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Radiology on Internet: advice in consulting websites and evaluating their quality

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Abstract. Services offered by Internet are increasing continually and 15,000 medical websites covering all the specialties are available presently. Finding relevant information with a spider-web organization is difficult. We recommend starting with hierarchical lists which propose a selection of sites corresponding to medical specialties. We give our selection of important radiological websites dealing with image databases, case reports, radioanatomy and continuing medical education. While surfing the Web, an evaluation of the quality of websites is necessary. We used quality criteria proposed by Darmoni to rate the quality of ten websites. The global quality is good; help pages and external links are the main noticed shortcomings. All webmasters should pay attention to quality criteria and show visible marks of Darmoni criteria on their home page. To be able to foresee which Internet options should be developed, we evaluated our website and sent a questionnaire to our users. Clinical cases are the most requested facilities; they could be used for continuing medical education.

Key words: Internet – Education – Quality control

Introduction

The medical world has been included in the transformation of society's communication means, and more than 15,000 medical sites are available presently. Websites are located mainly in the United States and are provided by universities, scientific associations and hospitals. They cover many specialities including dermatology [1], odontology [2] and pathology [3], and radiology. These sites represent huge amounts of knowledge which can be reached from work or from home, but the lack of hierarchical organisation of this spider-web network leads to the two main problems encountered by the novice "nternaut" how to find the website containing the information he is looking for and how to check the quality of the information discovered [4].The purpose of this paper is to suggest the current state of the art of the radiological websites, present our methodology to find information and define our quality criteria to evaluate the sites' quality. These data are developed in the first two sections. Since the Internet is constantly changing, this state of the art will be ephemeral; thus, in order to be able to foresee the evolution and to help people who are interested in making their own website, we conducted a study of the requests on our site and a poll of our users. The results of the survey and their conclusions are presented in the third section.

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How to find radiological sites

Site-seeking tools

To find a website highly empirical methods are used. The easiest method is to get the address in a publication dealing with the Internet [5] or in an advertisement. Some sites, such as Pubmed, which allows Medline's bibliographic requests, are well known and its address (http://www.ncbi.nlm.nih.gov/PubMed) is widely circulated. From a website links are often created by the Webmaster to other sites dealing with the same or complementary subjects, and information can be found by "surfing" from site to site by following these. This way of looking for information is time-consuming and the quality of the search depends on the quality of the available links. To overcome these disadvantages, sites with specialised hierarchical lists of homepages classified by topic can be set up. Webmasters define the topics (cardiology, radiology, etc.), initiate links and ensure that they are kept up to date. We propose a list of such sites, the first two of which are regarded as references for information retrieval for English and French speakers, respectively [6]:

Table 1. Names and addresses of main servers of image databases

Name	Address	proposed services
University of Nancy	http://www.spieao.u-nancy.fr/	Images concerning AIDS. Computer assisted teaching of chest imagong and temporo mandibular joint
Medical School of Grenoble	http://www-sante.ujf- grenoble.fr/SANTE/imavu/imavu.html	US images concerning vascular diseases (150 images)
Library University of British Columbia	http://cpmcnet.columbia.edu/dept/radiology/TUTORIAL/	Images of congenital malformations (fifty cases)
EMBBS Radiology Library	http://www.embbs.com/xray/xr.html http://www.njnet.com/ ~ embbs/xray/ctscan/ct.html	Normal and pathological plain films and CT
University of Toronto	http://www.utoronto.ca/imaging/images.htm	Images data base
Dr. Morimoto's Image Library	http://www.osaka-med.ac.jp/omc-lib/noh.html	Images data base
Shimane Medical University	http://www.shimane-med.ac.jp/IMAGE/Radiology.html	3D MR images data bases
Harvard University/Brigham RAD	http://brighamrad.harvard.edu/	3D MR images data bases

http://www.medmatrix.org/index.asp
http://www.chu-rouen.fr/ssf/ssf.html
http://www.caducee.net
http://www.cc.emory.edu/whsl/medweb.html
http://www.spinnaker.fr/siteor.html

On some sites information search can be carried out using key words, and these are very useful when looking for, for example, a specific disease. In order to find correct terms we recommend as first choice two servers using a glossary of indexed medical terms such as the MESH for Cliniweb:

http://omni.ac.uk
http://www.oshu.edu/cliniweb

Sites of hierarchical lists are very convenient, especially when starting to look for information on the web. The limitations of such sites are a lack of completeness, because all the information available is not referenced. The quality of such sites depends on the frequency with which they are updated.

When these two methods fail, use of search engines is necessary. With these servers, web sites can be found using key words (e.g., Alta Vista) or topics (e.g., Yahoo). An automatic indexing of all the referenced sites is performed 24 h a day by a syntax-analysing program:

http://www.altavista.com/
http://guide-p.infoseek.com/
http://www.yahoo.com/
http://lokace.iplus.fr/
http://www.nomade.fr/
http://france.ecila.com/
http://www.metacrawler.com/
http://www.dogpile.com/

The above websites are very easy to use and regularly updated, but no quality control is performed and the answer to a request can include thousands of sites. Once interesting sites are found, the address has to be kept as a "bookmark" or "favourite".

Our selection of radiological websites

Using the hierarchical list of Rouen University, MedicalMatrix and their suggested links between the sites, we propose a selection of the most interesting radiological sites. They are classified according to the services offered: image databases, case reports, radioanatomy, continuing medical education and debates (anyone is able to make their own list according to their particular needs [7]).

Image databases

A wide range of images, including plain films, ultrasound, CT and MR images, are available on radiological servers, with our selection presented in Table 1. The images are classified either by acquisition method, concerning a certain part of the body, or by pathology. Potentially any kind of image and its comment can be found because these image databases are well stocked. They are very useful for students and teachers because they can rapidly get an example of a precise pathology. One important limitation is the frequent lack of clinical context. Another drawback is the medium quality of the images especially for digitised plain films. To limit the size of the digital files and afford rapid image display, digitisation is usually performed with low resolution. The long delay needed to transfer and display the 3D image databases provided by some American universities limits their use.

Table 2. Name and addresses of servers with more than 100 clinical cases

Name	Address	Language	Number	Easy access	Interactivity
Harvard University	http://brighamrad.harvard.edu/	English	> 150	Yes	Yes
Indiana University	http://www.indyrad.iupui.edu/	English	Unknown	No	No
Case Western Reserve University	http://www.uhrad.com/	English	> 100	n	No
Laurie Imaging Center	http://130.219.15.246/	English	> 100	Yes	No
Nagasaki University Hospital of Dentistry	http://www.dh.nagasaki-u.ac.jp/rad/	English	Unknown	No	No
University of Alabama	http://www.rad.uab.edu/Radiology/UAB_Radiology_Teach_File/TF_main2.html	English	420	No	No
Wayne State University	http://www.med.wayne.edu/diag Radiology/wsuhomepage.html#Cases	English	> 100	No	No
Radiology Museum	http://www.sbu.ac.uk/ ~ dirt/im0.html	English	> 100	Yes	Yes
Penn State University	http://www.xray.hmc.psu.edu:80/tf.html	English	> 100[a]	No	No
Virtual Radiological Case Collection	http://radserv.med-rz.uni-sb.de/en.index.html	English/German	Unknown	Yes	No
University of Washington	http://www.rad.washington.edu	English	> 100	No	No
Uniformed Services University	http://radlinux1.usuf1.usuhs.mil/rad/home/teach.html	English	Unknown	No	No
Virtual University of Radiology	http://www.med.univ-rennes1.fr/ ~ seka/bibliotheque.html	French/English	> 3500	Yes	Yes

[a] Site with clinical cases from several universities

Table 3. Names and addresses of servers with less than 100 clinical cases

Name	Address
Bowman Gray School of Medicine	http://www.rad.bgsm.edu/radmain/htmls/cases/cases.html
New York University	http://nucmed.med.nyu.edu/RadPath/radpath.htm
Boston VA Med Center	http://med-www.bu.edu/bostonvamc/radcases/caseindx.htm?
Dalhousie University	http://bpass.dentistry.dal.ca/casestudies.html
McGill University	http://www.rad.mgh.mcgill.ca/Teaching/TeachingFiles.html
Rush Presbyterian–St. Luke's Medical Center	http://www.rad.rpslmc.edu/ ~ afield/cotw.html
Tulane University	http://www.tmc.tulane.edu/departments/Radiology/rad_home/recasarc/recasarc.html
University of Alberta	http://raddi.uah.ualberta.ca/ ~ hennig
University of Kentucky	http://fellow1.mri.uky.edu/
Michael Tobin Radiology	http://www.octet.com/ ~ mikety/residents.html
University of Palermo	http://mbox.unipa.it/ ~ radpa/tf.html

Case reports servers

Case reports servers are a more sophisticated method of information transmission, using the clinical cases which are a traditional means of medical data transmission, fitted to all specialities, and are very convenient.

The file display is not standardised; in the simplest way, the past history is given first, followed by images with their report and a diagnosis. A comment is sometimes included as well as a recall concerning the pathology. A more sophisticated option consists of presenting interactive files which stimulate the user's thoughts. The past history and the images are presented without the reports. The user has to make a report and a diagnosis to get the expert's advise. On our server an automatic correction is performed (http://www.med.univ-rennes1.fr/ ~ seka/eval_connaissance.html). Case reports can be classified either by speciality or alphabetic order. When a significant number of cases is presented, several search criteria are proposed in order to facilitate information research [8].

To evaluate the quality of these servers, we counted the available files. From all the radiological sites we evaluated, only 12 had more than 100 clinical cases (Table 2). In Table 3 we present the sites with fewer clinical cases but which we found particularly interesting. As mentioned previously, images are of medium quality, because of low resolution during the digitisation process or the use of compression algorithms to reduce transfer delays.

Two servers proved very interesting because of their interactivity, the first one located at Harvard University (http://brighamrad.harvard.edu) and the second at Marshall University School of Medicine (http://medicus.marshall.edu/medicus.htm). The first site is called "Finding the Path" and aims to teach how to make a diagnosis using interactive clinical cases. To achieve this task, the student learns how and when to use lab tests.

Table 4. Radioanatomy servers

Name	Address	Language	Inter-activity	Proposed services
The visible human project	http://www.nlm.nih.gov/research/visible/visible_human.html	English	Yes	Anatomical cuts
University of Washington Online Muscle Atlas	http://www.scar.rad.washington.edu/muscleatlas/	English	Yes	Schemes of the muscular system
University of Michigan – Atlas	http://www.med.umich.edu/lrc/Atlas/atlas.html	English	No	Anatomical cuts and schemes
Uniform Service University of Bethesda	http://radlinux1.usuf1.usuhs.mil/rad/iong/index.html	English	Yes	radioanatomy
Whole Brain Atlas	http://count51.med.harvard.edu/AANLIB/home.html	English	Yes	Normal and pathological radioanatomy
University of Washington	http://www.rad.washington.edu/AnatomyModuleList.html	English	No	Squelettal radioanatomy
Laurie Imaging Center	http://130.219.15.246/database/frameanat.html	English	No	Radioanatomy
Anatomical Institute of Paris	http://anatmac3.citi2.fr/anatomie/iconographie/icono.html	French	No	Human anatomical schemes
Virtual University of Radiology	http://www.med.univ-rennes1.fr/cerf/edicerf/RADIO ANATOMIE/TABMAT.html	French	No	Texts, images of the whole body

The second site is entitled "The Interactive Patient" and has a virtual patient who briefly relates his history. The user has to make a diagnosis after having asked for past history, carried out a clinical examination and chosen lab tests. No correction of the diagnosis process is performed, and the exercise ends when the adequate diagnosis and treatment are proposed.

Anatomy and radioanatomy servers

Radioanatomy lends itself very well to computer-assisted teaching: images and comments are at students' disposal; thus, everybody can learn at their own pace. A list of the main servers is presented in Table 4. They supply a lot of good-quality images covering all the organs, but few interactive options are available. We found only three sites, "The Visible Man", Bethesda University and Laurie Imaging Center, that offered such options which make learning more attractive and effective.

This situation is due to the great difficulty of building and maintaining such sites compared with the relative simplicity of dealing with sites with no interactive options.

The Internet is a powerful tool to teach anatomy and radioanatomy to the medical students and to practitioners during continuing medical education and training. The capabilities of 3D visualisation software are useful in understanding complex images using alternatively volume surface shaded rendering, translucency and maximum intensity projection.

Most of the servers present plain films or CT scans with the corresponding anatomical specimen and legends or text added. The lack of interactivity can induce a passive reading. We prefer the possibilities offered by more interactive servers such as The Visible Man, University of Bethesda or Laurie Imaging (Table 4). Improving interactivity means very sophisticated programs which are difficult to write and to maintain, and in order to do so a specialisation of the site is necessary. This option has been used by the team in charge of the "Whole Brain Atlas": the server is very rich and offers many possibilities but is dedicated purely to MR examination of the brain. We do think that these options will be taken by the majority of the websites dealing with radioanatomy teaching. The proposed virtual anatomy lessons have to be attractive in order to interest students in universities as well as physicians for continuing medical education. Following this point of view, care should be taken to present radioanatomy using all facilities of the 3D display software available including various systems of volume rendering.

Servers of continuing medical education

The Internet should be a major tool for continuing medical education (CME). It offers permanent access to regularly updated databases; nevertheless, it is not yet widely used for this purpose. Some sites located in the United States offer the opportunity to get credited hours using The Internet (Table 5). All of these sites offer the same performances: a case is exposed and several questions have to be answered. An automated correction is performed, if necessary. The validation of the credits is obtained after a good answer to a variable number of cases. This number and the subscription's cost vary with the websites. The Accreditation Council for Continuing Medical Education is in charge of the validation of the sites. Once a site is accredited, it is for all specialities.

Continuing medical education is certainly due to increase, although the remaining limitations are the low rate of connected computers in physicians' offices and the lack of diversity in information display.

Table 5. Servers of continuing medical education

Name	Address html	Fee	Validation
Anderson Cancer Center, University of Texas	http://netcme.mdacc.tmc.edu/	$10/h	A good answer to five clinical cases is mandatory
Radweb, cme course, University of Medicine of New Jersey	http://www2.umdnj.edu/radweb/intr_cme.html	Free	After image analysis a questionnaire has to be completed[a]
The Virtual Hospital, University of Iowa	http://vh.radiology.uiowa.edu	$45	After image analysis a questionnaire of 12 multiple-choice questions has to be completed
University of Washington	http://www.rad.washington.edu	Registration $25, then $10/h	One cme credit validated for ten clinical cases analysed with at least one good answer to questions
Loyola University, Chicago	http://www.meddean.luc.edu/lumen/	–	Registration is mandatory to access the site
Camberra Hospital	http://xray.anu.edu.au/cgi-bin/cme/cme-dbm.pl	–	Multiple-choice questions (evaluation in progress)
The Interactive Patient	http://medicus.marshall.edu/medicus.htm	Free	Examination, diagnosis and treatment of a virtual patient
The Uniformed Services University of the Health Science, Bethesda	http://radlinux1.usuf1.usuhs.mil/rad/home/teach.html	–	Evaluation modalities not yet fixed

Fee amounts in U.S. dollars
[a]Each case is 1 cme credit worth, and immediate results are obtained by e-mail

Forum servers

The Internet is a very powerful communication tool, having been designed to allow easy transmission of messages. This functionality is used with electronic mail and for chat rooms which are popular amongst the general population. Concerning the radiological world, this opportunity to have a discussion or to ask for advice is not widely used. We found only four sites which offered access to a forum page: the universities of Harvard (http://brighamrad.harvard.edu/), Rennes (http://www.med.univ-rennes1.fr/ ~ seka/frameSB1.html), Grenoble (http://ujf-iab.ujf-grenoble.fr/health/) and Lyon (http://194.167.219.18/). For all these forums, reflections or questions concerning subspecialties (e.g. neuroradiology, interventional radiology, contrast medium) are proposed and everybody is free to give their advice or comments.

Two websites offer the possibility of seeking advice for difficult situations: servers of Rennes (http://www.med.univ-rennes1.fr/ ~ seka/frameSB2.html) and Nagasaki (http://www.dh.nagasaki-u.ac.jp/rad/). On these two sites virtual staff with anonymous clinical cases and their requests are sent to a specialist or a group of specialists. After resolution of the problem, these exemplary cases are available for consultation on the server. In Nagasaki 147 cases were transmitted in 1 year and 57 didactic ones were left on the server. The main drawback described by the site's webmaster was the small amount of images which could be sent, with some consequent difficulties in performing a good report of an examination [9]. These problems should disappear with new interfaces which will be designed to prepare and consult easily digital files [10, 11].

Discussion

The information presented in this paper is not exhaustive and will be rapidly out of date because of the continual evolution of the Internet: websites disappear and are created every day. Improvement will occur in image quality, with digital data from CT, MR or ultrasound images to be directly transferred on websites. As these files will be larger, network performances will have to be increased at the same time in order to keep the same or reduce delay in transferring and displaying images.

Quality of the radiological websites

Evaluation of the global quality of a website as well as evaluation of the information validity is not easy. As demonstrated by Impicciatore et al. [12], poor information can be transmitted with the web. They looked for sites dealing with "fever treatment of a child". They have clearly demonstrated that the majority of the sites gave erroneous information by recommending either a bad way of taking the temperature or giving wrong recommendations concerning the start of a drug course. Only few sites gave adapted information, and they did not appear in the first choices. Wrong information was given before the advent of the Internet, of course (i.e., such problems occurred previously with papers). With the Internet, controls are difficult to set up or enforce; thus, no denial can be diffused. To overcome this difficulty it is important to check the credibility of the site. Its selection in a hierarchical list of a specialised server can be a guarantee to some extent. The systematic search of specific quality criteria is also necessary.

Table 6. Darmoni criteria

Institution's name
Last update
Authors
Target of the Website
Grants
Justification of the site
Editorial committee
Webmaster's identity
Electronic mailbox for criticisms, comments, suggestions
Information corresponding to evidence-based medicine
Internal search engine to facilitate the search of information
General index of all html documents htmlof the site
„What's new?" heading to visualize quickly the site's innovations
Help page
Map of the site
Regular checking of the validity of the hyper-links
In the event of modification of structure of a site, links between old html documents and new ones
Navigability: easiness of the information research
References to the original sources
Selection of external hyper-links
Distinction between internal and external hyper-links
The number of computers connected to the site and number of visualized documents

Darmoni criteria

Since the conventional reviewing methods are not adapted to this new communication tool, new evaluation criteria have to be found. Several papers which deal with new scales have already been published [13, 14, 15]. Darmoni made a synthesis and suggested using 22 criteria to evaluate the sites (Table 6). The aim is not to judge the quality of the information but to focus on the architecture of the site and on the help provided to find information. As mentioned previously, the main problem encountered on the Internet is to find information. Another goal of this evaluation is to measure the originality of the work. It is easy to build a site by copying data from other sites or to enable links.

In practise, for each of the 22 criteria, one point is given if the conditions are fulfilled. A score can be calculated and this allows the comparison of several sites. We did this comparison for ten sites, and the results are presented in Table 7. The main gaps which were obvious were the lack of search tools to help find data using key words, of help pages and of instructions. Concerning Laurrie Imaging Center, no clear statement concerning authors and the origins of the available data are presented on the homepage. Despite this, it is an excellent clinical-case website. For the Virtual University, insufficiencies concerning the lack of site map and links with other sites were noted.

Discussion

In dealing with a new means of communication, new presentation rules have to be established [16]. Care must be taken to respect presentation constraints, and to find a good balance between image quality and the time needed to display an image [17]. The quality of the sites has to be objectively recognised by all: several scales have already been discussed [18].

The major changes introduced by the Internet is changing our social behaviour, and this will have repercussions on the medical world [19, 20]. These modifications will be considered as improvements if the information available is of good quality. Webmasters must pay careful attention to this and ensure that the homepage points out that the quality of the site is one of their main concerns. Information verification is the first rule and should be performed by a reading committee. On the user's side, all "internauts" should look for the quality criteria before using a site.

In conclusion, it is imperative for webmasters to ensure the quality of information and show that they actively promote it by revealing visible marks of the criteria of Darmoni. The checking of the data by an editorial board identified is obviously the first rule to be respected. Any user of a site will have to seek these elements ensuring the pertinence of the site consulted to themselves.

Table 7. Scores of ten servers evaluated with Darmoni criteria

Name	Address html	Score (max. 22)
Laurie Imaging Center	http://130.219.15.246/	12
Anderson Cancer Center, University of Texas	http://netcme.mdacc.tmc.edu/	14
Radweb,cme course, University of Medicine of New Jersey	http://www2.umdnj.edu/radweb/intr_cme.html	14
The Virtual Hospital, University of Iowa	http://vh.radiology.uiowa.edu	16
University of Washington	http://www.rad.washington.edu	14
The Interactive Patient	http://medicus.marshall.edu/medicus.html	14
University of Nancy	http://www.spieao.u-nancy.fr/	15
Whole Brain Atlas	http://count51.med.harvard.edu/AANLIB/home.html	16
Harvard University–Brigham RAD	http://brighamrad.harvard.edu/	15
Virtual University of Radiology	http://www.med.univ-rennes1.fr/cerf/cerf.html	19

How to implement a radiological site

We are sure that we shall use the Internet more and more in the future, but it is difficult to foresee which options will be plebiscitary. Technological evolutions (transfer speed, ease of connection) as well as users' requests will also influence the choices made by webmasters. To evaluate our users' expectations, we have analysed the connections' rates on our website and conducted a survey. We are able to determine which of our services are most popular and what kind of services are expected.

VUR site presentation

The Virtual University in Radiology (VUR) started in 1997. Its aim is to teach radiology and medical imaging [21, 22]. It has been built by using the database of the multimedia server of the French Radiology Council created in 1994 [23]. It includes more than 3700 clinical cases (16,000 images) and a library of more than 15 books covering all the imaging specialities. Surfing indifferently on both databases is possible with the powerful search engine which has been previously developed [24, 25]. Using this software, which also analyses medical syntax, various computer-assisted learning modules with associated evaluations using multiple-choice questions and evaluated lectures have been developed [26]. A forum and a virtual staff allow a place for information exchange. A secretariat exists to allow registration and to obtain a password, which allows student evaluation and statistical collection to be performed.

Statistical analysis of connections to the VUR

The server of the CERF started in 1994, with the first statistics of the connections dating from 1995. The daily connection rate began at 1500, increased to 3000 in 1996 and to 15,000 in 1997. In the same period the number of connected computers rose from 150 to 300 and then to 1000. After an important development in the first years, connections stabilised at around 20,000 per day. No significant variation occurs during the year.

The VUR started in August 1997, and after a 6-month period 630 persons had registered and could access all the services; among them, 90% were medical doctors, 50% were working in a hospital, 25% in private practices and 15% were trainees. The geographical distribution shows that 15% are foreigners (primarily French speakers), but one also notes Italian, Spanish and Brazilian users. To know which facilities of the server are used, we analysed the statistics over a 3-month period. The requests are concentrated mainly on the clinical cases (70% of the requests), and then comes the library (10% of the requests); finally, the information retrieval by an indexing system called ADM-INDEX [25] is requested as much as the 15 books of the library called Edicerf. For the evaluations one also realises that the multiple-choice questions are used 12 times as much as the clinical question cases. As for access to the guides or the general public documents, they are much less important.

User survey

In February and March 1998 an investigation was addressed to the registered participants at the Virtual University. This questionnaire was sent to the 931 registered users and was also put online on the site's homepage. The participation rate was 15%, two thirds using conventional mail and one third using the Internet.

We present hereafter the questionnaire and the answers:

1. Profession: 90% were medical doctors; among them 63% were radiologists, 9% general practitioners and 12% trainees. Of all users, 57% had hospital exercise and 25% were in private practice.
2. When do you use Internet? 74% use it during their working time, 26% at home.
3. Which are your hardware and software? Personal computers are used mainly with Netscape Navigator.
4. How did you discover VUR? 34% from reading a paper, 26% while looking for information on the net, 26% during conventions.
5. What is the frequency and the duration of your Internet and VUR connections? 24% of the users get connected on VUR several times per day, 46% several times per week, 36% periodically. The duration of each connection on Internet is approximately 30 min with 10 min on VUR.
6. Why do you get connected to the Internet and the VUR? The main reason to get connected is to search for information and to exchange opinions in forums.
7. How do you evaluate VRU? Globally, Virtual University is judged in a positive way by 56% of users: 19% consider the site very good; 38% good; and 25% of medium quality. No answer was given by 15%.
8. How do you judge the functionality? The clinical cases database is the most used functionality (77% of cases): the main criticism concerns the medium image quality. The library is used in 50% of cases and is judged positively in 42% of the cases. The search engine is used in 43% of cases and is considered as good in 33% of the answers. The knowledge evaluation module is used in 56% of cases, the forums and virtual staff in 32%.
9. What new functionality would you like? Mailing lists and interactive forums come first, followed by interactive patients.
10. How do you organise your continuing medical education? It is based mainly on papers and book reading associated with refresher courses. CD-ROMs and the Internet are actually used less.
11. Would you be interested in getting credits for CME using the Internet? The majority of users agree with the use of the Internet but only to validate a quarter of the credits.
12. What is the size of your CME budget? The annual budget of CME represents more than 5000 FF for 42%

of the cases, between 1000 and 5000 FF for 30 %, and 30 % gave no answer.
13. Would you be ready to pay a subscription for the VUR? One half of users are not willing to pay, the other half is willing to pay approximately 500 FF per year.

Discussion

It can be said that the most required services are the clinical cases. The radiologists wish interactive functions but still use multiple-choice questions very often. The Internet is not the principal tool for continuous training but could be a part of it for 25 %. Connection times are short and it is thus essential that the internal search engine of the site be effective and make it possible to find information quickly. The quality of the images must be improved concerning the images of standard radiology.

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References

1. Bittorf A, Bauer J, Simon M, Diepgen TL (1997) Web-based training modules in dermatology. Med Comput 14: 371–376
2. Davis LG, Winstanley RB, Duffin R, Griffiths A (1998) Dental education resources on the Web. Eur J Dent Educ 2: 19–24
3. Horn KD, Sholehvar D, Nine J, Gilbertson J, Hatton C, Richert C, Becich MJ (1997) Continuing medical education on the World Wide Web. Interactive pathology case studies on the Internet. Arch Pathol Lab Med 121: 641–645
4. The web of information inequality (1997) Lancet 349: 1781
5. Piraino D, Recht M, Richmond B (1997) Implementation of an electronic teaching file using web technology. J Digit Imaging 10: 190–192
6. Eveillard P (1997) WWW une sélection de 50 sites. Rev Pract 396: 59–60
7. Weiler RM (1996) Creating a virtual materials and resources index for health education using the World Wide Web. J Sch Health 66: 205–209
8. Scalzetti EM (1997) Radiology teaching file cases on the World Wide Web. J Digit Imaging 10: 209–211
9. Kovalerchuk B, Ruiz J, Vityaev E, Fisher S (1998) Prototype Internet consultation system for radiologists. J Digit Imaging 11: 22
10. Khorasani R, Lester JM, Davis SD, Hanlon WB, Fener EF, Seltzer SE, Adams DF, Holman BL (1998) Web-based digital radiology teaching file: facilitating case input at time of interpretation. AJR 170: 1165–1167
11. Ohki M, Tsuru M, Yamada T, Iida H, Terada K, Izumi M, Yonetsu K, Ariji E, Nakamura T (1997) A remote conference system for image diagnosis on the World-Wide Web. AJR 169: 627–629
12. Impicciatore P, Pandolfini C, Casella N, Bonati M (1997) Reliability of health information for the public on the World Wide Web : systematic survey of advice on managing fever in children at home. Br Med J 314: 1875–1879
13. Wyatt JC (1997) Measuring quality and impact of the World Wide Web. BMJ 314 : 1875–1879.
14. Pealer LN, Dorman SM (1997) Evaluating health-related Web sites. J Sch Health 67: 232–235
15. Silberg WM, Lundberg GD, Musacchio RA (1997) Assessing controlling assuring the quality of medical information on the internet. J Am Med Assoc 277: 1244–1245
16. Scalzetti EM (1997) Radiology teaching file cases on the World Wide Web. J Digit Imaging 10: 209–211
17. Scalzetti EM (1997) Radiology teaching-file cases on the World-Wide Web: a second-generation viewer. AJR 168: 615–617
18. Berry E, Parker-Jones C, Jones RG, Harkin PJ, Horsfall HO, Nicholls JA, Cook NJ (1998) Systematic assessment of World Wide Web materials for medical education: online, cooperative peer review. J Am Med Inf Assoc 5: 382–389
19. Lapeyre AC (1997) The World Wide Web is already changing medical education Acad Med 72: 563–564
20. MacKenzie JD, Greenes RA (1997) The World Wide Web: redefining medical education. J Am Med Assoc 278: 1785–1786
21. Duvauferrier R, Chagnon S, Brunelle F (1997) The Virtual University: education in the 3rd millennium? J Radiol 78: 421–423
22. Duvauferrier R, Seka LP, Rolland Y, Rambeau M, Le beux P, Morcet N (1998) Virtual University of Radiology: context, concept, specifications and user manual. J Radiol 79: 825–835
23. Duvauferrier R, Rambeau M, Morcet N (1995) Image databases and multimedia works on server and CD-ROM in medical imaging. A French experience. J Radiol 76: 1079–1085
24. Seka LP, Fresnel A, Delamarre D, Riou C, Burgun A, Pouliquen B, Duvauferrier R, Le Beux P (1997) Computer assisted medical diagnosis using the Web. Int J Med Inf 47: 51–56
25. Duvauferrier R, Le Beux P, Pouliquen B, Seka LP, Morcet N, Rolland Y (1997) Value of automated medical indexing of an image database and a digital radiological library. J Radiol 78: 425–432
26. Denier P, Le Beux P, Delamarre D, Fresnel A, Cleret M, Courtin C, Seka LP, Pouliquen B, Cleran L, Riou C, Burgun A, Jarno P, Leduff F, Lesaux H, Duvauferrier R (1997) A network of web multimedia medical information servers for a medical school and university hospital. Int J Med Inf 46: 41–51