Acknowledgements

This research was supported by Grant-in-Aid for Scientific Research (S) (16100001) and Young Scientists (A) (16680024) from The Ministry of Education, Culture, Sports, Science and Technology, Japan.

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Design and Implementation of MVL: Medical VR Simulation Library

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Abstract

Developing medical VR simulators takes much labor and cost because of its complexity and high requirements for simulation. In this paper, we propose MVL, which gives simulation modules of several significant medical manipulations considering multiple organ interaction.

Keywords: Medical simulator, Simulation Library, Force feedback

1. Background

Development and introduction into clinical field of surgical simulators require both advanced technologies and empirical knowledge of medical doctors. However, much time and efforts are needed for medical doctors and developers to learn and implement basic physics and algorithms for haptic feedback. The aim of our study is to support and promote developing medical VR simulators by giving simulation modules with intuitive APIs. Foregoing studies of providing simulation modules, such like Spring [Montogomery et al. 2002], don't allow high accurate force feedback with multiple organ interaction. In this paper, we propose **MVL: Medical Virtual reality simulation Library**, which enables easy development of simulators with several important medical manipulations considering organ-organ interaction.

2. Method

The features of MVL are as follows.

1. Multiple medical manipulations and multiple organ interaction
2. Real-time and high accurate deformation and force calculation
3. API for simulating medical manipulations

Interaction model between elastic objects [Kuroda et al. 2003] enables to simulate collisions of multiple organs with force reflective manipulation. For real-time and high accurate deformation and force calculation, finite element method with Hirota's methods [2001] is implemented. Surgical manipulations such as cutting are implemented as well. Intuitive APIs are provided for each function such as loading an organ object and performing a surgical manipulation. Just a few lines coding allow simulating surgical procedures. Easy and flexible setting of physical parameters is also achieved by using utility software.

3. Results

Developed sample simulators using MVL are shown in Fig.1. Those simulators can be developed with less than 30 lines of coding for simulation modules.

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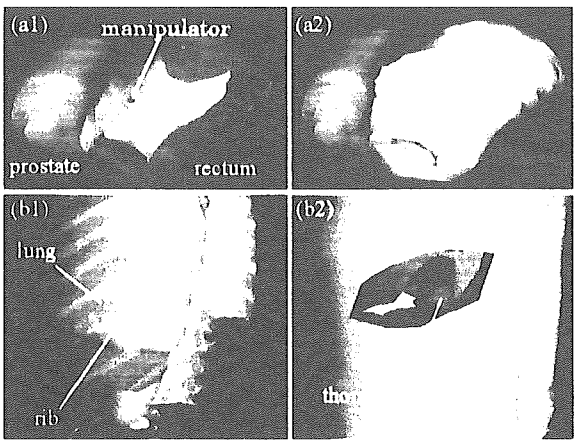

Fig. 1 Simulator Examples developed with MVL
(a1,2) Palpation simulator: Indirect touch pushing prostate indirectly from inside of rectum with force feedback
(b1,2) Surgical approach simulator: Series of manipulations such as cutting, retracting, and excluding are performed. Finally, aorta becomes visible and accessible.

4. Summary

This paper proposes MVL, which is supporting environment for developing force reflecting physics-based simulators. The results confirmed that MVL simulates several medical simulators with few lines of coding. Quantitative evaluation and GUI based developing environment are future work.

Acknowledgement

This research was supported by Grant-in-Aid for Scientific Research (S)(16100001), Young Scientists (A) (16680024) from The Ministry of Education, Culture, Sports, Science and Technology, Japan

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Shape Perception with Friction Model for Indirect Touch

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Abstract

The purpose of this paper is to study shape perception in the situation where the target object is interfered by other objects. This paper proposes a friction model that updates shear stiffness function of objects, in order to produce physics-based friction force in the situation of indirect touch. The result of experiments indicated that friction force influenced accuracy of indirect perception of convex shape.

1. Introduction

Touching an object in the situation, where the target object is interfered by other objects, occurs in many clinical occasions such as palpation. We call such a situation ***indirect touch***. As shown in figure 1, palpation skill for specifying the place of tumors in the organ is especially important.

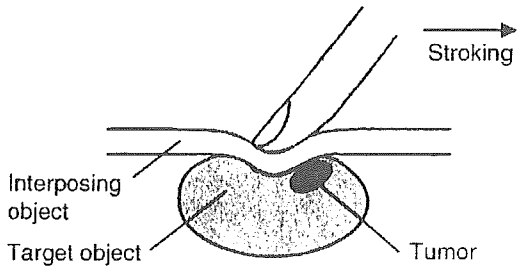

Figure 1. Shape perception in indirect touch

It requires indirect perception of both stiffness and shape information. Our study has simulated indirect stiffness perception [1]. Although Lederman et al. examined influence of spatially distributed forces on the fingertip on shape perception [2], few researches for the simulation of indirect shape perception have been found.

Robles-De-La-Torre et al. reported that force along stroking direction was important in perceiving concave and convex shape [3]. The authors applied the results on the case of indirect touch. Then, friction force, which is the force along stroking direction, will influence on shape perception. Foregoing friction models [4] were not applicable to the case, because collisions of soft tissues have not been considered.

This paper proposes friction model for indirect touch and examines influence of friction force on indirect shape perception.

2. Friction model for indirect touch

Friction model should simulate Coulomb friction force proportional to normal force. The important point is that the relation between force and displacement changes in indirect touch because of collisions of soft tissues. For stability of force feedback with interactive manipulation, the model is based on constrained-based method [5]. The amount of proxy movement Δu is given by

$$state = \begin{cases} sticking & (state = sticking, f_h < \mu_s f_n) \\ sliding & (state = sticking, f_h \geq \mu_s f_n) \\ sticking & (state = sliding, f_h < \varepsilon) \\ sliding & (state = sliding, f_h \geq \varepsilon) \end{cases} \quad (1)$$

$$\Delta u = \begin{cases} 0 & (state = sticking) \\ \overline{P_1 P_2'} - g^{-1}(\mu_d f_n) & (state = sliding) \end{cases} \quad (2)$$

where f_h and f_n are shear and normal force, P_1 is previous proxy position, P_2' is projected fingertip position onto surface polygon, g is a function of

shear stiffness, μ_s and μ_d are coefficients of static and kinetic friction respectively, is a constant. Function g is repeatedly updated based on the values of shear force and displacement in the last clock period. The model enables to display stable friction force proportional to normal force.

3. Evaluation and results

Influence of friction force on indirect shape perception was examined. The experiment compared the case of applying proposed friction force with the case of applying no friction force [5].

Figure 2 shows simulation environments of experiments. Plate object (4745 tetrahedra) is located above sphere objects (5320 tetrahedra). All virtual objects have 1.0MPa elastic modulus and 0.4 Poisson ratios. Interaction between them is calculated with interaction model based on finite element method [1]. μ_s and μ_d are set as 0.0, 0.4 respectively. The simulator consists of PC (Dual CPU Xeon 2.8GHz) and PHANToM™.

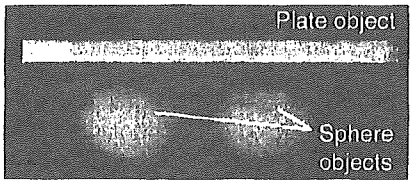

Figure 2. Simulation environments

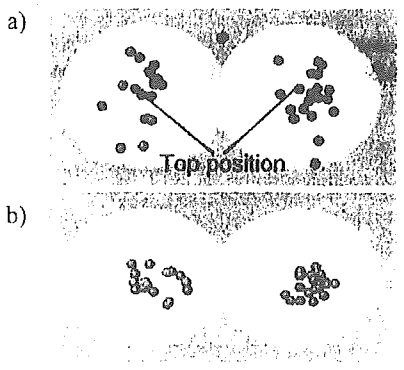

Figure 3. Results of indirect shape perception
(a) Applying no friction [5] (Score: 0.37)
(b) Applying friction by proposed model (Score: 0.27)

Five volunteers participated in the experiment. Each examinee tried to find top of sphere objects by stroking from upper side of plate object. Four trials are performed per each sphere object. The scores were calculated as the distance between the pointed and top position divided by a radius of the sphere objects. Pointed positions are plotted on the image of top view (Figure 3).

Fig. 3 showed decrease of the error of indirect perception by applying friction force. The average scores were 0.37 and 0.27, respectively. The statistical difference between the cases existed ($n=40$, $p<0.05$). The results of experiments showed that physics-based friction force was closely related to indirect shape perception.

4. Conclusion

This paper proposed physics-based friction model for indirect touch based on updating stiffness function and found the influence of friction force on indirect shape perception. Comparison with the case in real world and the study of correlation between finger movement and accuracy of perception is future works.

Acknowledgement

This research was supported by Grant-in-Aid for Scientific Research (S)(16100001), Young Scientists (A) (16680024) from The Ministry of Education, Culture, Sports, Science and Technology, Japan, and Inoue Foundation for Science.

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Tutorial

New uses for computer in medical education, clinical practice, and patient safety in the US and Japan

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ABSTRACT
There has been a rapid expansion of computer use in medicine recently in the US and Japan. The reasons are availability of high speed and wireless connections, decreasing cost, demands for increased quality of care and documentation, and improving medical education. On the other hand, there are disadvantages which are extra time and effort needed, vulnerability to viruses, breaches of patient confidentiality, and high cost at start-up.
One way to decide if the advantages of computers in medicine overcome the disadvantages to show physicians computer programs that may be useful to them. There are many such programs in Japanese as well as in English which are discussed in this paper.
A major difference between the US and Japan is the high use of personalized digital assistants (PDAs) by US physicians as compared to Japanese physicians. PDAs can decrease medical errors due to rapid information access while improving efficiency.
Although the market for the PDAs is currently decreasing in Japan, the coming merger of the cell phone and the PDA into the "smart phone" is likely to stimulate Japanese physicians' interest in PDAs for medical use, especially considering the widespread popularity of cellular phones in Japan.

KEYWORDS
Computer, personal digital assistance (PDA), medical education, clinical practice, patient safety, smart phone

1 Introduction

1.1 Computerization in the field of medicine in Japan

The history of computerization in medicine started in 70s. [1] At that time, the main purpose of computerization was labor-saving for the process of insurance claim and the scope was limited only within administrative section in medical institutions. The physician order entry system (POES) appeared in 80s by a centralized system of a host computer and based on the computerization of clinical laboratory and pharmacy. [2] The POES contributed reducing patient's waiting time in clinical institutions and also making the process of insurance claim efficient. The growth of networking, especially the Internet in 90s enhanced cooperation among clinical professionals or clinical institutions. [3] Also, the electronic medical record (EMR) came into realistic and a hospital in the west of Japan implemented EMR and got rid of paper first in 1999. [4]

In 2001, Japanese government established e-Japan policy, and health care and social welfare is one of the main target fields. [5] Then, the ministry of health labor and welfare (MHLW) published "IT ground design for healthcare system" in the end of 2001. It focused on EMR and the national standard software for electronic process of insurance claim. It made target to implement by the end of 2006; over 60% of institutions which has more than 400 beds should install EMR and over 70% of institutions should install the national standard software for electronic process of insurance claim. [6] According to the survey by the MHLW in 2002, [7] only 1.3% out of total

Received July 26, 2005; Revised September 6, 2005; Accepted Sepember 7, 2005.
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DOI : 10.2201/NiiPi.2005.2.2

8,023 hospitals have EMR and 15.3% have the POES. It is also only 2.3% that the percentage of hospitals installed the national standard software for electronic process of insurance claim. However, such numbers are dramatically increasing recently.

As overall, computers are very popular among Japanese people and international survey in 2003 [8] showed that 38% had laptop or desktop computers in 2002 and 68% had a mobile phone in 2003 in Japan. The corresponding numbers for the US were 66% and 54%. The percentage of the Internet users were 45% for Japan and 55% for the US in 2002 (ITU Telecommunication Indicators).

1.2 Computerization in the field of medicine in the US

There has been a rapid expansion of computer use in medicine recently in the US for a number of uses including medical education at all levels, point of service medical information (especially diagnostic, treatment, and medications), medical research, EMRs, electronic billing, electronic prescribing, and the collection of data to determine quality of care and quality of medical education.

Some possible reasons why computers are increasingly used in US medical care are availability of high speed connections, availability of personal digital assistants (PDAs), availability of wireless connections, decreasing cost of hardware and software, public and government demands for increased quality of care and documentation of that quality, too much information to process without electronic help.

Wireless LANs are much more common today in hospitals than in doctors' offices. Only about 8 percent of physician practices have gone wireless. By comparison, 61 percent of integrated delivery networks and 36 percent of stand-alone hospitals have some wireless capability in the US. [9]

In terms of security, wireless network should be protected, at least, by a combination of wireless-specific ways such as WPA/EAP according to IEEE802.1X with IPSec/VPN technologies. In addition, a separation of traffic by creating VLANs, and installation of a firewall between wired and wireless networks tightened the security of the WPA/EAP-equipped wireless networks. [10]

2 The advantages and disadvantages of using the computer in medicine

How can computers improve quality of care and document that quality? They can avoid illegible handwriting, can be programmed to find errors in dosage, medication name, medication interactions, and identifying allergic patients or the wrong patient, computerized records can be backed up and are less likely to be lost or unavailable, computerized records can more easily be transferred even over long distances, more easily collect data such as mortality or number of patients seen or types of diagnosis seen.

How can computers improve medical education? They can decrease the amount of class time where there is information transfer without interaction, increase the amount of class time available to answer questions and concentrate on confusing or difficult topics, teach medical students and residents how to efficiently get the most accurate, useful, and up to date information through computer programs. They can then use this technique for the rest of their career. Computers can decrease the amount of information needed to be memorized and reduce the chance of error due to faulty memory. Finally they can decrease the amount of time needed to read journals and books while still maintain high quality knowledge.

What are the disadvantages of computer use in medicine? They can be less useful for those physicians who cannot type quickly, take extra time and effort to get used to, create psychological discomfort with a new way of practicing medicine, be vulnerable to viruses and technical problems that risk lost of data unless backed up, be vulnerable to breaches of patient confidentiality, sometimes increase the amount of time needed to get work done, create fear that computerized data can be used by the legal system against doctors and hospitals, create the fear of making the interaction between the patient and doctor seem less personal and have high cost at start-up

3 Useful websites for medicine

3.1 Japanese language websites for laptops or desktops

One way to decide if the advantages to computers in medicine overcome the disadvantages to show physicians computer programs that may be useful to them. Some of the useful programs for free of charge are as follows:

3.1.1 Clinical guideline

There are about 30,000 new Japanese language medical articles published monthly. [11] It is difficult to catch up with up-to-date clinical evidence. Medical Information Network Distribution Service (Minds) http://minds.jcqhc.or.jp which is shown in Fig.1 is run by Japan Council for Quality Health Care (JCQHC). [12] There are several clinical guidelines; such as asthma, lung cancer, diabetes, etc. These guidelines were provided some grants from the MHLW and developed by way of Evidence Based Medicine (EBM). There are two types of guideline for each disease; one is for clinical professionals and the other is for lay people.

3.1.2 Drug information

Drug reference is the most frequently asked among clinical professionals and even asked by patients. Even in Japan, 1 drug on average is approved for use each week. [13] The Pharmaceuticals and Medical Devices Agency (PMDA) http://www.info.pmda.go.jp/ which is shown in Fig.2 provides electronic insert packages for prescription drugs and also rug safety information. [14] It used to be an affiliation of MHLW, however, it was incorporated since 2004.

3.2 English language websites for laptops or desktops

In terms of medical education, http://www.healcentral.org is a U.S. non-profit group dedicated to promoting on-line medical education and is available to medical educators world-wide. [15] This organization gathers programs from many medical schools which are primarily in the US. Their site is in English although there are some multi-lingual areas such as patient instructions written in Japanese. Healcentral.org which is shown in Fig.3 has over 30,000 images plus videos and interactive programs. Heal information is not copy-righted and available to anyone. There are two new projects being undertaken by healcentral.org.

The first project is called heal/local and information is available at healcentral.org. It is a trial project available to any medical school or professor in the world which will personalized the heal information for that particular school or professor. More information is available at their website.

The second project was announced in June, 2005 and is a merger of healcentral.org with a large non-profit medical education on-line learning organization in England which will add a large amount of additional content to healcentral.

In terms of clinical care, the most frequent uses of computers and PDAs by US physicians is for information gathering and, more specifically, to find drug information. A very popular but expensive program written in English is www.uptodate.com which takes no money from any outside organization and therefore claims to be free of bias. [16] It is a commercial company which hires outside experts to update its information every six months. It is a searchable data-base with information by disease or by drug. In addition, there is a program to detect drug interactions and an area for the latest developments in a specialty. It is limited to Internal Medicine and most of its subspecialties, Pediatrics, Obstetrics and Gynecology, and is adding Neurology soon. There is a PDA version of this information. An on-line introduction for up-to-date which is shown in Fig.4 is available at http://www.uptodate.com/subscribers/tutorial/index.html.

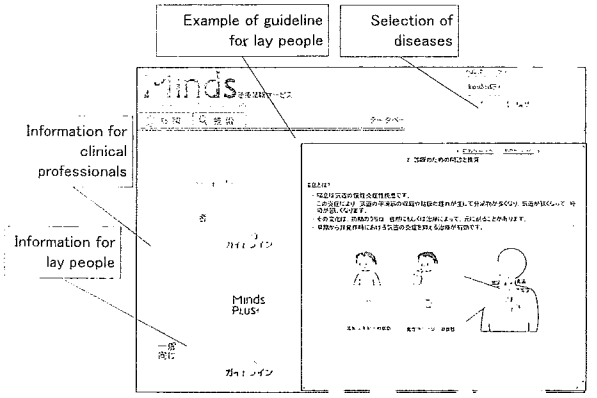

Fig.1 The guideline for asthma as an example for the site of Minds.

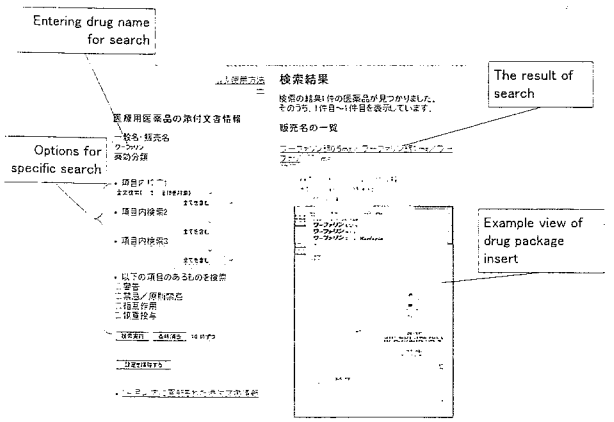

Fig.2 The webpage of PMDA and example of drug package insert.

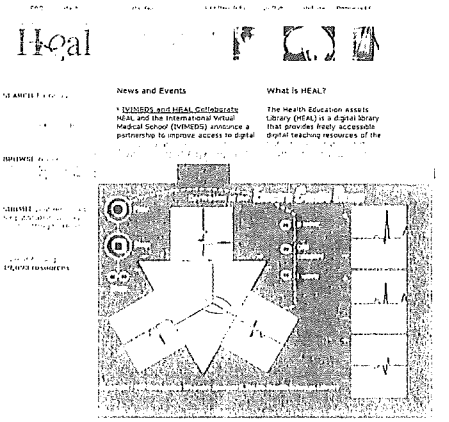

Fig.3 The webpage of Heal and an example of animation for Electro Cardio Gram.

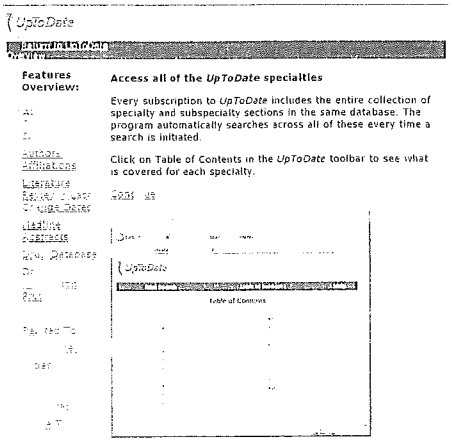

Fig.4 The webpage of introduction for Up-To-Date.

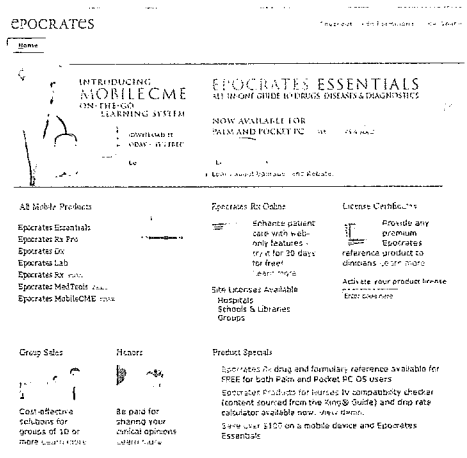

Fig.5 The webpage of epocrates.

Another program which claims to be the most popular computer program in the US is www.epocrates.com as shown in Fig.5. [17] This program is either for computer or PDA use. It is a commercial program that does receive financial support from the drug industry and therefore is very reasonably priced but at risk of bias. The key feature that distinguishes epocrates from other programs is its easy to use "multi-check" function which can find drug interactions for up to 30 medications including non-prescription medications and alternative medications such as herbs. This program is written in English only and the company does not have any immediate plans to convert it to the Japanese language. Japanese physicians were surprised to find out that there is a warning in both the epocrates and up-to-date program concerning the consumption of green tea and the use of blood thinners such a warfarin since green tea also has an anti-coagulation effect. This is an example of information that would be very difficult and time consuming to get from a paper-based product.

4 Utilization of the PDA for medicine

4.1 PDA for Japanese medical professionals

Comparing to the US, people do not use the PDAs so much in Japan. The PDAs are relatively expensive in Japan, and have the difficulty of entering Japanese characters. The cell phones are more popular than PDAs in Japan. These issues seem the reasons for minor use of PDAs in Japan. The Statistics Bureau in the ministry of internal affairs and communications in Japan published the survey of household economy of 2004, [18] and items related to information shows that the percentage of PDA ownership is 1.7%. The similar figures among medical professionals can not be available. According to Japanese proceeding of Joint conference on Medical Informatics in 2004, there are only two articles about PDA out of 568. [19]

The most usage of PDA in the medical fields is for patient safety. [20] PDA with bar code reader scans ID code on a name tag of medical staff, ID code of a patient's wrist band, and bar code on a bag of intravenous drip or blood transfusion. It enables to identify what was done, who did it, when it was done, whom it was done to, why it was done, and how it was done. In other words, it can keep track of clinical process. If any mistake occurs, such as wrong blood type, wrong medication, or misidentify a patient, PDA shows warning.

In addition to patient safety, PDAs can be useful for enhancing clinical care and medical education. PDAs can be available for drug information, reference to clinical guidelines, medical dictionary, or calculations of creatininine clearance and pediatric dosage, etc. The example is shown in Fig.6. According to the information from a PDA software company, the number of downloading trial version of software from March 2005 through June 2005 are about 5,000 for drug information and clinical guidelines respectively, and about 2,000 for pediatric dosage calculation and concise medical dictionary for abbreviations. However, the number of purchase is not obtainable. The approximately 95% of the users are medical professionals and the rest of users are medical representative at pharmaceutical companies.

4.2 PDAs for english medical professionals

The major difference noted by the second author, who is an American physician, is the high use of mobile computer technology by U.S physicians as compared to Japanese physicians. The most commonly used mobile device in US medicine is PDA. For example, approximately 40% of U.S doctors use PDAs in

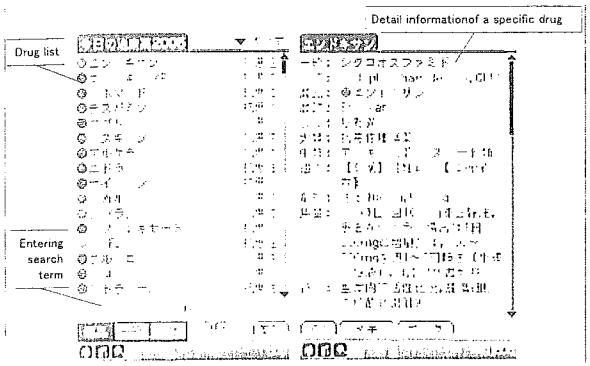

Fig.6 Drug information as an example of software for PDA.

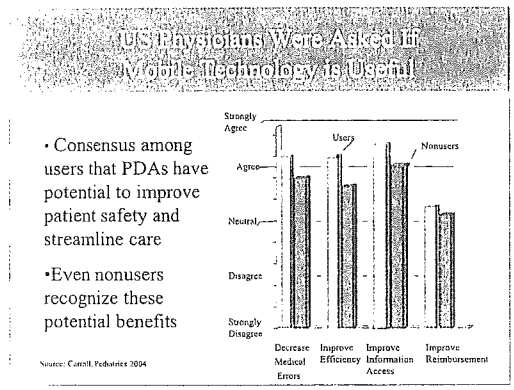

Fig. 7 Physicians' recognition about usefulness of mobile technology in the US.

2003 which was a 50% increase since 2001. This is expected to grown to >75% of all US physicians by 2007. Half of all members of the American College of Physicians (Specialty of Internal Medicine) were using PDAs in 2001. Specialist use of PDAs is highest among cardiologists, anesthesiologists, psychiatrists, and oncologists.

A survey of physicians using PDAs in 2002 showed that approximately 70% used them for drug reference and approximately 40% used them for scheduling. The remaining uses such as dictation, electronic prescribing, hospital interface, and other uses were approximately 20% or lower. [21]

When US physicians were asked if mobile technology is useful, the majority of users and non-users agreed that they decrease medical errors, improve efficiency, and improve information access. The result is shown in Fig.7.

In an article in The Journal of the American Medical Informatics Association in 2001, Bates reported that physicians using PDAs reported that these devices prevented an average of two adverse events. [22]

Why do PDAs improve patient safety? Insufficient drug and drug interaction information are the most common causes of serious errors and is easier to obtain quickly from a PDA. PDAs can be updated frequently so their drug information is more up to date. Multiple drug interactions are extremely difficult to determine without computer technology. PDAs can send wireless alerts with physiologic, laboratory, and medication information. PDAs can manage the transition between house staff with less chance for error. PDAs can reduce handwriting errors.

Japanese physicians may be reassured that pharmacies have computer technologies to detect drug incompatibility but errors detected after the prescription is written require extra time to correct for the pharmacist, patient, and physician. In addition, patients may sometimes go to more than one pharmacy so that interactions may not be detected.

What is the proof that PDAs improve patient safety? There is only limited information in this new field but initial reports are encouraging. For example, improvement in compliance to US national asthma guidelines in patient evaluation and drug therapy occurred after the introduction of PDAs containing these guidelines. [23] Improved documentation and patient follow-ups by emergency medicine residents was noted after the introduction of the PDA. [24] An interesting study showing that patient use of PDAs improved health was reported by Szynal in 2001 in the journal, Health Data Management. [25] The outcome measurement was improved admission condition when used by patients awaiting transplant surgery

Why do US physicians think that mobile computing improves their efficiency? When desktop computers are shared, there is extra time required for each physician to log in. This is not a problem with a personal PDA even if there is a once a day log in. In addition, PDAs do not involve the physician leaving the patient to find a computer. Furthermore, diagnostic and treatment help is available within seconds and may save lives or reduce complications if seconds are critical in patient care. Finally, PDAs are more up to date than paper books so physician does not have to look for multiple texts to get the most up to date information.

Do PDAs help promote good medical education? There is also limited data since this field is so new. One study showed use of PDAs improved learning of evidence-based medicine. [26]

5 The future-probable merger of cell phone and the PDA in near future in both US and Japan

Many companies providing the PDAs have been withdrawing from Japanese market, for example Handspring, IBM Japan, Palm Computing, and Sony. But recently, a new type of merging cell phone and the PDA has become a real product and its market is

increasing in the world. Such product is called "smart phone" and some companies, for example Palm, Nokia, NTT DoCoMo have already produced such smart phones. Major OS companies for PDA are Microsoft and Palm. Furthermore, Bill Gates, chairman and chief software architect of Microsoft announced the release to manufacturing of windows mobile 5.0. [27]

Some people may be concerned about the electromagnetic interference between cell phones and medical devices. As recent information, patients, visitors and staff may use cell phones in any area of the hospital, as long as they are at least 1 meter from operating medical devices. [28]

Taking it into consideration that popularity of cell phone in Japan and the PDAs in the US, it seems that the future of smart phone is promising even in medicine. Also there is a business chance to expand mobile computer technology in medicine.

6 Conclusion

There has been a rapid expansion of computer use in medicine recently along with the diffusion of information technology in the US and Japan. There are a lot of pros and cons for computer use. Since governments promote computerization in medicine, if medical staff recognizes more benefits of computers, they can use them for improving safety and efficiency in medicine.

The use of mobile computer technology in medicine is much less prevalent in Japan as compared to the US. There is still a possibility to enhance medical education, clinical practice and patient safety by using such technology in Japan. In order to implement such mobile computer technology into medicine, more collaboration is necessary for both medical institutions and computer companies.

Acknowledgement

We thank Kimitaka Kaga, MD; Kiyoshi Kitamura, MD; Junji Otaki, MD; Hirotaka Onishi, MD; and other staff at the International Research Center for Medical Education, the University of Tokyo. They provided us an opportunity to give a joint seminar at the University of Tokyo, on May 25, 2005. This article is the revised version of the contents at the seminar. We also thank Thomas S. Inui, MD, and Shinichi Takamoto, MD for their suggestion concerning this collaborative work.

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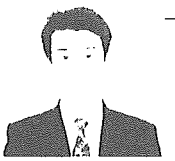

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Appendix 1

ComputerApplications For Teaching and Clinical Care - Japanese

Desktop applications

Electronic clinical guidelines
http://minds.jcqhc.or.jp/to/index.aspx Medical Information Network Distribution Service (Minds)
http://www.mnc.toho-u.ac.jp/mmc/guideline/index.htm Library, Toho Medical University

Electronic textbooks
http://www.banyu.co.jp/merck/index.html Merck Manuals
http://www.ibaraisikai.or.jp/treasure/chisivew/chisiki.html Knowledge of Internal Medicine
http://www.kanazawa-med.ac.jp/~hasumura/ A Physical Examination Skills
http://next.bml.co.jp/diagnosis/contents.html diagnosis on Web / Contents
http://www.kanazawa-med.ac.jp/~htogkmu/msnote.html Ob/Gyn HyperText for Medical Students
http://www.qent.med.kyushu-u.ac.jp/virtual.html Virtual Otolaryngology Hospital
http://www2.kpu-m.ac.jp/~picu/ Pediatric ICU Manual
http://cancerinfo.tri-kobe.org/ Cancer Information Japan (PDQ,etc)
http://www.srl.info/index.html Clinical laboratory
http://www.hamt.or.jp/KENSA/MSTAFF/ECG/ecg.html Electrocardiogram ECG
http://www.jichi.ac.jp/usr/cpth/us./us.home.html Ultrasound
http://web.kanazawa-u.ac.jp/~med23/NMImageConf.html Nuclear Medicine Imaging Conference
http://web.sc.itc.keio.ac.jp/anatomy/anatomy/anatomy.html anatomy
http://www.lib.kobe-u.ac.jp/products/anatomy/index.html anatomy
http://bme.ahs.kitasato-u.ac.jp/qrs/phy/index.html Physiology
http://pharma1.med.osaka-u.ac.jp/textbook/Pharm-Textbook.html Pharmacology 1
http://pharma1.med.osaka-u.ac.jp/textbook2/Pharm-Textbook2.html Pharmacology 2

Electronic journals
http://e-medicine.sumitomopharm.co.jp/e-medicine/index2.html Journal Watch
http://www.nankodo.co.jp/yosyo/user/html/ New England Journal of Medicine

Drug information
http://www.info.pmda.go.jp/ Pharmaceutical and Medical Devices Information (PMDA)
http://mid.cc.kumamoto-u.ac.jp/top.html Drug Package Insert
http://www.nihs.go.jp/dig/jindex.html Drug Info Guide
http://bme.ahs.kitasato-u.ac.jp:8080/docs/ts/html/note/index.html Drug Information for Patients
http://www.jah.ne.jp/~kako/ Emergency Drug information
http://www.j-poison-ic.or.jp/homepage.nsf Japan Poison Information Center
http://center.umin.ac.jp/cgi-open-bin/hanyou/lookup/search.cgi?parm=POISON UMIN Poison Database

Medical laws
http://law.e-gov.go.jp/cgi-bin/idxsearch.cgi Database of laws and regulations
http://web.kyoto-inet.or.jp/org/kanpo/3W/houki/houritu.html Medical laws, etc.

Medical writing
http://www.sunmedia.co.jp/kitei.html#A Instructions for Authors Domestic
http://www.toukoukitei.net/index.html Instructions for Authors Oversea
http://www.biwa.ne.jp/~fumika/eiyou.htm English writing support
http://mhlw-grants.niph.go.jp/ MHLW Grants System

Micellaneous
http://s2001.medic.mie-u.ac.jp/icd/ ICD 10 and DPC (Diagnosis Procedure Combination) coding

http://lsd.pharm.kyoto-u.ac.jp/ja/index.html Medical and Pharmaceutical dictionaries
http://www.sam.hi-ho.ne.jp/tootake/yougo2.htm Medical and Pharmaceutical dictionaries
http://di.m-pharma.co.jp/foreign/index.html Foreign Language Conversation in Hospital and Pharmacy
http://food.tokyo.jst.go.jp/index.html Food Composition Database
http://www.geocities.jp/kazu_hiro/index.html Nursing Site

PDA sites

Software
http://www.medicalview.co.jp/stedman/stedman03.shtml STEDMAN'S Medical Dictionary
http://www.m2plus.com/mproducts/05pda/pda.html Drug information 2005 for PDA
http://www.m2plus.com/mproducts/resident/resident.html The Resident
http://www.m2plus.com/mproducts/migiude/migi1-2.html Mr. Reliable Vol. 1/2 (Introduction)
http://www.geocities.jp/palmpro/HOW/HOWDRUG.HTM DoseSpeed Ver.8.0
http://www.geocities.jp/palmpro/HOW/HOWMEDUNIT.HTM Medical Unit Converter
http://www.nextftp.com/moritaro/Develop/Dev-Acd.html Acid-Base for Palm
http://www006.upp.so-net.ne.jp/kono/BSACalc.htm BSA Calculator

Link sites
http://www5.ocn.ne.jp/~palm-med/ Palm Med & Pharma
http://unoubeya.main.jp/ Right Brain ^^ Room
http://www.lab.toho-u.ac.jp/med/peds/link2/ Palm user's links for medical professionals

Appendix 2

ComputerApplications For Teaching and Clinical Care -English

Desktop applications

http://www.healcentral.org Central data site for many multimedia programs some with voice and thousands of images for medical student education in the basic sciences and clinical areas. Site is run by three US medical school with a government grant and is free and open to the public including international medical schools. There are a few Japanese language patient education documents. Excellent site for medical education, and the best I have seen so far.

Heal Local System for Individual Medical School-in testing phase-available sometime in 2005. contact bas@mednet.ucla.edu. if interested in participating. Will have any information needed from "heal" site plus local University information with local control of the site. It is being created to fit into international computing standards. University of Tokyo could consider running such a site and possibly sharing it with other medical schools. Alternatively, Japan Ministry of Education could consider running such a site for all Japanese medical schools with a mixture of English language and Japanese language programs.

www.nlm.nih.gov National Library of Medicine has medline plus which is English and Spanish Language Patient Information including animation and voice

http://www.umassmed.edu/strokestop/module_one/module_fr.html This is the free program from the University of Massachusetts that Dr. Peskin demonstrated to teach neuro-anatomy and neuro-physiology. It is not a protected document and you are welcome to use it

http://www.med-ed-online.org An American on-line medical education journal. Go to resources for multimedia educational programs

http://www.msu.edu/user/inetproj/homepage5.html American med-school with a number of on-line curricula including how to use the internet for medical education

http://www.epocratesonline.com on line US drug reference with excellent drug interaction feature, and including non-prescription drugs, and herbal medications. There is also a pill identifier for patients using an unknown medication, tables, alerts on drug adverse reactions or major medical news of clinical importance. It is updated weekly. You may try it free for one month and is $US59 per year. Problem for Japanese physicians is that it is US medications. Dr. Peskin contacted them and they have no plans for a Japanese language version soon. Japan could benefit greatly from a program like this with the program for drug interactions being most useful.

http://mycourses.med.harvard.edu/vp_view.asp?frame=Y&tracking=Y&case_id={B517ED16-BFB1-4856-B207-12F9623B539D}

continuing medical education/ available for anyone but not free

http://cme.nejm.org/

continuing medical education based on the New England Journal of Medicine articles

PDA(PERSONAL DIGITAL ASSISTANT) APPLICATIONS

-FOR THOSE JAPANESE PHYSICIANS WHO WOULD LIKE TO START USING PDAs NOW

-FOR THOSE JAPNESE PHYSICIANS WHO WILL WAIT AND BUY A CELL PHONE-PDA COMBINATION DEVICE, AND WILL NEED

THIS INFORMATION WHEN THEY MAKE THAT PURCHASE

WHICH PDA TO BUY, YOU MUST FIRST DECIDE-Which operating system (software system that runs the machine) to use (current choices):

Palm OS-runs on devices made by companies such as Palm and Handspring Advantages: small, lightweight, comfortable to carry with you. Less Expensive, Lots of Medical Software. Long battery life. Disadvantages: Does not easily merge with all Microsoft desktop applications. Is losing market share and medical applications may not be as plentiful and well supported in the future. For example, Sony currently makes these but is stopping production for the Japanese market.

Pocket PC (being discontinued and replaced by Mobile 5 so you can buy a current Pocket PC or wait a short time for Japanese mobile 5 PDAs) Runs on devices made by Hewlett Packard, Compaq, and Casio. Advantages: Larger with bright color screens so easier to see, coordinates with Windows functions very well, Disadvantages: More Costly, Larger size makes them less comfortable to carry with you, less medical software available but quickly catching up with PalmOS devices.

Mobile 5-Sharp and Samsung are coming out with devices soon for the Japanese market. Will be used to combine cell phones and PDA. This may be what is needed to get large numbers of Japanese physicians to use PDAs for medical applications.

PDA Buyer's Guide: www.epinions.com; www.barginpda.com, www.cnet.com

WHERE TO GET MEDICAL PROGRAMS THAT YOU WANT TO USE ON YOUR PDA

- www.handango.com: leader in medical software
- http://pbrain.hypermart.net/: Great source for medical PDA info, software, news
- www.zdnet.com site with software & hardware reviews, comparison buying, more

Utilities: (only needed for some programs. in my opinion, only useful for advanced users)

Adobe Acrobat: http://www.adobe.com/products/acrobat/readerforpalm.html

Medical Calculator: http://www.doctorsgadgets.com/software/free-pda-drug-reference.htm

Treatment Guidelines/References:

Am Coll. of Cardiology Guidelines: http://www.acc.org/clinical/palm_downloadstep1.htm

Asthma NHLBI Guideline: http://www.aafp.org/x28143.xml

Breast Cancer Prediction Tool: http://smi-web.stanford.edu/people/pcheng/breastca/

Cholesterol ATP III Calculator: http://hin.nhlbi.nih.gov/atpiii/atp3palm.htm

Current Clinical Strategies (Book/PDA Out & In-Pt, Medicine, HIV, CCU, Psychiatry, Peds) http://ccspublishing.com/ccs/ ($15-25/book, $50 for all in the series)

Evidence Based Pearls: www.handango.com; search "Evidence Based Practice" ($19.95/year)
(Dr. Frank Domino, Associate Professor at the University of Massachusetts, who helped prepare some of the PDA information in this handout, has a financial interest in Evidence Based Pearls)

Immunizations: http://www.immunizationed.org/anypage.aspx?pagename=shotshome

Medical Decision Tools (MedRules): http://pbrain.hypermart.net/medrules.html

OB Wheel: http://www.fppda.com/timobppc.htm

Drug Databases

Epocrates Drug Database: http://www2.epocrates.com/products/os/rx_subs.html
Three choices:

"Essentials" Most expensive and complete. ($US139/year)
Most popular drug reference in the US. Dr. Peskin's favorite. Includes information on diagnosis of a large number of diseases, commonly used tables, US used medications including prescription, nonprescription, and herbal medications. Most useful is ability to check for up to 30 drug interactions. Also has infectious disease information, lab information, automatic alerts for warnings about drugs or very important news concerning medical issues. Updated weekly. Is inexpensive relative to "Up To Date" partly due to this private company taking money from drug companies. Dr. Peskin finds it reliable but there is the potential for conflict of interest.
Problem for Japanese physicians is that it is based on US drugs. In Dr. Peskin's opinion, a PDA version in Japan is very likely to reduce medication errors and drug interactions, and to lead to more correct diagnoses.

"RxPro" (just Drug and Diagnosis Information: $59/year) Excludes the laboratory information.

"Rx" (just Drug information. Free. Great for medical students and others who need to limit their expenses

PDA Resource Pages

Ectopic Brain: http://pbrain.hypermart.net/

Medical Student PDA Café: http://www.medstudentcafe.com/pdacenter.htm

Text-Like Apps

InfoRetriever—EBM Abstracts, Cochrane, POEMS, Practice Guidelines (Pocket PC) $250.00
- www.infopoems.com ($249.00 per year)
- HanDBase—database application; download free applets or write your own; On-Call; $30.00 www.handango.com
- UpToDate—full database of web version, free with subscription ($400-500) www.uptodate.com (In Dr. Peskin's opinion, too expensive, and the drug information is not as useful as Epocrates for US Physicians. The drug information has even less usefulness for Japanese physicians. Diagnostic information may be useful for residents in specialties where they are in and out of operating room and do not have easy access to desk-top computers.)
- SkyScape : 5 Minute Clinical Consult, FerriGuide, etc. Abridged Textbooks (part of Epocrates Essential) www.handango.com

Electronic Medical Records

- Patient Tracker—www.handheldmed.com; Intuitive, FREE, desktop for $300
- PatientKeepter—Biggest, $35-40; Enterprise Option (busy for me)
- Handbase Patient Tracker Applet—Free, Simplistic

Web Resources on PDA's

Ectopic Brain: http://pbrain.hypermart.net/: Great source for medical PDA info, apps, news

UT HSC SA: http://www.library.uthscsa.edu/internet/pda.cfm good links

—Counseling Tools:
Smoking Cessation: http://www.smokefree.gov/hp-hcsit.html
Preventive Services: http://pda.ahrq.gov/index.html

3) 文献検索と Critical Reading

東京大学大学院医学系研究科
クリニカルバイオインフォマティクス研究ユニット
小出 大介
Daisuke Koide
(特任助教授)

Key Words Medline, EBM, シソーラス, 研究デザイン, バイアス

Summary

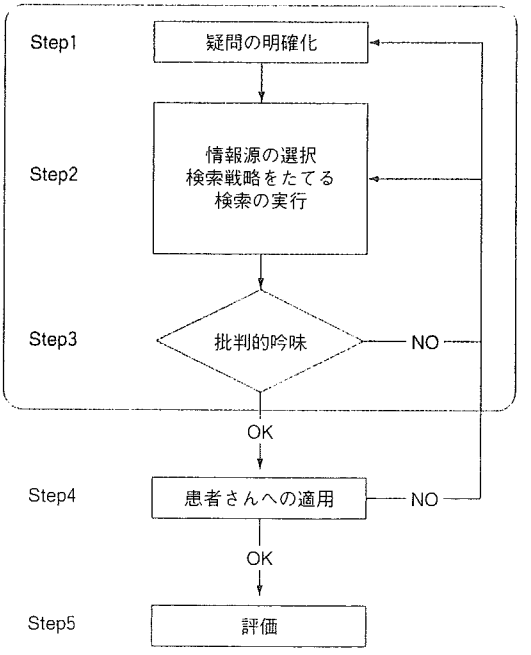
文献検索と Critical Reading は，EBM の 5 段階のプロセスの 1～3 に相当する。まず検索の契機となる疑問を 4 つの軸すなわち(1)カテゴリ，(2)対象，(3)介入または曝露，(4)アウトカムについて明確にする。また情報源である文献データベースには，Medline などの網羅性はあるが質が雑多なものと，専門家により選別されて質は高いが収載数は少ないものとあり，使い分けが重要である。検索に際しては，用語を体系的に辞書化したシソーラスをうまく使うと効率よく検索できる。

Critical Reading に関してはエビデンスレベルと勧告のグレードなどが参考になるが，杓子定規にあてはめるのではなく，技術や資源の問題，最終的には患者の価値観や意向も考慮して適用可能性を検討する必要がある。

Surgery Frontier 10(4) : 89-92, 2003

はじめに

EBM が注目されるようになって久しく，既に EBM のプロセス[1]は Sackett らにより確立され，　にあるように 5 つのステップに分かれる。文献検索及び Critical Reading に関してはこの EBM のステップの 1 から 3 に該当する。



検索編

1 疑問の明確化

まず検索に先立ち，検索理由である疑問について明確な形で表現できなければこの先の作業をうまく進めることができない。そこで疑問を次の4軸に分割して明確化する[2]。例として「重篤な熱傷の患者へのヒトアルブミン製剤投与の可否」という疑問について考えてみる。1つめの軸は「どのカテゴリに属するか」を考える。カテゴリには通常「治療」「診断」「病因」「予後」がある。例では「治療」となる。2つめの軸は「どのような対象者であるか」である。例では重篤な熱傷の患者である。3つめの軸は「介入または曝露は何か」ということで，例ではヒトアルブミン製剤の投与の有無である。4つめの軸は「アウトカム」で，生じる結果で重要なものは何かということであり，例では死亡率となる。

2 情報源の選択

次に何を用いて検索をするかであるが，年間数十万の論文が発表される中で，必要なエビデンスを見つけ出すことは容易ではない。　　に，主な文献データベースを示すが，大きく種別すると網羅性はあるが質は雑多なデータベースと，選別されて質は高いが収載数は少ないデータベースとある。前者の代表がMedlineで，現在はPubMedとしてインターネットを介して無料で利用可能であり，日本の論文では中央医学雑誌も有料であるが存在する。後者のデータベースとしてはCochrane Library，Clinical Evidence，UpToDate等があり，有料ではあるがその価値は十分にある。後者で的確なエビデンスがみつかればよいが，無い場合は前者のPubMedなどで検索の上，自ら質を評価する必要がある。

3 シソーラスの理解

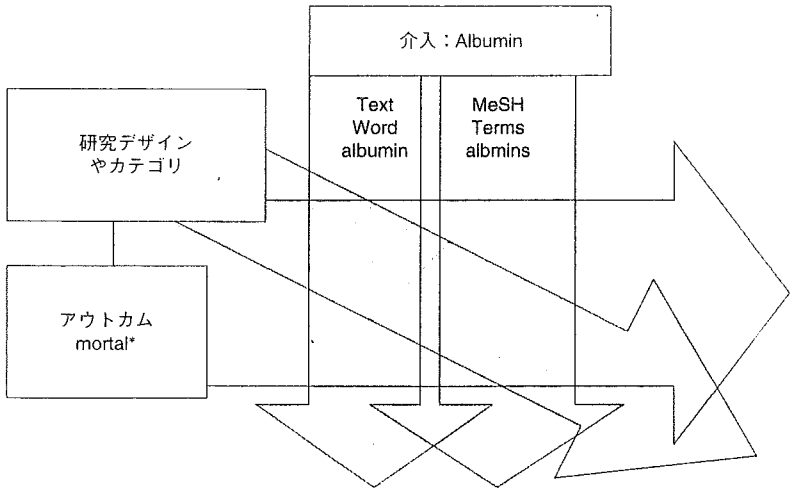
検索を行う際，論文のキーワードやタイトル，アブストラクトで使われた特定の単語を隈無く検索するテキスト検索という方法を用いることもあるが，この際には注意が必要で，例えば「癌」で検索すれば「腫瘍」や「新生物」は検索漏れとなってしまう。この場合に概念を代表する用語で網羅的に検索できれば便利である。そこで登場するのがシソーラスであり，これは「同義語類義語，関連語，概念上広義または狭義の用語を体系的に辞書化したもの」である。特に米国立医学図書館(NLM)が医学用語目的に作成したシソーラスはMeSH (Medical Subject Headings)という。

4 検索戦略

質の高いデータベースではあまり複雑な検索戦略を必要としないが，網羅性はあるが雑多な文献データベースを利用する場合，検索を組み合わせて出来る限り感度・特異度とも高い方法を考える必要がある。検索結果で論文数が多い場合，一般的に用語を限定して検索しがちであるが，先の疑問の明確

種	情報源	媒体	解説
網羅性あるがやや雑多	MEDLINE http://www.ncbi.nlm.nih.gov/PubMed (PubMed)無料	Online (CD)	1966年から保健医療分野から前臨床領域まで含む。NLMが制作。約70ヵ国の4,000誌以上から年間40万件以上の文献の情報及び抄録等が収載される。
	医学中央雑誌 http://www.jamas.gr.jp/index.htm 紀伊国屋，丸善，ユサコ，サンメディア	冊子 Online CD	起源は1903年。収載はCD 1987年～，Onlineは1983年～。約2,400誌から年間28万件を超える文献が収載される。
質は高いが収載数は少ない	Cochrane Library http://wwwwww.update-software.com/ 国内では南江堂，ベルブック等	CD Online	コクラン共同計画により1996年から提供。専門家によるレビューやメタ分析の結果等も収載。
	Clinical Evidence http://wwwwww.clinicalevidence.org 国内では南江堂，ユサコ(OVID)	冊子 (CD) Online	1999年よりBMJから発行。印刷版は半年ごと，オンラインは毎月更新。内科，外科，看護など網羅。
	UpToDate http://wwwwww.uptodate.com 国内ではユサコ	CD Online	内科系19領域。診療・治療・予防。現在5,000トピック収載。年3回更新。

化で用いた4つの軸を参考に，各軸は検索漏れがないように幅広く，そしてむしろ各軸を組み合わせて絞り込むと感度及び特異度を高く検索できる。先の例では，　のように介入である「Albumin」という語ではテキスト検索及びMeSHの検索結果の論理和(OR)を取り，研究デザイン(例えばmeta-analysisや randomized controlled trial)で検索した結果及びアウトカムの死亡を意味する「mortal*」で検索した結果との論理積(AND)を取るなどが考えられる。なお「mortal*」の*は語尾変化を考慮した前方一致検索をこの場合意味する。



Critical Reading編

1　エビデンスレベルと勧告のグレードについて

吟味していく過程では，2つの視点がある。すなわち質の高いエビデンスであるかと疑問への的確性や患者への適用可能性である。質に関しては　のようにエビデンスレベルと勧告のグレードというものがある[3]。グレードはA～D，レベルは1～5までで，この表で上にあるほど質が高い。これは主に研究デザインと関連があり，その理由については前章の「臨床試験のデザイン」を参照願いたい。ただしこのエビデンスレベルもあくまで目安で，リスクを評価する場合に無作為化比較試験の論文があるとは考え難い。ある程度害があることが予想されるタバコ等を無作為に対象者へ割り当てることなど倫理的に問題があり，論文としてあるのはコホートか症例対照研究くらいと考えられる。

グレード	レベル	治療/予防/病因/害について
A	1a	無作為化比較試験の系統的レビュー(均質)
	1b	個別の無作為化比較試験(狭い信頼区間)
	1c	対象者が全て死亡または死亡者なしの場合
B	2a	コホート研究の系統的レビュー(均質)
	2b	個々のコホート研究(質の低い無作為化比較試験を含む：例えば追跡率80％未満)
	2c	“アウトカム(結果)”研究
	3a	症例対照研究の系統的レビュー(均質)
	3b	個別の対照症例研究
C	4	一連の症例(質の低いコホート研究や症例対照研究)
D	5	専門家の明確な批判的吟味のない意見、または生理学的研究に基づいたものや，“第一原理”というもの

2　エビデンスの妥当性について

疑問への的確性や適用可能性については，医療技術の問題，資源の問題，さらには患者の価値観や意向との関連で判断することも必要となる。ここでは1つFlecherらの「臨床研究の妥当性決定に関する基本ガイドライン」[4]を紹介する。これはさらに(1)すべての研究用，(2)診断的検査に関する研究用，(3)有病率研究用，(4)コホート研究用，(5)ランダム化試験用，(6)症例対照研究用，(7)メタアナリシス用に分かれる。