PERSONAL PRACTICE

Can paediatricians benefit from the Internet?

Mikael Benson, Ingemar Kjellmer, Sten Rosberg, Håkan Billig

The Internet, the global network which connects millions of computers in a web, makes almost immediate communication possible, irrespective of the location of its users. The fast growth in the total number of users, both private and professional, is exceeding most predictions.

Likewise, the amount of accessible medical information is increasing rapidly. Ideally, this could provide a formidable opportunity for paediatricians to exchange and process medical information with colleagues around the world from their office or home. Can the Internet be of any practical use to the paediatrician today? A non-technical commentary is given here, with examples of the clinical, educational, and research applications available today as well as possible future directions.

Background

The general characteristics of the Internet have been thoroughly reviewed[1–5] and are probably familiar to most readers of this journal. It might, however, be appropriate to mention that essentially four types of services are found on the Internet: e-mail, discussion groups (UseNet), access to public documents, and file databases (ftp sites). The most popular and user friendly service is the World Wide Web, which is reached by a point and click interface. The two main applications of the Internet are electronic mail, which usually involves the interpersonal exchange of information, and reading documents posted as Web sites on the Net, primarily a form of one way communication.

Table 1 lists some useful Internet addresses in the same order as they appear in this paper. It is important to emphasise that such addresses may change, but may then be found using search programs such as Altavista. Table 1 is also available on the Internet with direct links to the Web sites.

Web sites

Anything that can be digitised can appear on a Web page, including text based documents, pictures, animations, and sounds. Although most sites only offer the passive consumption of information by the viewer, a few offer various forms of interactivity. The main drawbacks of searching for information on the Net are that the quality of the Web sites varies considerably, which is often difficult to judge from the initial presentations. Furthermore, the transmission of data can be slow during busy periods, for instance during daytime in the USA, or if the viewed Web page contains large sets of data such as pictures and video clips.

Daily news feeds

It is possible to display up to the minute news on your computer screen from newspapers and broadcasting corporations such *The Times* and CNN, which have Internet editions. More interesting for the clinician is the possibility of receiving daily medical news. For instance, CNN (CNN Health) offers a continuously updated Web site on medical news in laymen's terms. A more professional service, for instance that provided by Reuters health information service, is offered at the Professional Medical News Web site, which has high credibility because the source of information is always clearly posted. The subjects covered are clinical and scientific news, and news from the pharmaceutical industry. In addition, this site has an advanced search capacity for previously published material.

Clinical applications

General practitioners in remote locations in Norway have used e-mail to consult with specialists. Both parties were pleased and the skills of the general practitioners improved.[6] The specialists appreciated that e-mail, unlike the beeping pager, did not interrupt their work and gave them more time for reflection than a telephone conversation. Documents such as case histories could be attached to the messages. This type of communication is known as telemedicine, which implies the transmission of medical information at a distance. It has been used to send radiographs and electrocardiograms, but standard multimedia equipment makes it possible to send not only pictures and text, but also videos and sound. As communication and the interactive use of information is an integral part of medical work, telemedicine may prove useful in clinical practice.

The Internet can also be used for various forms of digital meetings. International Pediatric Chat, for example, provides scheduled meetings on various topics where members can ask and answer questions. NICU-NET is another example of an active network for discussion on general neonatal topics and on

Department of Paediatrics, East Hospital, S-41685 Gothenburg, Sweden
M Benson
I Kjellmer

International Paediatric Growth Research Centre, Department of Paediatrics, East Hospital, Gothenburg, Sweden
S Rosberg

Department of Physiology, Gothenburg University, Gothenburg, Sweden
H Billig

Correspondence to:
Dr Benson.

specific case related problems. This form of communication may have legal implications, however. Who is responsible if a patient is treated as a result of a digital conference[7] ?

The Internet World Congress on Biomedical Sciences offers a digital conference, complete with poster sessions, symposia, welcome party, and virtual tours of the organisers' country. The congress includes a paediatric section where visitors can exchange comments with the authors via e-mail. The welcome party consists of the exchange of e-mail messages or an 'on-line real time party' for experienced users. Special software enables and allows real time conversations.

MEDLINE can be reached on the Internet and, in our experience, is the most useful resource for the retrieval of information on published material in journals and books. This service is free of charge for employees in many centres, but usually these sites are either closed to the public or can be accessed for a nominal fee. We found, at the time of writing this paper, at least one site where MEDLINE was open without cost. Immediate access to medical information through one's own desktop computer can be tremendously helpful in many clinical situations.

OMIM is another searchable database dedicated to genetic diseases. It is the continuation of the McKusick database on clinical syndromes, regularly updated from the National Institutes of Health, USA. For example, to find out information about a child with thrombocytopenia and aplasia of the radius, an OMIM search based on the words 'thrombocytopenia and radius' will yield five matching diseases, with links to MEDLINE and relevant retrievable abstracts. It is also possible to obtain images of the diseases. An increasing number of medical journals, including *Archives of Disease in Childhood*, have online publications that offer lists of contents, abstracts, or, in some instances, full papers.

PEDINFO offers a comprehensive list of Web sites of interest to paediatricians and is ordered by subject. These sites include paediatric subspecialties, educational and parental resources, on-line publications, and paediatric institutions. Many hospitals and clinics have Web sites which include information about their staff, training programmes, and research projects.

PEDINFO also has a link to paediatric software, such as interactive games designed to teach children how to cope with chronic illness. The object in one such game is to 'Get Derwood the Diabetic through an adventure packed day without ending up in the hospital'. There are also sites that give information intended for use by parents and children (in some instances detailed descriptions of the doctor's professional and personal achievements, including photos). The information can be in the form of questions and answers, comprehensive descriptions of diseases, or investigative procedures. The authors' own experience is that this information may be appreciated by parents and children, if carefully designed. The main advantages are that written information can be saved, reread, and become the basis for questions and discussions. Several patient and parent organisations also offer information on their own Web sites. In some instances these may be inaccurate or misleading. As the usage of the Internet by patients, parents, and paediatricians increases, however, it is possible that material obtained from the Web may become an important part of clinical reality in the near future.

Education

There are many sites on the Internet which offer educational material integrating text, photos, sounds, and video clips. The Virtual Hospital is a good example, where a presentation of pseudocroup may have links to the sound of the cough and a video of a coughing child. Other sites offer heart and lung sounds in health and disease. There are also sites with interactive case simulations. For example, a description of a child with respiratory arrest can be followed by a panel of clickable icons with different procedures and treatments. Correct choices in the right order are required to proceed in the simulation. Multimedia and interactivity are clearly useful for realistic medical education and the Internet offers a means of cheap distribution of the material. Furthermore, interactive programs with special aims, such as preparing the student for the emergency room, may be made with links to relevant sites. It is also easy to update and collaborate with such programs. Downloading educational material is usually free and requires some extra, but relatively inexpensive, multimedia equipment.

Research

The main benefit of the Internet to research is probably as a tool for communication and collaboration. E-mail makes it easy to exchange information, such as spreadsheets with data, or to develop research programs or to collaborate with the authors of papers. Immediate access to MEDLINE or specific databases such as the Genome Database is helpful to researchers. It is also possible that the increased use of the Internet will lead to the development of the computer both as means of communication and also as a research tool *per se*.

The Cybermouse project, although not paediatric, exemplifies these possibilities. The project attempts to make computer simulations of the mouse immune system. These simulations can be used for 'in silico' experiments that are open to the international scientific community via the Internet. The project is interesting for a number of reasons. It highlights the enormous potential for collaboration via the Net, irrespective of geography. It also makes critical scrutiny possible. The author was asked directly about the Cybermouse project by e-mail. This inquiry resulted in a swift reply with references. The most interesting references were retrieved from MEDLINE and were stored in a reference program, one of which was copied and added to the reference list in this paper.[8] A MEDLINE search showed that a commentary letter had been written

Table 1 Some examples of interesting Web sites

Name of site	*Internet address*
Table 1 on the Internet	http://webnet.mednet.gu.se/~billig/table_1.html
Altavista	http://www.altavista.digital.com/cgi- bin/query?pg=q
CNN Health	http://cnn.com/HEALTH/index.html
Professional Medical News	http://www.reutershealth.com/news
International Pediatric Chat	http://www.pedschat.org
NICU-NET	http://weber.u.washington.edu/d08/neonatal/NICU-NET/subscribe.html
Virtual Congress	http://www.3iwc.riken.go.jp
Medline	http://darst-sgi2.rockefeller.edu/search-it-all
OMIM	http://www3.ncbi.nlm.nih.gov/Omim
On-line Publications	http://www.uab.edu/pedinfo/Journals.html
Pedinfo	http://www.uab.edu/pedinfo/index.html
'Derwood the Diabetic'	http://www.nd.edu/~hhowisen/vd/virtual.html
Virtual Hospital	http://indy.radiology.uiowa.edu
Case Simulation	http://www.njnet.com/~embbs/pals/pals.html
Genome Bank	http://gdbwww.gdb.org
Cybermouse	http://bitmed.ucsd.edu/cybermouse.html
NIH Grants	http://medoc.gdb.org/best/fedfund/nih-intro.html

about the Cybermouse. A search of National Institutes of Health grant applications produced a description of the research program.

'In silico' research may actually evolve as an important alternative in medical research, with virtual reality models not too far off. The Internet and 'in silico' research are intimately linked, and may develop interactively.

Quality control, security, and legal issues

Of the more than 300 papers recorded on MEDLINE during the last year dealing with the Internet, most are enthusiastic, spelling out the possibilities with this type of communication. A few, however, draw attention to the quality, security, and legal problems connected with the Internet. A paper in a medical journal implies strict rules of presentation and peer review. Cyberspace has no such restrictions. Although it can be costly to create and update a comprehensive document on the Internet, a brief Web site is inexpensive. There are more than 12 million host computers offering some form of information at present. Problems in terms of quality and finding the relevant information are clearly present. Both viewers and publishers would benefit from some form of editorial service, although free speech is important. Presumably this service will have to be addressed in economic terms by producers and editors charging for their services. Better navigational tools with some sort of quality sensor might also help. Many solutions have been suggested, such as adding peer comments or scores, or showing the number of times a paper has been retrieved. Electronic robots are now being developed to help cope with the information overload. These can 'leave their home machine to fan out through cyberspace' and select relevant information and perhaps collaborate with other robots in doing so.[9]

Computers used in universities and hospitals often contain classified information on patients and research data. These computers are often connected to the Internet. If there is a way out to the Net, then there is also a way in and this gives hackers an opportunity and challenge to get in. Benign hackers only leave their trademark behind, showing that they succeeded in getting in. A break in could, however, result in alterations to scientific data, patient files could become public, or changed, and false e-mail messages could be sent out from inside the hospital, appearing to be authentic. In addition, e-mail messages could be intercepted with relative ease during transmission and are in many ways no more confidential than a postcard. The security of e-mail messages could, however, be increased by one of many available encryption programs.

The easiest way of protecting against intrusion from the Internet is simply not to connect the organisation to the Net, or by building up separate computer systems for internal and external data storage and communication. Many companies and other organisations concerned with security have put up a 'firewall', which are programs funnelling and filtering away unauthorised communication, thus protecting against unwanted visits. Some types of firewalls have been claimed to hamper efficiency and access to communication for those users within the organisation.[10]

Although security problems are related to the Internet, perhaps the biggest security threat against the integrity of scientific and clinical data is not the Internet itself. Leaving your computer unattended when switched on, or leaving behind printouts of e-mail messages with confidential clinical information may pose a greater problem, in combination with software problems and computer hardware crashes. It is advisable to select passwords with care and change them regularly. In addition, computer terminals should be automatically logged off and a periodic backup routine should be used. The British Medical Association has published useful guidelines about how to keep computer based clinical and scientific data protected and secure.[11]

Information presented in e-mail based discussion groups or on a Web site may present legal problems. The advice or procedures described may be inappropriately used or be faulty, leading to malpractice with unclear legal implications in countries with different jurisdiction.[12] For this reason it is advisable to include a disclaimer on Web sites containing clinical information.[7]

The future

There is no reason to believe that the growth of more than 3000 new sites or listings per week on the Web will decrease in the near future. The possibility of finding, storing, and processing data in one's own office computer is probably useful to most biomedical workers. Internet applications and the Net itself will develop interactively as a result of increased use. If virtual clinical rounds become practical, for example, the transmission of huge data rates will be required. Some forms of commercialism, such as pay per view sites, will probably evolve to make this and other useful applications possible. Publishing houses and individuals will launch their products on the Web, with the advantage of low distribution costs and easy updating of new editions. This is particularly attractive for educational material in languages where the print run is too small to make a profit. Likewise, textbooks in disciplines with a