Internet Resources for Podiatric Medical Students

A Second Update

Charles R. Fikar, MD, MSLS*
Scott H. Nguyen, BS†

In this article, we present a selection of Internet resources covering subject areas found in standard medical education curricula. Basic sciences and clinical resource sites are explored. We also review Web sites that offer useful materials that can be downloaded to handheld devices such as palmtop computers, smartphones, and portable media players. We judged the sites based on their potential to enhance the learning process, provide practice questions or study guides for examinations, or aid in the preparation of manuscripts. Medical students, residents, educators, and practitioners of podiatric medicine and surgery who require a quick reference source to either the basic science foundations of podiatric medicine or the clinical side of basic medicine, may find this paper useful. (J Am Podiatr Med Assoc 97(6): 486-492, 2007)

The continued abundance of learning resources offered freely on the Internet necessitates revision of previous articles in this series.[1,2] In the present article, we emphasize sites created by academic institutions, governmental departments, medical institutions and societies, established medical and technological firms, and sites developed by medical students or student organizations. Internet sites that provide timely access to materials that may be of use to medical students, residents, practitioners, and educators in the field of podiatric medicine and surgery, are presented. Anyone requiring quick reference sources to either the basic science foundations of podiatric medicine or to the clinical aspects of general medicine, may find it useful to explore sites reviewed in this article. Some of these educational tools can provide added options to the learning process, and thus enhance the educational experience. All Web addresses were current as of the time of this writing. Readers should note that free Web sites are emphasized in this article, and those that require a fee for all services are not presented. A few sites are reviewed that do charge for some content but make available other useful material at no charge.

*Woods Health Sciences Library, Caritas Health Care/Mary Immaculate Hospital, Jamaica, NY

† Ross University School of Medicine, Edison, NJ

Corresponding author: Charles R. Fikar, MD, MSLS, Caritas Health Care/Mary Immaculate Hospital, Woods Health Sciences Library, 152-11 89th Ave. Jamaica, NY 11432.

New technologies have emerged and are now commonly used by professionals. The personal digital assistant (PDA) is a small, handheld computer that is now better known as a pocket or palmtop computer. A Pocket PC is a PDA that is run with a specific operating system provided by Microsoft Windows (Microsoft Corp, Redmond, Washington). Current versions of these devices perform many tasks, including but not limited to e-mail, Web access, and audio and video recording and playing, not to mention word processing, spreadsheet, and address book capabilities. Handheld devices with the added feature of mobile phone service are termed *smartphones*. Those with global positioning systems (GPS) can help one drive to unfamiliar terrain.[3] Another device of potential medical use is the iPOD (Apple, Cupertino, California) and related portable media players. Podcasts are digital audio or video files that can be played by these devices.

Because of the popularity of these devices, we emphasize Web sites that offer free downloadable files specifically for use with these devices. New sites with these features are appropriately annotated in the sections that follow.

The information presented on all Web pages must be attentively screened according to one's personal standard of excellence. An attempt has been made to provide authoritative sites for this article, but each student or practitioner should judge their usefulness on an individual basis. One must be aware that graph-

ics, video clips, sound files, or other digital items on Web pages are the intellectual or artistic creations of persons or groups and as such may be protected by copyright law. Although these items may be freely available and easily downloaded, one may not have the right to distribute such work to others without appropriate permission. The United States Copyright Office Web page at the Library of Congress site contains practical information about copyright law.[4]

Basic Sciences Web Sites

Table 1 presents a listing of selected basic sciences Web sites. As in the previous articles,[1,2] most of the subject areas covered in the first two years of the typical podiatric medical curriculum have been included. Academic areas emphasized include anatomy, biochemistry, embryology, ethics, genetics, histology, imaging, immunology, microbiology, nutrition, pathology, pharmacology, physiology, and statistics.

Although not a new site to this series of articles, ePodiatry.com is again mentioned because it is an exceptional podiatric learning tool. This treasure house of information sources covers virtually all of the basic science areas likely to be needed by the podiatric medical student. Topics not usually mentioned on most basic-science–oriented Web sites, such as biomechanics, are thoroughly covered here. The site is copyrighted by ePodiatry.com, located in Sydney, Australia. MedicalStudent.com is a site notable for its excellence and currency. Every student should have this wonderful metasite bookmarked, because it offers such a wealth of valuable Web pages in its very comprehensive listing of basic science and clinical medicine sites. The copyright for MedicalStudent.com is held by Dr. Michael P. D'Alessandro from the Department of Radiology at the University of Iowa, Iowa City.

The Karolinska Institute is Sweden's largest medical school. The Biomedical Links page is useful for medical students at all levels of the educational process. This page includes links to clinical case studies and grand rounds, medical images and illustrations, and a directory of quality controlled internet links. There is also a link to a page on diseases and disorders that is organized by subject, where one can find an abundance of information on specific conditions. All of these links lead to resources in English. The Directory of Links page leads to a page of biomedical information resources and services organized by subject. The Karolinska Institute in Stockholm, Sweden, holds the copyright to this Web site.

Anatomy Modules is a site presented by the University of Washington Diagnostic Radiology Residency Programs. The University of Washington Department of Radiology in Seattle, Washington, is the copyright holder. As of the time of writing, featured anatomic areas included the knee, distal thigh, the anatomy of hallux valgus, and the radiologic anatomy of the skeleton. This site also features online atlases of upper and lower extremity muscles that provide the basic anatomical facts of origin, insertion, innervation, blood supply and action(s) of the muscle, as well as colorful illustrations.

Videos of actual human cadaver dissections are available for viewing at the Anatomy Dissections page of the University of Wisconsin's Madison Medical School site. The copyright holder is the University of Wisconsin Anatomy Department, located in Madison, Wisconsin.

CELLS alive! is a medical education resource that uses film and computer-enhanced images of living cells and organisms to supplement and augment medical education and research. Continuously updated, this site is copyright by Quill Graphics, located in Charlottesville, Virginia. Animations, text, and graphics demonstrate topics from cell biology, microbiology, and immunology. Details concerning cell structure, mitosis, meiosis, the cell cycle, bacteriophage physiology, HIV infection, and much more are presented. For diversion, there are even on-screen jigsaw puzzles of cells to piece together.

CardiologySite is copyrighted by A.S.M. Systems, located in Augusta, Georgia, and offers numerous educational materials. Many of the lesson modules are designed for both desktop and pocket PC devices. Serving as a remote learning experience for healthcare providers, students, and residents, CardiologySite was designed to provide the equivalent of classroom lectures and demonstrations with the use of the latest Web-based multimedia technology. Available at this site are instructional videos, 3-D animations, anatomic models, interactive video clips, interactive heart sounds and heart murmurs, and interactive echocardiograms. The educational content and material was designed and developed by Abdulla M. Abdulla, MD, a clinical professor of medicine and prior chief of cardiology at the Medical College of Georgia.

Blaufuss Multimedia's Heart Sounds and Cardiac Arrhythmias is another site devoted to cardiology. This site provides animations that demonstrate the beating heart concomitantly with real-time EKG, heart sounds, and murmurs for a variety of heart and heart valve pathologies. Cardiac arrhythmias are also presented. Students who take advantage of this site will most likely have an easier time understanding and remembering information presented in standard physiology and physical diagnosis textbooks. On this site, one can learn about the physiology and patho-

Table 1. Selected Basic-Sciences Resources on the Web

Name of Site	Uniform Resource Locator
Acid-Base Tutorial	http://www.acid-base.com
American Podiatric Medical Students' Association	http://www.apmsa.org
Anatomy Dissections	http://www.anatomy.wisc.edu/courses/gross
Anatomy Modules	http://www.rad.washington.edu/anatomy/
Bacteriology 330 Host-Parasite Interactions at UW-Madison	http://www.bact.wisc.edu/bact330/bact330homepage
Blaufuss Multimedia-Heart Sounds and Cardiac Arrhythmias	http://www.blaufuss.org/
CardiologySite	http://www.cardiologysite.com
CELLS alive!	http://www.cellsalive.com/
Countway Library of Medicine	http://countway.med.harvard.edu/dl/other.shtml
Dartmouth Atlas of Health Care	http://www.dartmouthatlas.org/
Department of Microbiology	http://microbiology.mtsinai.on.ca
eAtlas of Pathology	http://esynopsis.uchc.edu/eatlas/
ECG Library	http://www.ecglibrary.com/ecghome.html?
ePodiatry.com	http://www.epodiatry.com
Forensic Medicine for Medical Students	http://www.forensicmed.co.uk
Human Embryology Website	http://cna.uc.edu/embryology
Interactive Atlases: Digital Anatomist Project	http://www9.biostr.washington.edu/da.html
Interactive Respiratory Physiology	http://oac.med.jhmi.edu/res_phys/index.HTML
Internet Pathology Laboratory for Medical Education	http://library.med.utah.edu/WebPath/webpath.html
JayDoc HistoWeb	http://www.kumc.edu/instruction/medicine/anatomy/histoweb
Karolinska Institute-Biomedical Links	http://ki.se/ki/jsp/polopoly.jsp?d=1388&a=4145&l=en
LUMEN Homepage	http://www.lumen.luc.edu/lumen
LUMEN: Structure of the Human Body	http://www.lumen.luc.edu/lumen/meded/grossanatomy
Martindale's Health Science Guide	http://www.martindalecenter.com/HSGuide.html
Martindale's the "Virtual" — Medical Center: Anatomy & Histology Center	http://www.martindalecenter.com/MedicalAnatomy.html
Medical Education Ring	http://i.webring.com/hub?ring=mededrg
MedicalStudent.com	http://www.medicalstudent.com
Microbiology Textbook	http://www.textbookofbacteriology.net
Molecular Visualization Resources at MolviZ.Org	http://www.umass.edu/microbio/chime
Molson Medical Informatics Student Projects	http://sprojects.mmi.mcgill.ca
National Board of Podiatric Medical Examiners	http://www.nbpme.info/
National Center for Complementary and Alternative Medicine	http://nccam.nih.gov
NetPharmacology	http://lysine.pharm.utah.edu/netpharm/
Nutrition Source: Knowledge for Healthy Eating	http://www.hsph.harvard.edu/nutritionsource
Pathweb	http://pathweb.uchc.edu/
PCI Health Training Center	http://www.pcihealth.net/pcin
Principles of Clinical Pharmacology	http://www.cc.nih.gov/researchers/training/principles.shtml
StATS	http://www.childrens-mercy.org/stats/index.asp
Student Doctor Network	http://forums.studentdoctor.net/links/index.php
Student National Podiatric Medical Association	http://npmaonline.org/snpma.html
StudentDoc: A Student Doctor's Home	http://www.studentdoc.com
THE Medical Biochemistry Page	http://www-isu.indstate.edu/thcme/mwking/home.html
UC Medware Homepage	http://www.med.uc.edu/medware2
University of Wisconsin Department of Anatomy: Teaching Resources	http://www.anatomy.wisc.edu/teaching.html
UNSW Embryology Homepage	http://embryology.med.unsw.edu.au/
USMLE Board Readiness Site-Creighton University	http://www2.creighton.edu/medschool/medicine/boards
USUHS Medical Biochemistry Exams	http://bob.usuhs.mil/biochem/exams/exams.html
ValueMD	http://img.com.tripod.com
Virtual Mentor	http://virtualmentor.ama-assn.org
Whole Brain Atlas	http://www.med.harvard.edu/AANLIB/home.html
World Index of Molecular Visualization Resources	http://molvis.sdsc.edu/visres

physiology of the heart and blood vessels by starting with basic cardiovascular anatomy that is instantly correlated with a standard x-ray image. The entire cardiac cycle is illustrated with a simultaneous animation of the beating heart. The mouse can control the speed of the animation and can bring one to any specific time within the cycle. This feature helps to make this site a good learning tool. This site is worth bookmarking. Blaufuss Multimedia, located in Palo Alto, California, is the copyright holder.

Forensic medicine and pathology are not usually studied in the first two years of medical school. But because there is much general interest in this biomedical field, we mention a site that is created specifically for medical students. Forensic Medicine for Medical Students presents authoritative information on wounds, firearms, autopsy, asphyxia, legal issues and laws of evidence, forensic science, and many additional topics. Dr. Richard Jones, a trainee in forensic science at the Wales Institute of Forensic Science in Cardiff, South Wales, United Kingdom, is the creator and copyright holder of this site.

The Virtual Pathology Facility of the Pathology Department at the University of Connecticut Health Center has created several resources, including Pathweb, eSynopsis of Pathology, eAtlas of Pathology, and PathCrawler. This set of Web resources is the product of the University of Connecticut, and is copyrighted by Dr. Richard R. Lindquist, located in Farmington, Connecticut. Information is classified by the organ affected or by the specific disease process. Illustrations of the pathology, as well as concise textual information, are given for a wide variety of conditions. From the eAtlas of Pathology, one can find links to the other major features of this remarkable endeavor. PathCrawler is a Web search engine that is dedicated specifically to finding pathology images on the Internet.

NetPharmacology is presented and copyrighted by the Department of Pharmacology and Toxicology and the Spencer S. Eccles Medical Library of the University of Utah, located in Salt Lake City. Developed as a teaching tool for cardiovascular pharmacology, the site offers lecture notes, test questions, animations, charts, graphs, and a listing of important cardiovascular drugs. Very useful as a learning and test preparation aid, this site is easily navigated and is full of complete yet concise information.

Principles of Clinical Pharmacology is essentially a course given online by the National Institutes of Health's Clinical Center. This site is created by the federal government and is not copyrighted. The slides are professionally prepared, and one can view the lectures as a standard PowerPoint presentation or as video clips. The National Institutes of Health also provides videos of lectures of potential interest in various areas of the basic sciences at the NIH VideoCasting site, which also has many lectures available as podcasts. Again, this site has no copyright restrictions unless specifically posted.

The Department of Microbiology of Mt. Sinai Hospital, located in Toronto, Canada, is the copyright owner for the site of the same name. In the education section are a listing of resources that cover a very broad range of topics including sections devoted to mycology and clinical mycology, parasitology of helminths and protozoa, in-depth articles about selected pathogenic organisms, multimedia presentations, and links to more resources. The multimedia presentations include such subjects as SARS, influenza, tuberculosis, antibiotic-resistant organisms, and many more important and interesting topics.

For those interested in epidemiology, biostatistics, and health-care disparities, the Dartmouth Atlas of Health Care offers much data, information, and the ability to find specific data for a chosen state and city by year. Reports, monographs, and articles on appropriate topics are freely downloadable. A series of lectures with slides are also available. The Trustees of Dartmouth College, located in Hanover, New Hampshire is the copyright holder.

Clinical Web Sites

Clinical Web sites are presented in Table 2. The American College of Foot and Ankle Surgeons Web site offers free downloads of clinical practice guidelines relating to such topics as adult and pediatric flatfoot (pes planus), heel pain, and the diabetic foot. Also available are articles on conducting and interpreting research, including the topics of grant writing, evaluating the quality of data, reading and writing scientific manuscripts, and more. Those aspiring to write an article in a biomedical journal would do well to visit this site. Members are allowed access to many additional resources. The site is copyrighted by the American College of Foot and Ankle Surgeons, located in Chicago, Illinois.

DermIs is a comprehensive collection of dermatologic information, including photographic examples of skin disorders. Encyclopedic in scope, the basic atlases are divided into adult and pediatric sections. Most descriptions of skin conditions offer a differential diagnostic section with quick links to pictures of similar but different conditions. Another nice feature at this site is the ability to click on any region of the body, resulting in the display of pictures of disorders involving that exact particular anatomical area. This unique site is a product of the cooperative efforts be-

Table 2. Selected Clinical Web Sites

Name of Site	Uniform Resource Locator
American College of Foot and Ankle Surgeons	http://www.acfas.org/
BloodLine	http://www.bloodline.net/
CardiologySite	http://www.cardiologysite.com
Centers for Disease Control and Prevention	http://www.cdc.gov
Clinical Cases and Images	http://clinicalcases.blogspot.com/
Countway Web Resources	http://countway.med.harvard.edu/dl/other.shtml
CurbsideMD	http://www.curbside.md
Dartmouth Atlas of Health Care	http://www.dartmouthatlas.org
Department of Microbiology	http://microbiology.mtsinai.on.ca
DermIS	http://dermis.multimedica.de
eMedicine	http://www.emedicine.com
ePodiatry.com	http://www.epodiatry.com
Hardin MD: Medical Pictures	http://www.lib.uiowa.edu/hardin/md/index.html
Indiana University Radiology Teaching Files	http://www.indyrad.iupui.edu/rtf/index.html
Karolinska Institute-Biomedical Links	http://ki.se/ki/jsp/polopoly.jsp?d=1388&a=4145&l=en
Learning Resources: Indiana University Department of Radiology	http://www.indyrad.iupui.edu/radweb/Education/CoursesandResources/tabid/189/Default.aspx
Martindale's Health Science Guide	http://www.martindalecenter.com/HSGuide.html
MDchoice.com	http://www.mdchoice.com/index.asp
Medical Education Ring	http://i.webring.com/hub?ring=mededrg
MedicalStudent.com	http://www.medicalstudent.com/
MEDLINE: PubMed	http://www.ncbi.nlm.nih.gov/entrez/query.fcgi
MedNets	http://www.mednets.com/
MedWeb	http://www.MedWeb.Emory.Edu/MedWeb
Merck Manual	http://www.merck.com/pubs/mmanual
Molson Medical Informatics Student Projects Site	http://sprojects.mmi.mcgill.ca/
National Board of Podiatric Medical Examiners	http://www.nbpme.info/
National Center for Biotechnology Information	http://www.ncbi.nlm.nih.gov
National Center for Complementary & Alternative Medicine	http://nccam.nih.gov/
NIH VideoCasting	http://videocast.nih.gov/default.asp
PCI Health Training Center	http://www.pcihealth.net/pcin/
PRESENT Podiatric Residency Courseware	http://www.podiatricresidency.com/
Principles of Clinical Pharmacology	http://www.cc.nih.gov/researchers/training/principles.shtml
RSNA Link: Education Resources	http://www.rsna.org/Education/
Teaching/Learning Evidence-based Medicine	http://www.ebmny.org/teach.html
University of Washington Department of Radiology	http://www.rad.washington.edu/
University of Washington Health Links	http://healthlinks.washington.edu/
USMLE Board Readiness Site	http://www2.creighton.edu/medschool/medicine/boards
Value MD	http://img.com.tripod.com/
Virtual GI Clinic and Classroom	http://www.bcm.edu/gastro/VGICC/index.html
Virtual Mentor	http://virtualmentor.ama-assn.org

tween the Department of Clinical Social Medicine of the University of Heidelberg, located in Heidelberg, Germany, and the Department of Dermatology of the University of Erlangen, in Erlangen, Germany. This site, including all images, is copyright by these two institutions. Permission must be obtained to place any image on a Web page, but the use of some pictures for lecture presentations by faculty may be permitted, with appropriate acknowledgements. Complete copyright information is available at the Web site.

CardiologySite, mentioned in the basic sciences section, also offers an abundance of material of potential usefulness in the clinical sciences. Again, this site supports pocket PC devices. The Department of Microbiology of Mt. Sinai Hospital, Toronto, in addition to the basic science aspects of microbiology discussed

earlier, includes many clinical case presentations, including unknown cases, which may prove very instructive to students who are studying the clinical sciences.

Teaching/Learning Evidence-based Medicine is a site from which to learn about evidence-based medicine (EBM). Part of the Evidence-Based Medicine Resource Center, this metasite leads to authoritative sources throughout the world. The site is designed to provide help in finding the best evidence and critically appraising studies. The teaching of EBM is also addressed with the provision of links to online tutorials and presentations. The site also allows one to access aids such as user's guides, worksheets, and calculators needed for finding and appraising the evidence. The site is the collaborative effort of the New York Academy of Medicine and The American College of Physicians, New York Chapter. The New York Academy of Medicine, located in New York, New York, is the copyright holder.

eMedicine is a highly popular and well-regarded source of clinical medical information. The clinical knowledge base is large and kept current by physician authors, all of whom are overseen by several levels of editorial and peer reviewers. Articles are available for about 7,000 specific conditions, and the emphasis is on evidence-based content. A doctor of pharmacy also reviews all content prior to publication. This site has PDA downloads available to those whose institutions subscribe to eMedicine. The site is copyrighted by WebMD, located in New York, New York.

Created and copyrighted by Praxeon, Inc, located in Cambridge, Massachusetts, CurbsideMD is a new resource. Designed with a powerful search engine specifically engineered to understand medical queries, results are presented in a very user-friendly manner. Materials are organized into sections entitled Visual Diagnosis, Quick Consult (guidelines and recommendations), Best Evidence (clinical guidelines and clinical trial outcomes), Clinical Trials, and Best Hits. At the time of writing, this site was primarily neurologic in scope, but as the year progresses, all areas of medicine are intended to be covered. There is great coverage of the diabetic foot, diabetic neuropathy, and many other foot disorders and injuries, from the neurologic viewpoint.

Carden Jennings Publishing, located in Charlottesville, Virginia, is the copyright holder for BloodLine. This is an authoritative site for information in the fields of hematology and oncology. An image atlas, case reports, presentations on various conditions, and continuing education activities are available.

The Karolinska Institute is again mentioned here because of the wealth of clinical information of potential usefulness to medical students. An extensive listing of clinical cases by specialty, logically arranged in order of quantity, with sites offering the most cases listed first and sites with fewer cases lower, is offered, along with many other materials.

Clinical Cases and Images offers an large menu of free clinical cases ranging from such diverse fields as cardiology, pulmonology, gastroenterology, nephrology, endocrinolology, hematology/oncology, rheumatology, infectious diseases, neurology, and others. Most cases have links to other similar cases. Links to 20 medical schools are available. This site is featured in the *British Medical Journal* as well as on Medscape.com. Started by physicians at the Cleveland Clinic and Case Western Reserve University (St. Vincent/St. Luke) Internal Medicine Residency Program, the site is copyrighted by Vesselin Dimov, MD, located in Cleveland, Ohio.

Virtual GI Clinic and Classroom has a wide variety of case presentations that are freely available and do not require registration. The presentations are divided into the following divisions: ethics, basic and advanced diagnostic and management problems, and nutrition. Appropriate color images taken from actual grand rounds at this highly respected academic medical institution enhance the learning process. Cases may be viewed either as unknown clinical problems or as known cases with specific learning objectives. Continuing medical education credits are available. Baylor College of Medicine, located in Houston, Texas, is the copyright holder.

Readers are encouraged to examine the "Podiatric Medical Resources on the Internet"[5-10] series of articles appearing periodically in JAPMA for a more comprehensive listing of Web sites specifically devoted to general clinical medicine and podiatric medicine. An update in this series is forthcoming.

Conclusion

We are indeed quite fortunate that a multitude of free information resources is available through the technology of the Internet. These Web pages can provide much to enhance the educational experience of podiatric medical students. Both basic and clinical sciences sites have been presented in this article. Web sites with material specifically for PDA-type devices are also mentioned due to their increasing popularity. The medical school curriculum is a very challenging one, but perhaps the Web pages presented in this series can continue to make the learning experience a little easier, more exciting, and a bit more fun.

Financial Disclosures: None reported.
Conflict of Interest: None reported.

References

1. Fikar CR, Fikar RM: Internet resources for podiatric medical students. JAPMA **91:** 316, 2001.
2. Fikar CR: Internet resources for podiatric medical students: an update. JAPMA **95:** 211, 2005.
3. Personal Digital Assistant. Wikipidea Web Site. Available at: http://en.wikipedia.org/wiki/Personal_digital_assistant. Accessed April 18, 2007.
4. United States Copyright Office: "Copyright." Available at: http://www.copyright.gov. Accessed April 24, 2007.
5. Fikar CR, Tran MQ: Podiatric medical resources on the Internet. JAPMA **87:** 80, 1997.
6. Fikar CR, Tran MQ: Podiatric medical resources on the Internet: an update. JAPMA **87:** 438, 1997.
7. Fikar CR: Podiatric medical resources on the Internet: a second update. JAPMA **88:** 462, 1998.
8. Fikar CR: Podiatric medical resources on the Internet: a third update. JAPMA **90:** 473, 2000.
9. Keith L, Dobrochasov D, Fikar CR: Podiatric medical resources on the Internet: a fourth update. JAPMA **92:** 516, 2002.
10. Fikar CR: Podiatric medical resources on the Internet: a fifth update. JAPMA **96:** 162, 2006.