	2.02%

[Type here]

## Discussion

This section discusses the results obtained and compares results from the three studies. The impact of the evaluation on development of the new site is reported and we discuss lessons learned for future evaluations of NeLI.

### *Comparison of data collected by the three methods*

This section compares the data collected in terms of navigation and RAs.

#### **Navigation data**

It is clear that whilst there are some commonalities in the three sets of data, there are also discrepancies. The online questionnaire results seem to differ most from the log data and free text search data. This is probably because many of the online questionnaire respondents were visiting the site for the first time and it was a relatively small sample size ( $n = 25$ ). There is also the possibility that they are not accurately reporting their online behaviour [10]. Free text searching is a popular way of finding information despite not being used by the questionnaire respondents. This lack of use of Boolean operators is supported by the evidence from research into web seekers' structuring of search queries [13]. However, the online questionnaire respondents all claimed to have found the information they were looking for and, although none used the free text search, only 11 per cent claimed to have used a combination of browsing and searching, suggesting that in general one method is successful. In addition to the support of the questionnaire results, log data specific to individual queries would be useful to indicate whether or not users are finding what they want from the search or whether they are leaving the site or using another navigation tool.

#### **Reviewer's assessment data**

Despite the value placed on the RAs by the questionnaire respondents and the increase in access over the last 3 years, this key feature of the site is underdeveloped and underused. The decrease in hits in the first quarter of 2005 is perhaps due to a lack of new RAs for new documents in the library and users not so commonly accessing the older documents. Since the creation of NeLI it has been an ongoing problem to get professionals to write these assessments [14], despite the interest in this key value-adding feature of the library supported by the NeLI Project and Advisory Boards. It is possible that the previous NeLI website did not make it easy enough for users to submit reviews. In addition, due to the relatively small number of assessments currently available they are possibly not noticed by many users. Therefore many users may not realize that they need to contribute, a problem that is difficult to resolve until more assessments are written. The next section discusses how these observations were used to influence the new website development.

### *Impact of the results on the new website design*

This section discusses the impact of the results on the navigation design and the promotion of reviewer's assessments.

## **Navigation**

The browsing options have been altered with the migration to the new website, with the underused antimicrobial resistance options being removed. The societies option has been moved to the 'other resources' section as this is not a way into the documents held in the library. The top 10 option is currently unavailable until the most popular pages have been identified. The popularity of the top 10 option was probably in part due to its presence on the home page as well as in the browsing menu; it would previously have been providing positive feedback, thus increasing hits to popular topics and making them more popular. As a result of this we are running an online survey to identify the most popular topics for which information is most often needed. This will make for an interesting comparison with the web access logs. The four browsing options are currently: A to Z index, Factsheets, Guidelines and New Resources. Despite this last option having little use by public users, it was felt that it is a useful tool for the NeLI team, particularly for monitoring which resources are added, and will be useful for identifying new resources that require RAs. The search page includes a free text search at the top of the page, improving its visibility on the page, and a keyword search where users can select a keyword from a dropdown menu and filter results by publication, level of evidence or category.

## **Reviewer's assessments**

In response to the lack of interest in professionals in writing RAs, the current website allows online submissions of reviews and highlights the need for contributors clearly on the home page. Automatic allocation of new documents to reviewers – sending an e-mail request to review a document in their expertise area and following this up – is being implemented [15]. The new NeLI website also now highlights the need for reviews for all documents that are not already assessed, and a button to allow users to click through to the online RA form is now at the top of each resource record. In addition, a related project, The National Resource for Infection Control (NRIC: [www.nric.org.uk](http://www.nric.org.uk)), also developed by the NeLI team, secured funding for an expert to write RAs for documents in infection control and it is hoped that this will help by showing NeLI users how useful these reviews are and how easy they are to write.

## *Lessons for the future evaluation of NeLI*

We now discuss lessons we have learned from this evaluation for future evaluations of NeLI.

### **Combine methods for more representative evaluation**

Log data alone give an incomplete picture of how users are behaving in the library, as do search query data, user questionnaires or informal feedback. Only by combining methods can we gain an accurate picture of how the library is used and whether it is meeting user needs. This is known as triangulation and has been reported as important for evaluation studies [16]. At NeLI we know that searching is more popular than browsing according to the log data but not according to the questionnaire data [10]. It is only when we can look into the log data of those questionnaire respondents to see whether they browsed or searched that we can be sure they are reporting what they actually did. In addition the free text search query data showed how many searches were performed but it is only by

[Type here]

looking at the log data that we can see what proportion of all searches are free text. We have learnt from our evaluation that we must more consistently combine evaluation data in order to gain a representative picture of how the library is being used and whether its design is appropriate for user needs, e.g. looking at how free text search queries compare with choice of keywords in the dropdown search and whether users use one or the other search method or both and in which order. This and other questions raised by the current evaluation will be investigated in future evaluations as an extension of the work already done.

### **Track users more accurately**

As previously discussed and as we discovered during analysis, there are problems with the accuracy of web log access data. It is not possible to know whether a second access by an IP address in one day is the same person or another person sharing the computer. There is also the issue of gateway IPs where several computers use the same IP address to access the website as in the case of NHS computers. It is possible to track users' activity more accurately by encouraging them to register, something we will be developing on the NeLI website in the near future. This will enable us not only to analyse the web access logs more reliably but also to link demographic and personal data on users to their activity on the website. Another more subtle way of identifying unique users (i.e. reducing problems in resolving IP addresses to individual users) more accurately is to use cookies, something we will be developing on the NeLI Antibiotic Resistance website ([www.anticbioticresistance.org.uk](http://www.anticbioticresistance.org.uk)) in the near future. However, this is not a complete solution as cookies can be rejected by the receiving computer or deleted by the user and cannot easily store information about user backgrounds and demographics.

### **Link use of NeLI to national and international outbreaks, media coverage, promotion at events etc.**

In August 2002 there was a large increase in hits to the legionella pages of the NeLI which coincided with an outbreak in the north of England that was widely reported in the national media. It will be useful in future to identify increases in access to topics during outbreaks and media interest, first to identify gaps in content and second to ensure that NeLI is promoted at these times in appropriate ways, e.g. links from BBC news reports, Health Protection Agency website (<http://www.hpa.org.uk>) etc. It will also be useful to evaluate the impact of promotion of NeLI at various events by analysing the log data and number of new user registrations after these events.

### **Investigate use of data mining tools and semantics**

The web access logs show that two-thirds of users only access one page per session [12]. At NeLI we are currently investigating ways of using the log data more effectively. We want to be able to identify easily entry and exit pages to determine whether this is due in part to deep linking. For users visiting several pages we want to link pages together, e.g. users who visited page X also visited page Y, and in particular to link an individual's log data with their questionnaire data and free text search data. Along with registration of users this will allow us to build up a picture of what people are really doing in the library and which bits of the library are commonly visited together, allowing us to eventually automatically personalize the library to a user according to their activity within the

[Type here]

[Type here]

site [15]. Amazon.com is a good example of recommendation by analysing user activity. For each book a list of other books that shoppers have bought with the specified book is provided, allowing customers to identify potentially relevant books. Amazon also provides a list of recommended products for registered customers based on their preferences and previous shopping habits. It is also possible to recommend potentially relevant documents in the library using the ontology that the library is built around. Using a semantic ontology to improve the search would allow users to broaden or narrow their search by pruning or widening the underlying ontology. For example, in the MESH tree a semantic relation may exist between two terms, such as eye infection including conjunctivitis; this can be used so that when a search is performed for eye infection the results for conjunctivitis are automatically returned as well as other diseases in the 'eye infection' branch of the MESH tree.

### **Keep asking users for feedback and promoting NeLI at relevant events**

Our results from the questionnaire survey also highlighted the fact that more awareness of NeLI was needed (as most of the users were accessing the questionnaire for the first time). Consequently, NeLI has been promoted at various medical and health events (such as the Health Protection Agency Annual Conference and the Federation of Infectious Societies Annual Conference) and informal feedback from visitors to the NeLI stand has proved invaluable both in informing site development and in promoting the library to new users. Formal feedback, such as a feedback form on the library website, the online questionnaire previously discussed, and advisory board and project board meetings have also indicated where NeLI can be improved and have provided ideas for development. In addition the online questionnaire asked users to try to answer an information need using NeLI and asked for feedback on how easy this was and where improvements could be made. The information received was used along with other feedback as described above in directly informing redesign of the library website earlier this year. We need to keep asking users as the Internet is a dynamic platform and users are less likely to be loyal should something better come along. A recent paper discussed the potential of iterative system design for NeLI [17].

## **Conclusion**

Five years of evaluating the use of the NeLI has helped us redesign our digital library and taught us some valuable lessons for future evaluation methods to be employed for NeLI or any other medical digital library. We need to ensure that future evaluations are comprehensive and robust in design. It is necessary for a service to have a solid user base before comprehensive evaluation of the service can be performed. Initially when the pilot library was launched in 2000 the focus was on building the service, generating core content and raising awareness to establish this user base. The importance of triangulating methods has been highlighted in this study and lessons have been learned for future evaluation of NeLI. We at NeLI do not consider evaluation of NeLI as a one-off activity but consider it as a continuous process to ensure that our library remains the key resource of information on infectious diseases.

[Type here]

## References

- 1 Adams A, Blandford A. Acceptability of medical digital libraries. *Health Informatics Journal* 2002; **8** (2); 58–66.
- 2 Gray M, de Lusignan S. National electronic Library for Health. *British Medical Journal* 1999; **319**; 1476–9.
- 3 Kostkova P, Mani-Saada J, Weinberg J. Agent-based up-to-date data management in National electronic Library for Communicable Disease. In Nealon J, Moreno T eds *Applications of Intelligent Agents in Health Care* 103–22. Whitestein Series in Software Agent Technologies, 2003.
- 4 Smith K. The role of professional societies in the development of the National electronic Library for Communicable Disease. MSc thesis, City University, 2000.
- 5 Horby P, Rushdy A, Graham C, O'Mahony M, PHLS Overview of Communicable Diseases Committee. PHLS overview of communicable diseases 1999. *Communicable Diseases and Public Health* 2001; **4** (1); 8–17.
- 6 Rozic-Hristovski A, Hristovski D, Todorovski L. Users' information seeking behaviour on a medical library website. *Journal of the Medical Library Association* 2002; **90** (2); 210–17.
- 7 Nicholas D, Huntington P, Williams P. Micromining log files: a method for enriching the data yield from Internet log files. *Journal of Information Science* 2003; **29** (5); 391–404.
- 8 Madle G, Kostkova P, Mani-Saada J, Weinberg J. Evaluating the changes in knowledge and attitudes of digital library users. In Koch T, Torvik Sølveberg I eds *Proceedings of the 7th European Conference on Research and Advanced Technologies for Digital Libraries (ECDL 2003), Trondheim*. Berlin: Springer, 2003.
- 9 Madle G, Kostkova P, Mani-Saada J, Williams P, Weinberg J. Changing public attitudes to antimicrobial prescribing: can the Internet help? *Informatics in Primary Care* 2004; **12** (1); 19–26.
- 10 Roy A. Results of the online questionnaire evaluation of NeLI. August 2004 to September 2004. Available at <http://topcat2.soi.city.ac.uk/Anjanareport3.nsf/Reportquest?OpenPage>.
- 11 Van den Brinka J L, Moormana P W, de Boerb M F, Pruync J F A, Verwoerdb C D A, van Bemmela J H. Involving the patient: a prospective study on use, appreciation and effectiveness of an information system in head and neck cancer care. *International Journal of Medical Informatics* 2005; **74** (10); 839–49.
- 12 <http://www.staff.city.ac.uk/~jane/weblogs.html>.
- 13 Jansen B. The effect of query complexity on web searching results. *Information Research* 2000; **6** (1); <http://informationr.net/ir/6-1/paper87.html>.
- 14 Mani-Saada J, Madle G, Williams P. Initial experience with developing communities of practice around the National electronic Library for Communicable Disease. In *Proceedings of the 1st Healthcare Digital Libraries Workshop (HDL 03) at ECDL 2003, Trondheim*.
- 15 D'Souza S, Kostkova P. Agents in online healthcare digital library management of the National Resources for Infection Control. In *Proceedings of the 3rd Healthcare Digital Libraries Workshop (HDL 05) at ECDL 2005, Vienna*.
- 16 Ammenworth E, Iller C, Mannsman U. Can evaluation studies benefit from triangulation? A case study. *International Journal of Medical Informatics* 2003; **70** (2–3); 237–48.
- 17 Patel N, Kostkova P. Design research: the deferred actions of the design of the National electronic Library of Infection (NeLI). In *Proceedings of the 3rd Healthcare Digital Libraries Workshop (HDL 05) at ECDL 2005, Vienna*.

## Correspondence to: Gemma Madle

---

**Gemma Madle** MSc, Research Assistant

City eHealth Research Centre  
City University, Northampton Square, London  
EC1V 0HB, UK  
E-mail: [g.c.madle@city.ac.uk](mailto:g.c.madle@city.ac.uk)

**Patty Kostkova** PhD, Head of Research Centre

City eHealth Research Centre  
E-mail: [patty@soi.city.ac.uk](mailto:patty@soi.city.ac.uk)

[Type here]

**Jane Mani-Saada** MSc, Research  
Assistant

*City eHealth Research Centre*  
E-mail: [j.mani-saada@city.ac.uk](mailto:j.mani-saada@city.ac.uk)

**Anjana Roy** MSc PhD, Project Manager

*National Knowledge Service – TB Pilot*  
*Health Protection Agency*  
61 Colindale Avenue, Colindale, London  
NW9 5EQ, UK  
E-mail: [Anjana.Roy@hpa.org.uk](mailto:Anjana.Roy@hpa.org.uk)

[Type here]