

UMIN -National Information Infrastructure for Biomedical Sciences

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Abstract: University hospital Medical Information Network (UMIN) is a public network organization in Japan, which provides various useful information services to biomedical researchers, including many databases, email, mailing lists, web hosting, electronic biomedical library, on-line data entry system for clinical research, etc. Today, more than 150,000 Japanese researchers have UMIN user accounts and the number of web accesses is more than 12,000,000 page views per month. UMIN is now considered as indispensable national information infrastructure for biomedical sciences in Japan. Some important factors essential to the successful development of UMIN or similar infrastructure are discussed in detail.

Keyword: information services, information centers, clinical research, computer security

Introduction

Many projects are now planned or under way, aiming at facilitating informatization and networking around the world. In Japan, the UMIN project for biomedical sciences has been in operation since 1989, funded by the Ministry of Education, Science, Sports, and Technology (MEXT)[1]. UMIN, originally established only for the national university hospitals, has evolved into one of the largest and most versatile academic network organizations in the world, and provides various information services covering research, education, clinical practice, and hospital administration [2].

In this paper, I review the current status of UMIN and discuss lessons to be learnt from my practical experience of its development and management.

Overview of UMIN

1. Services and usage statistics

Major UMIN services are listed in the Table. Among its many services, Electronic Library for Biomedical Sciences (ELBIS), Internet Data and Information Center for Clinical Research (INDICE), and Online Academic Society Information Service (OASIS) are very popular.

ELBIS covers all the functions necessary for an ordinary Internet-based electronic library. Besides these, it has an online abstract entry system for academic meetings, which is used by more than three hundred Japanese academic meetings each year, and the cumulative number of abstracts and papers collected is more than 180,000. The collected abstracts and their bibliographic information are automatically compiled in an electronic library database and are retrievable via the Internet.

INDICE is an Internet-based application software service for clinical research[3]. UMIN customizes the INDICE software package and provides it to clinical research groups. Currently 26 clinical research projects using UMIN INDICE are under way, and the cumulative number of patients enrolled in these projects is more than 34,000. This means that almost all Internet-based clinical research projects use UMIN INDICE.

OASIS is member-only homepage hosting service for academic societies, etc. In order to use this service, more than twenty academic societies have registered all their members with UMIN. The merits for academic societies of using OASIS, compared with developing their own individual member-only homepage services, are as follows:

1) Development and operational cost

UMIN offers server hardware, software, and user support free of charge. Each academic society can spend most of its budget on digital contents for its members.

2) One UMIN ID for multiple academic societies

Each registered biomedical researcher has only one UMIN ID and, using it, he or she can access all the member-only homepages of academic societies whose membership he or she has. This is very convenient for the researchers.

3) Commonly used application software

UMIN offers the commonly used application software it has developed for academic societies free of charge.

In order to use the many services mentioned above, more than 150,000 biomedical researchers have registered themselves with UMIN and obtained UMIN IDs. Currently the number of total WWW accesses amount to more than 12,000,000 page views per month.

Table. Major UMIN services

Research	Clinical practice
ELBIS	AIDS treatment manual full text database
INDICE	ICD-10 based disease nomenclature database
OASIS	Drug information full text databases
Academic society and meeting database	Intoxication database
Research funding and funding organization database	University hospital management
Research hospital database	Hospital management statistics database
Biomedical research organization database	University hospital guides
Biomedical researcher database	Nursing practice survey statistics database
Job opportunity database for biomedical researchers	Official documents database
Visible human project data file archives	Medical supplies and materials database
Adult cardiovascular surgery database	Master databases for patient fee calculation
Education	Miscellaneous
Supercourse, the Internet and global health	Email and mailing list hosting service
Quality management system for medical education	News service
Evaluation system for postgraduate clinical training	Homepage hosting service

2. Organizations

UMIN is governed by the Steering Committee, which is made up of representatives from eleven medical and two dental national university hospitals, and from three medical professions in the national university hospitals, namely pharmacists, nurses, and laboratory technicians. Under the Steering Committee, there are seven subcommittees for discussing matters related with specialized fields, namely the Hospital Administration Subcommittee, Drug Information Subcommittee, Laboratory Information Subcommittee, Nursing Information subcommittee, Network Technology Subcommittee, Clinical Research Subcommittee, and Dental Information Subcommittee.

All the UMIN information services are provided by the UMIN Center located at the University of Tokyo Hospital. Its budget is about 2,000,000 dollars (1 dollar = 120 yen) a year. Currently, one faculty member, one secretary, one clerk, and five operators work for the UMIN Center. The staffs, other than the faculty member and clerk, are dispatched from an employment agency. In addition, several system engineers or programmers from vendors are usually engaged in system maintenance and software development. In all the national university hospitals and some private university hospitals, there is one part-time clerk who is engaged in local user administration and support.

3. National Information Infrastructure

In Japan, many biomedical researchers have come to recognize the resources provided by UMIN as indispensable national information infrastructure for their academic activities. The resources can be classified as (1) well-maintained server hardware, (2) many user accounts (UMIN IDs), (3) useful application software, and (4) databases. The characteristics of the national information infrastructure are as follows:

1) Public common property

The UMIN resources are public common property for the Japanese biomedical academic community, and are thus available to its biomedical researchers free of charge or at low prices.

2) Free selection of necessary resources

Universities, academic societies, research groups, etc. can select necessary UMIN resources freely and utilize them in combination. As an example, an academic society can use UMIN OASIS server hardware and software for preparing its member-only homepage, and can choose whether the society should use the member retrieval system provided by UMIN or develop its own one and install it to the UMIN OASIS server.

3) Multiple purposes -

Universities, academic societies, research groups, etc. can use UMIN information infrastructure for multiple purposes, including research, education, and clinical practices. This is more efficient than developing different independent information centers for different purposes.

Discussion

I believe that, in any country, national information infrastructure for biomedical sciences similar to UMIN would be beneficial for biomedical academic activities. The first merit is the reduction of the national cost for developing and maintaining information resources by sharing them via the Internet. From a national point of view, it is not efficient if each academic organization develops and maintains similar, but separate information resources independently. The second merit is an increase in system reliability and security. In order to assure sufficient reliability and security, much labor and expenditure are necessary. Thus, building many small information centers would be inefficient. The third merit is standardization of data formats and user interfaces. In Japan, as most biomedical academic societies have adopted the ELBIS online abstract entry system for academic meetings, its data format specification for abstracts and their bibliographic information has become the de facto standard in biomedical sciences.

From my experiences of developing and managing UMIN, I have learned some important factors which are, I believe, essential to the successful development of UMIN or similar projects. These are as follows:

1) Competitive environment

A national administrative authority should not force its academic community to use its project products. Academic community should have freedom of choice. A small number of users proves that the project is failed and should be abandoned.

2) Leadership

It is difficult to manage a non-profit organization efficiently. This is partly because it is difficult to measure its achievement in numeric terms. It is desirable to appoint an excellent leader who can make his or her staffs have a sense of mission.

3) Authority and responsibility for the leader

The project leader should have full authority and responsibility for the project. This is because decisions should be made quickly and be consistent.

4) Single discipline

Information infrastructure for academic activities should be developed for a single academic discipline such as medicine, or a few closely related ones. Researchers in different academic disciplines are usually much different in way of thinking and sense of values. They do not go together well in managing a common information center.

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UMIN INDICE and Virtual Coordinating Centers for Clinical Research

Takahiro Kiuchi

Abstract— UMIN, the largest Japanese medical network organization with more than 150,000 registered medical professionals, has established an Internet-based, application service provider (ASP) for investigator-initiated clinical research called Internet Data and Information Center (INDICE). It has developed sophisticated and flexible software packages for clinical research and has gained an overwhelmingly high market share among investigator-initiated, Internet-based clinical research projects in Japan. While, in other industrialized countries, many research groups have their own coordinating centers for medical research, develop their own software, and maintain their user accounts for medical researchers independently, many research groups in Japan share the network-based, information system and user accounts of UMIN in common. We call these methods of operations virtual coordinating centers for clinical research, and believe that they are cost-effective and laborsaving.

Index Terms— Internet, medical information systems, communication system security, medical treatment

I. INTRODUCTION

IN Europe and North America, there are many permanent public coordinating centers for investigator-initiated clinical research, and they play central roles in running Internet-based clinical research as well as conventional telephone-, fax-, and mail-based research. In Japan, there have been few permanent public coordinating centers for investigator-initiated clinical research because experimental medical research using cells and animals as materials has been much more popular than clinical research which evaluates the effectiveness of medical treatments and the correctness of diagnostic methods for humans. Only recently, physicians have come to realize the importance of clinical research and to launch many clinical research projects.

In these circumstances, University hospital Medical Information Network (UMIN) [1]-[3], the largest and most versatile medical network organization in Japan established an Internet-based application service provider for clinical research called Internet Data and Information Center for Clinical Research (INDICE) and initiated its high quality services.

Accordingly, almost all Internet-based clinical research projects in Japan use UMIN INDICE. Clinical research groups in Japan do not tend to establish their own permanent coordinating centers, unlike their counterparts in Europe and North America, but they share UMIN INDICE in common via the Internet, and run Internet-based clinical research using it. In this paper, I present an overview of UMIN INDICE and discuss its role and significance, especially focusing on the difference in circumstances between Japan and other industrialized countries in Europe and North America.

II. BACKGROUND

A. UMIN

UMIN was established in 1989 as a network organization for national university hospitals in Japan, funded by the Ministry of Education, Culture, Science, Sports, and Technology (MEXT). Although its first network was a closed one among the national university hospitals, it began to provide its services to all Japanese medical professionals via the Internet in 1994, considering the growing popularity of the Internet at the time. Currently UMIN provides a wide variety of useful information services, covering research, education, clinical practice, and hospital administration. The number of its web accesses and registered users are more than 13,000,000 page views per month and 150,000, respectively. UMIN has now become important information infrastructure for medical academic activities in Japan.

B. Coordinating Centers in Europe and North America

A public coordinating center for clinical research is a permanent center where planning, progress management, data management, statistical analysis, etc. of investigator-initiated clinical research are performed [4]. It plays a central role in investigator-initiated clinical research in Europe and North America. In the 1950s, when permanent coordinating centers began to be established, computers were not used. Before long, computers were introduced to coordinating centers for the purpose of statistical analysis at first, and then for the purpose of data management. Finally, they have come to be used for more sophisticated tasks such as management of research progress, remote data entry, etc. At present IT specialists such as system engineers, programmers, operators, etc., usually work for coordinating centers, in addition to data managers, statisticians, etc. From the view of information systems, these

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IT specialists are considered "providers" of information systems, while other staff such as data managers, statisticians, etc., are considered as "users" of information systems. In Europe and North America, both "users" and "providers" of information systems usually work together in the same coordinating centers.

C. Clinical research and coordinating centers in Japan

In Japan, medical research had substantially meant experimental biological research using cells and animals till recently, and investigator-initiated clinical research with patients had not been popular. Thus there are few public permanent coordinating centers for investigator-initiated clinical research even now, although commercial coordinating centers for industry-initiated clinical research run by profit-making business are increasing in number thanks to the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH) and Good Clinical Practice (GCP) guidelines for quality and ethically appropriate clinical research conducted by pharmaceutical companies [5]. However, Japanese physicians have now come to realize the importance of investigator-initiated clinical research with patients, and they have latent needs for coordinating centers for their investigator-initiated clinical research.

III. OVERVIEW OF UMIN INDICE

A. History and concept

I have studied application of the Internet and its technology to remote data entry systems for clinical research since the early 1990s[6]-[9]. Ever since then, I had been planning to establish a computer center for Internet-based remote data entry in UMIN, but had not been able to realize it until the end of 1999 because, due to the export regulation imposed by the U.S. government, it was impossible in Japan to use U.S.-made, strong encryption algorithms which are essential for transferring patients' information via the Internet. In December 1999, the regulation was relaxed. Thus, in January 2000, UMIN established a public application service provider for investigator-initiated clinical research, namely INDICE.

Services of INDICE are limited to providing application software services via the Internet (Fig. 1). All user research groups have to secure their own secretariats, data managers, and statisticians by themselves. INDICE provides mailing list and member-only homepage hosting services to each research project for the communication of research-related information among its project staff and participant researchers. For the data entry and access to the member-only homepage, UMIN accounts (IDs) are issued to all the participants. These will contribute to the further recognition and promotion of UMIN service in general and, thus, INDICE exhibits synergic effects with other UMIN information resources.

B. Hardware and its operation and maintenance

For security protection, INDICE employs 1) two firewalls for controlling and checking external accesses, 2) encryption of all

the transactions using 128-bit strong encryption algorithm, and 3) an intrusion detection system. In addition, in order to prevent physical invasions, the INDICE computer room is equipped with a security gate with a fingerprint authentication system and surveillance cameras. For security reasons, I cannot explain the servers, network configuration, etc. of INDICE in further detail.

In the UMIN Center, four or five operators work on weekdays and one operator works on holidays by rotation. The holiday work is indispensable to detect system troubles earlier and to respond to enquiries from users immediately during holidays.

C. Software

UMIN has developed four software packages for INDICE, as mentioned below. The patient registration and random allocation system and patient follow-up data collection system are customized before provision, according to the requirement of each clinical research group.

1) Patient registration and random allocation system

This system is a software package dedicated to initial patient registration for all types of clinical research, and to random allocation for randomized clinical trials (Fig. 2). This system is indispensable to high quality clinical research because initial patient registration (and random allocation in the case of randomized clinical trials) conducted by an independent third party is essential to the quality of research.

In addition, data entry items for patient registration and random allocation are limited in number. Therefore, it is relatively easy to develop this system as compared with the patient follow-up data entry system. Thus UMIN developed this system separately from the follow-up data entry system.

2) Patient follow-up data entry system

This software package is dedicated to collecting patients' data other than those for patient registration and random allocation. This system is usually used in conjunction with the patient registration and random allocation system.

3) Research projects management system

This system is used for the management of all research projects in UMIN INDICE. The major functions are project-related information management, project progress management, overall operational statistics collection, access log management, etc.

4) INDICE user management system

This system is used for individual user information management, issue and revocation of user accounts, the allocation of each user to individual research projects, etc.

D. Usage Statistics

Almost all Internet-based clinical research projects in Japan use UMIN INDICE (Fig. 3). The user research projects are listed in the Table. The cumulative number of patients enrolled in them is more than 34,000 in total (Fig.4).

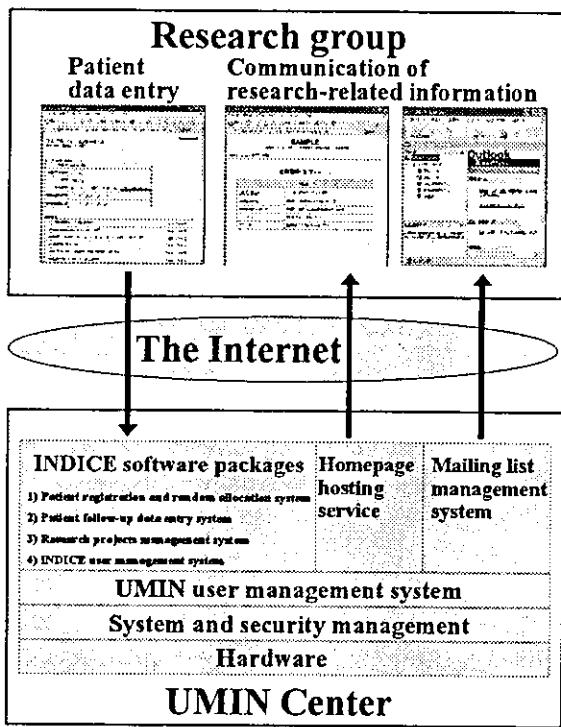


Fig. 1. A schema of the services of INDICE

The screenshot shows a web browser displaying a patient registration form. The title is "患者登録フォーム/SAMPLE". The form includes the following fields: "患者(レジスタ)名" (Patient Initial), "性別" (Sex), "生年月日" (Date of birth), "同意文書取得日" (Date of informed consent), and "手術実施日" (Date of operation). Below these fields is a table for "適格基準" (Eligibility criteria) with columns for "Yes" and "No".

適格基準	Yes	No
1. 年齢が20歳以上、70歳未満です	<input type="checkbox"/>	<input type="checkbox"/>
2. Performance Status が 0-2 の範囲です	<input type="checkbox"/>	<input type="checkbox"/>
3. 既往症(血圧、糖尿病、腎臓病、心臓病、肝臓病、腎臓病、呼吸器病)が安定しています	<input type="checkbox"/>	<input type="checkbox"/>
4. 薬剤師が処方します	<input type="checkbox"/>	<input type="checkbox"/>
5. 既往症(腎臓病、心臓病、肝臓病、呼吸器病)が安定しています	<input type="checkbox"/>	<input type="checkbox"/>
6. 白血球が 3000 /mm ³ 以上あります	<input type="checkbox"/>	<input type="checkbox"/>
7. 血小板が 50000 /mm ³ 以上あります	<input type="checkbox"/>	<input type="checkbox"/>

Fig. 2. A sample data entry form of the patient registration and random allocation system

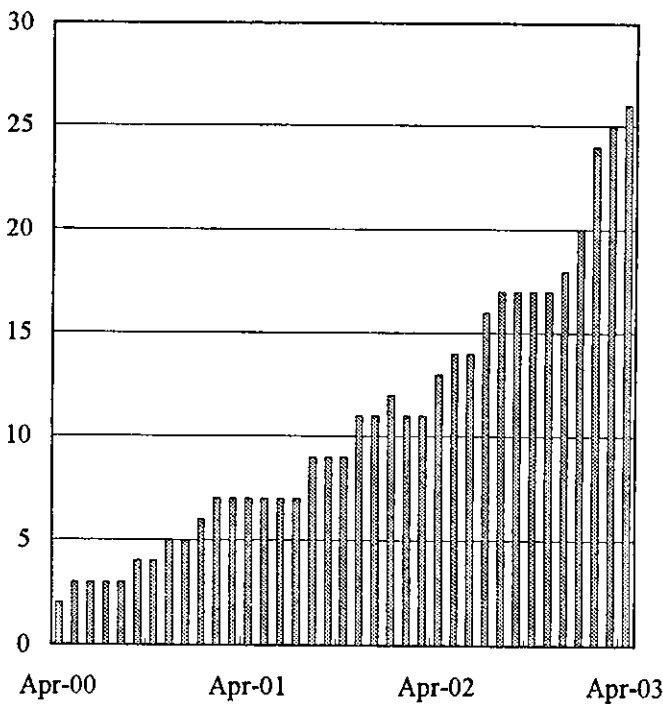


Fig. 3. The number of research projects using INDICE

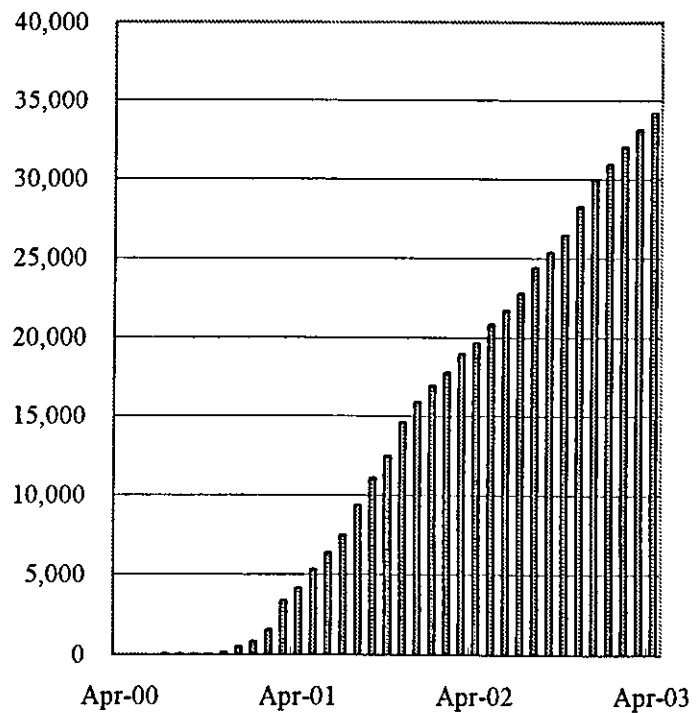


Fig. 4. The number of patients enrolled

TABLE.
List of research projects (May, 2003)

Date	Specialty	Research design	Number of patients	Status
2000/03	Cardiology	Randomized clinical trials	10-100	In operation
2000/04	Ophthalmology	Randomized clinical trials	10-100	In operation
2000/05	Hematology	Randomized clinical trials	100-1,000	Terminated
2000/09	Intensive Care Medicine	Randomized clinical trials	100-1,000	In operation
2000/11	Cardiology	Epidemiological research	10,000-100,000	In operation
2001/01	Neurosurgery	Single group clinical trials	10,000-100,000	In operation
2001/02	Cardiology	Randomized clinical trials	10-100	In operation
2001/08	Cardiovascular surgery	Case registration	10,000-100,000	In operation
2001/08	Urology	Randomized clinical trials	100-1,000	In operation
2001/11	Urology	Randomized clinical trials	100-1,000	In operation
2001/11	Cardiology	Randomized clinical trials	100-1,000	In operation
2002/01	Neurosurgery	Randomized clinical trials	100-1,000	In operation
2002/03	Gastrointestinal surgery	Randomized clinical trials	100-1,000	In operation
2002/04	Hematology	Randomized clinical trials	100-1,000	In operation
2002/04	Cardiology	Randomized clinical trials	100-1,000	In operation
2002/07	Orthopedic surgery	Randomized clinical trials	100-1,000	In operation
2002/07	Cardiovascular surgery	Randomized clinical trials	100-1,000	In operation
2002/08	Mammosurgery	Randomized clinical trials	100-1,000	In operation
2002/11	Orthopedic surgery	Randomized clinical trials	100-1,000	In operation
2003/01	Emergency medicine	Randomized clinical trials	100-1,000	In operation
2003/01	Radiology	Randomized clinical trials	10-100	In operation
2003/02	Radiology	Single group clinical trials	10-100	In operation
2003/02	Radiology	Single group clinical trials	10-100	In operation
2003/02	Radiology	Single group clinical trials	10-100	In operation
2003/03	Endocrinology	Randomized clinical trials	100-1,000	In operation
2003/04	Cardiology	Epidemiological research	100-1,000	In operation
2003/04	Cardiology	Randomized clinical trials	1,000-10,000	In operation

IV. DISCUSSION

A. Internet-based clinical research

Internet-based data entry has an advantage over conventional telephone-, fax-, and mail-based entry in labor cost and convenience [5]. In addition, it improves data quality by means of automated range, logical data check, etc. However, it is usually costly to develop server software for each project. In general, the larger the number of patients, the lower the software development cost per patient. This is because the cost for software is the same regardless of the number of patients collected. Consequently, Internet-based clinical research is more reasonable in cost for large-scale research. In addition, research projects which need 24-hour initial registration, such as those in emergency medicine, etc., are more suitable to the Internet-based research because 24-hour-a-day service by humans is very costly.

B. Situations in Japan and its implications

In Europe and North America, existing coordinating centers which have conducted conventional-style clinical research also have introduced and conducted Internet-based clinical research. In Japan, there are few permanent public coordinating centers, and clinical research itself is not very popular. However, there is a large-scale, public network information center with user accounts for many researchers, namely UMIN. There are no similar public network organizations in Europe and North America. In this situation, UMIN initiated the INDICE project, and has gained the overwhelming high market share among

investigator-initiated, Internet-based clinical research in Japan. Many researchers have experienced Internet-based clinical research without any experiences of conventional-style research in Japan, just like many people use mobile telephones without any experiences of using fixed telephones in China.

The reasons why INDICE has become so popular in Japan are as follows:

1) High quality service with low cost

UMIN INDICE software packages are flexible, easy to use, and sophisticated in function. By further specializing in our usual role, we have succeeded in enhancing the quality of our INDICE services. UMIN offers them at very low price, which is made possible because of the government funding for UMIN and of efficiency of UMIN services. In addition, UMIN has existing member-only web hosting and mailing list hosting services, and offers them to each research group free of charge.

2) User accounts

More than one hundred and fifty thousands medical professionals have their user accounts with UMIN. These user accounts can be used for INDICE as they are. This is convenient for both research groups and individual researchers.

3) Reliability and security

Much labor and expenditure are necessary to assure sufficient reliability and security in information service. Thus, building an individual center for each research group would be inefficient.

4) Publicity

As reflected by its many users and many kinds of useful information services, UMIN has been very popular among medical professionals in Japan. Thus, UMIN can easily grab the attention of Japanese clinical research groups.

Now, thanks to the prevalence of the Internet and the progress of security technology, it has been made possible to use distant information systems securely via the Internet. Thus an information system for Internet-based clinical research does not have to be installed in each coordinating center. UMIN INDICE provides only Internet-based information systems to research groups, and has only "providers" of information systems as its staff. Each research group can complete the necessary staff and equipment for an ordinary coordinating center by securing staff members including data managers, statisticians, etc., and PCs for Internet-terminals in addition to UMIN INDICE (Fig. 5). We call this method of operation of a coordinating center "virtual coordinating center for clinical research." The mission of UMIN INDICE, I believe, is to provide Internet-based information systems to many research groups and become a central information center for "virtual coordinating centers" in Japan.

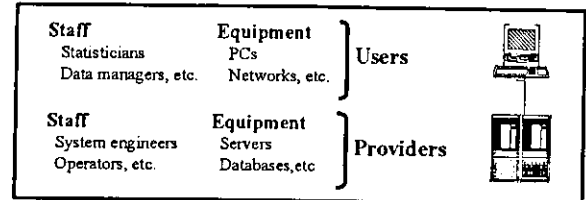
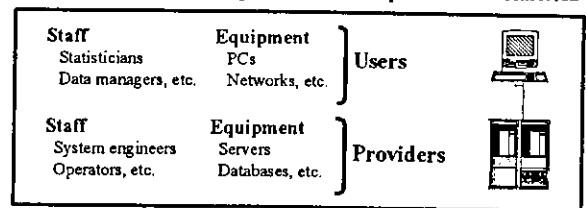
There is much benefit in virtual coordinating center system. The integration of information systems contributes to the reduction of cost and enhancement of security and reliability. As user accounts are shared by multiple projects, the burden of issuing and maintaining user accounts for both information center and each user will be much reduced. In addition, by using the same software packages, user interfaces and data formats of collected data will be standardized. As for software, it may be desirable that a few kinds of packages are made available, and each research group can choose one of them according to its preference, because monopoly may cause a slower rate of functional upgrades and lower quality of maintenance.

In Europe and North America, there are many information systems for Internet-based clinical research operated independently of one another. Each system is different from others in functions, user interface, data formats, platforms, etc. and it seems very difficult to standardize them and integrate them into one or a few systems. However, as the merit of integration of information systems is apparent from mid- and long-term perspectives, I believe that they will be also gradually integrated into a few central systems. In addition to cost, reliability, and convenience, a centralized large information center provides other benefits. Namely, it can provide many kinds of academic information services other than those for clinical research, just as UMIN does in Japan.

ACKNOWLEDGMENT

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(1) Ordinary Coordinating Centers in Europe and North America



(2) Virtual Coordinating Centers in Japan

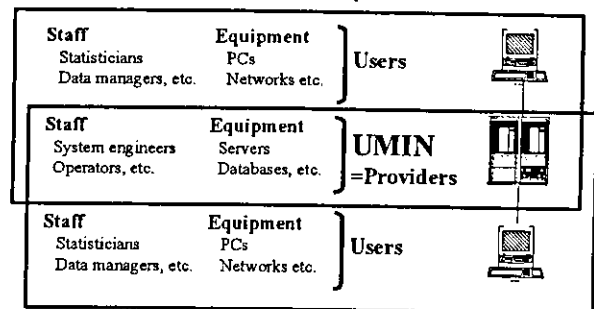


Fig. 5. Two types of coordinating centers for clinical research

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Takahiro Kiuchi was born in Kisarazu City, Chiba, Japan in 1962. He received an M.D. degree from the Faculty of Medicine, the University of Tokyo, and a Ph.D. degree in medicine from the Graduate School of Medicine, the University of Tokyo, in 1986 and 1996, respectively.

From 1986 to 1987, he was a trainee physician with the University of Tokyo Hospital. Then he enrolled in a course in medical informatics at the Graduate School of Medicine, the University of Tokyo in 1987 and left it in 1991. From 1991 to 1996, he was an instructor of the Department of Epidemiology and Biostatistics, Faculty of Medicine, the University of Tokyo. Since 1996, he has been

the Director of University hospital Medical Information Network (UMIN) Center, the University of Tokyo Hospital. He was also an assistant professor of the Faculty of Medicine, the University of Tokyo in 1996, and has been an associate professor since 1997. His current research interest is application of information technology to clinical medicine.

Dr. Kiuchi has been a member of the Japanese Association of Medical Informatics since 1988, and the American Medical Informatics Association since 1998.

UMIN - Concept, History, and Current Status

Takahiro Kiuchi

Abstract—University hospital Medical Information Network (UMIN), Japan, was established in 1989 to share common database and application software among national university hospitals in Japan. Thanks to its successful management and successive funding from the government, UMIN has evolved into one of the largest and most versatile public academic network organizations in the world and indispensable information infrastructure for the Japanese medical academic community. Currently, the number of its registered medical professionals and its web page views per month is about 153,000 and 15,000,000, respectively. I believe that similar public information centers for academic activities would be also beneficial for other academic specialties in other countries.

Index Terms—Internet services, medical information systems, communication system security

I. INTRODUCTION

UMIN was established in 1989 as a network-based, common computer center for national university hospitals in Japan [1]. Currently it is made available to all Japanese medical professionals and has become one of the largest and most versatile Internet-based medical information centers, covering research, education, clinical practice, hospital management, etc. [2].

In this paper, I present the concept, history, and current status of UMIN, and discuss its roles in the Japanese medical community. Lessons that I have learned during its development are also discussed.

II. CONCEPT—SHARING INFORMATION RESOURCES

In the 1960s, computers were extremely expensive. Thus, the Japanese government established collaborative computer centers in its seven major national universities, which were open to researchers in other universities and research institutes. In the middle of the 1970s, a computer communication protocol named N1 was developed in order to use distant computers via communication lines. N1 was a very simple protocol which did not define control sequences and, accordingly, supported only line mode terminals, but its implementation was relatively easy and all major computer vendors in Japan at that time such as Fujitsu, IBM, NEC, Hitachi, DEC, etc. supported it. All the computers in the seven collaborative computer centers were connected via an N1-based network named Science

Information Network (SINET) and were shared online among Japanese researchers. The concept of UMIN was originated from this N1-based, nation-wide computer network for research.

There are eighty medical schools in Japan, of which forty-two are national. National universities have been allocated a relatively large amount of the government budget, and have played a leading role in the development of modern medicine in Japan. The national university hospitals have been also pioneers in introducing advanced hospital information systems. Up to the middle of the 1980s, hospital information systems had been introduced to all the national university hospitals. However, they had been designed and developed independently of one another, and their standardization for interoperability had not been taken into account. There had been no mechanisms to share information resources such as documents, databases, application software, etc. among the national university hospitals. UMIN was envisaged for sharing such information resources. It was assumed that collaborative development and joint purchase of database, application software, etc. would reduce the overall burden and cost of national university hospitals.

Dr. Kaihara, a professor of the Hospital Computer Center, the University of Tokyo Hospital, and other specialists in medical informatics had been requesting the necessary budget for UMIN from the Ministry of Education, Science, Sports, and Culture for a several years. Finally they succeeded in acquiring the necessary budget in fiscal year 1988. Immediately the Steering Committee was organized, and UMIN Center was established in the Hospital Computer Center, the University of Tokyo Hospital. In order to make the concept of UMIN easier for medical professionals to understand, the Steering Committee laid out five purposes of UMIN as follows:

1. To provide up-to-date information to healthcare professionals
2. To promote communications among healthcare professionals.
3. To support collaborative projects among university hospitals.
4. To support collaborative medical research.
5. To standardize medical data and to collect hospital statistics

III. HISTORY—MORE SERVICES FOR MORE USERS

I present an overview of the development process of UMIN,

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classifying its history into the four phases mentioned below.

A. Initial N1-based system - From 1988 to 1994

A mainframe server computer for UMIN was introduced to the center at the end of 1988. N1 protocol was adopted as a communication protocol after the SINET, but the communication lines for UMIN were independent from those for the SINET in order to assure security. The Internet was not adopted by UMIN because it was considered not suitable to interconnecting host computers in hospitals due to its security problems. In addition, operational experience of the Internet in Japan was insufficient, and its future prospects were obscure at that time.

Official UMIN service was initiated in 1989, interconnecting eight national university hospitals among the total forty-two. Since then, several additional national university hospitals were connected to UMIN each fiscal year until 1994. Under the Steering Committee, three subcommittees, namely the Drug Information Subcommittee, Hospital Administration Subcommittee, and Nursing Information Subcommittee, were organized. In the Steering Committee and these subcommittees, information services which were needed, such as databases, application software, communication services, etc., were intensively discussed. As a result, the first UMIN provided the following services to its users:

1. Communication services
Electronic mail, Bulletin board system, etc.
2. Databases jointly purchased by the university hospitals
Drug information database, National Health Insurance Drug Price Standard database, Research organization and hospital database, Drug adverse effect database, etc.
3. Databases collaboratively developed by the university hospitals
Drug information database for pharmacists, Case report database, Standardized nursing procedures database, etc.
4. Gateway services for other external centers
National Institute of Information (NII), Japan Science and Technology Corporation (JST), BRS/Colleague, etc.

The Steering Committee, Subcommittees, and UMIN Center staff did their best to develop and manage UMIN, and were also actively engaged in publicity through newsletters, brochures, explanatory meetings, etc. However, users were limited in number. The reasons might be as follows:

1. Low availability of terminals accessible to UMIN

The UMIN services were available only from the national university hospitals, although most of them were useful not only to medical professionals in the national university

hospitals but also to those in other hospitals. Even in the national university hospitals, only a few terminals were available in each ward. In addition, each terminal was used for both local hospital information systems and UMIN, and so tended to be occupied during the daytime.

2. User unfriendly interface

The user interface of the N1-based UMIN system was user unfriendly, supporting only a line-mode, character user interface.

B. Adoption of the Internet -From 1995 to 1996

In the early 1990s, the Internet began to spread around the world at overwhelmingly high speed. The Internet then was much superior to N1-based networks from all viewpoints except security. The Steering Committee determined that all the UMIN services should be provided via the Internet. In accordance with this decision, all the application software and data were transported from the initial mainframe server to new UNIX-based servers. The new Internet-based system used a TELNET-based, full screen character user interface in the image of Gopher, and Gopher service itself was also integrated into the new system. The security problem of the Internet was not considered seriously because, up to this time, UMIN had not dealt with identifiable patients' information. However, some still valued a secure N1-based private network because the need for transferring identifiable patient information might arise later.

With the adoption of the Internet, the number of registered users increased rapidly. However, most of them obtained UMIN user accounts for nothing more than using Internet electronic mail. At the time, most national universities did not have their own electronic mail services, and many users thus took UMIN as a synonym for Internet electronic mail. Other UMIN services were not very popular. There were no killer digital contents or application services provided by UMIN. In addition, although TELNET-based, full screen character user interface was more sophisticated than that of the former N1-based system, users did not think that it was user-friendly because GUI-based operation systems such as MS-Windows and Mac OS had already become popular at that time.

Before the Internet era, only institutions or companies which owned or leased physical communication lines could provide network-based information services. However, in the Internet era, such physical networks are not essential to network-based information services, and it had become dramatically easier for anyone to initiate such services. In medicine, many commercial companies and non-profit institutions initiated their own information services. UMIN had lost its privileged status. For example, each university hospital had come to set up its own electronic mail service. I suspected that UMIN electronic mail users would gradually switch to the services of their own institutions.

C. WWW-based services -From 1997 to 2000

The WWW had the advantages of its user-friendly graphical user interface and reasonable development cost of its application software. Thus UMIN adopted WWW instead of Gopher and updated the TELNET-based systems completely, using WWW technology. In line with the Japanese government policy to promote the Internet, the UMIN budget was increased. Thanks to the WWW adoption and increased budget, the number of UMIN information services, especially those related with research, was much increased.

In those days, there were many net ventures around the world that aimed at providing Internet-based information services to medical professionals. Their typical business strategy was to spend much money to collect medically-related digital content at first, to solicit as many users as possible at the earliest possible time; then, using this content as a feature, finally to earn much more money. UMIN did not adopt such a business strategy. Its strategy was not to spend its limited budget on medical content itself, but to invest it in developing information systems to collect and provide digital content, such as ELBIS (Electronic Library for Biomedical Sciences), OASIS (Online Academic Society Information Service), INDICE (Internet Data and Information Center of Clinical Research), etc., as mentioned later. Thanks to the popularity of these services, UMIN became well-known to most medical professionals in Japan [3]. In particular, the influence of OASIS was the most important. In order to use this service, several large academic societies, such as the Japanese Circulation Society with about 20,000 members, the Japanese Society of Gastroenterology, etc., registered all their members to UMIN, which contributed greatly to the recognition of UMIN.

D. Virtuous circle -From 2001

The large number of useful services attracts many medical professionals. As a result, they register themselves to UMIN. The resulting many user accounts attracts many parties, such as universities, academic societies, research groups, etc. These parties propose new information services for UMIN. As a result, the number of services will increase further. Accordingly, a virtuous cycle ensues, and the number of users and services continues to increase. Currently the number of registered medical professionals and web page views are more than 153,000 and 15,000,000, respectively (June, 2003).

IV. CURRENT STATUS -ONE OF THE LARGEST AND MOST VERSATILE MEDICAL NETWORK ORGANIZATIONS IN THE WORLD

A. Current UMIN services

Current major information services of UMIN are listed in the Table [3]-[5]. It is next to impossible to detail all of them in this paper. Thus, I briefly explain three major services of UMIN, namely ELBIS, OASIS, and INDECE.

ELBIS is an Internet-based electronic library, and its

characteristic is that it has an online abstract and paper entry system for academic meetings, which is used by more than three hundred Japanese academic meetings every year. The cumulative number of abstracts and papers collected is more than 180,000. The collected abstracts and their bibliographic information are automatically compiled in an electronic library database and are retrievable via the Internet.

INDICE is a kind of Internet-based application service for clinical research [3]. The INDICE software packages, developed by UMIN, are customized and provided to clinical research groups. Currently 26 clinical research projects use this service, and the cumulative number of patients enrolled in these projects is more than 35,000. This means that almost all Internet-based clinical research projects in Japan have been carried out using UMIN INDICE.

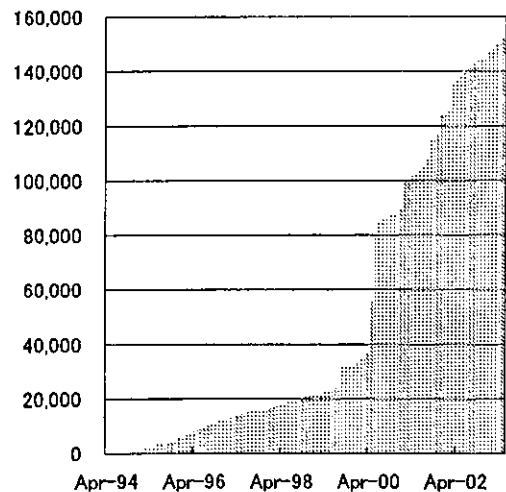


Fig. 1. The number of registered medical professionals

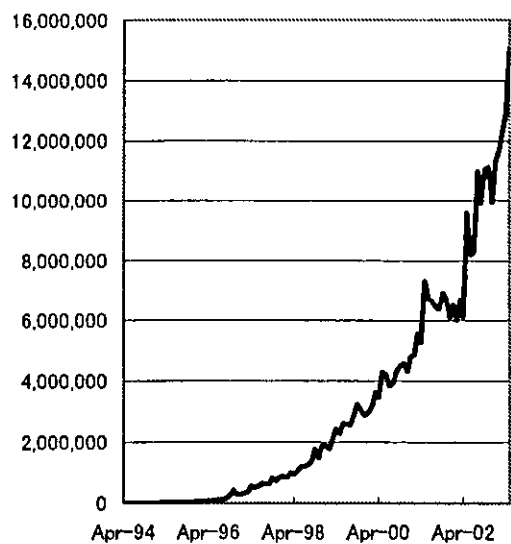


Fig. 2. The number of web page views per month

Table. Major information services of UMIN

Services	Data source, etc.	Access
A. Research		
ELBIS (Electronic Library for Biomedical Sciences)	Application service	Open/Limited
AC (Academic societies and meetings database)	Database developed by the UMIN Center	Open
FIND (Fund Information Database)	Database developed by the UMIN Center	Open
INDICE (Internet Data and Information Center for Clinical Research)	Application service	Open
ROCOLS (Recruiting System for Our Colleagues and Students)	Database developed by the UMIN Center	Open
Researcher database	Developed by online data entry	Limited
B. Education		
Supercourse <i>The Internet and global health</i>	Online lectures compiled by Pittsburgh Univ., U.S.A.	Open
Web-QME (Web-based Quality Management System for Education)	Application service	Limited
Visible Human Project Image Data	Digital data prepared by.nlm, U.S.A.	Limited
C. Clinical practice		
HIV treatment manual	Manual developed by Hokkaido University Hospital	Limited
Sarin intoxication treatment manual	Manual developed by St. Luke's International Hospital	Limited
Drug information full text database	Database jointly purchased by the national university hospitals	Limited
Drug information text database for patients	Text database developed by Hokkaido Univ. Hospital	Limited
Drug information text database for pharmacists	Text database developed by Kanazawa Univ. Hospital	Limited
Drug adverse effect reporting and retrieval system	Application service	Limited
Intoxication database	Text database developed by Yamaguchi University Hospital	Open
Standardized nursing procedures database	Text database developed by Kagawa Medical School Hospital	Limited
Classification of intensity of nursing care	Text database developed by Kagoshima University Hospital	Open
D. University hospital management		
Basic hospital statistics database	Application service	Limited
Hospital management statistics database	Application service	Limited
University hospital guides	Application service	Open
Nursing practice survey statistics database	Application service	Limited
Official documents database	Text database developed by online data entry	Limited
Medical supplies and materials database	Database jointly purchased by the national university hospitals	Limited
Master databases for patient fee calculation	Database jointly purchased by the national university hospitals	Limited
National Health Insurance Drug Price Standard database	Database jointly purchased by the national university hospitals	Limited
Medical term dictionary for hospital clerks	Database developed by Hokkaido University Hospital	Limited
E. Multipurpose		
<i>Communication</i>		
Email service	Application service	Limited
Mailing list service	Application service	Limited
New service	Application service	Limited
Bulletin board system	Application service	Limited
VPN for national university hospitals	Security service	Limited
<i>Homepage hosting service</i>		
Open homepage hosting service	Application service	Open
OASIS (Member-only homepage hosting service)	Application service	Limited
VOD hosting service	Application service	Open/Limited
<i>Databases</i>		
Research organizations and hospitals database	Developed by the UMIN Center	Open
MINCS-UH broadcasting programs database	Database developed by MINCS-UH member hospitals	Open

OASIS is a member-only homepage hosting service with a web-based member list management system and member mailing list service for academic societies, medical schools, etc. If a user organization of OASIS alters its member list using its member list management system, member lists for member-only homepage and mailing list are also altered accordingly. The most important merit for organizations of using OASIS, compared with developing their own individual member-only homepage services, is the reduction of development and operational cost. UMIN offers server hardware, software, and user support free of charge. Another merit is commonly used application software developed and provided by UMIN, such as document retrieval system, bulletin board system, etc. Each organization does not have to develop them separately. As for the merit for each individual user, only one UMIN ID is required, which enables access to all the member-only homepages of academic societies of which the user is a member. This is very convenient for each researcher.

B. Current UMIN organizations

UMIN is managed by the Steering Committee, made up of representatives from thirteen medical and two dental university hospitals, and from three professions in national university hospitals, namely pharmacists, nurses, and laboratory technicians. Under the Steering Committees, there are seven subcommittees in which specific issues in each specialty are discussed, namely Hospital Administration Subcommittee, Pharmaceutical Information Subcommittee, Nursing Information Subcommittee, Laboratory Information Subcommittee, Network Technology Subcommittee, Clinical Research Subcommittee, and Dental Information Subcommittee.

UMIN Center, located in the University of Tokyo Hospital, plays a central role in operating UMIN services. Its yearly budget is about two million dollars. The center staff includes one faculty member (associate professor), five system engineers, one operator, and one part-time clerk. The system engineers and operator are dispatched from an employment agency. In each national university hospital, there is one part-time UMIN staff member who is engaged in user registration, user support, etc.

V. DISCUSSION

A. Sharing Information Resources

The goal of UMIN at the time of its establishment was sharing information resources such as documents, databases, application software, etc., among national university hospitals. I believe that this initial goal has been achieved, although the Internet is now employed instead of the initial N1-based network. Furthermore the introduction of the Internet and its Web technology improved some important aspects of UMIN

services as follows:

1. The expansion of users

Since the Internet was adopted, medical professionals other than national university staff or students can now use UMIN services. Thus, both the number and range of users have expanded.

2. The broadening of kinds of services

Thanks to the expansion of users, some services, especially those concerning research such as ELBIS, INDIECE, etc., have been made much more useful. The participation of non-university users is even essential to these services. Thus the kinds of services have been broadened accordingly.

3. Security protection methods

In an N1-based system, the security protection mechanism completely depends on physical communication circuits, while the current Internet-based system uses encryption technology for security protection. Encryption is more secure, reasonable in cost, and flexible than physical circuits.

4. Easy-to-use software developed in reasonable cost

As compared with mainframe-based software development, a WWW-based system has a more user-friendly interface and its software development cost is more reasonable.

The Internet became popular rapidly. UMIN was already in being, with its committees and center staff experienced with N1 network-based information services, when the Internet began to get popular. If UMIN had been established after the popularization of the Internet, it could not have won the overwhelming success it has. Thus I do not think that N1-based UMIN was thoroughly fruitless.

B. National Information Infrastructure

Before the Internet era, information infrastructure usually meant physical communication lines. Today the Internet infrastructure, that is open communication media for general-purposes, is taken for granted by everybody in the industrialized countries around the world. The information resources of UMIN can be classified as (1) well-maintained server hardware, (2) many user accounts (UMIN IDs), (3) useful application software, and (4) databases. They are public common property for the Japanese medical academic community, and are thus available to its members, namely medical schools, academic societies, research groups, individual researchers, etc., free of charge or at low prices. They can select necessary UMIN resources freely and utilize them in combination for multiple purposes, including research, education, and clinical practices. As an example, an academic society can use UMIN OASIS server hardware and software for

preparing its member-only homepage, and can choose whether the society should use the member retrieval system provided by UMIN or develop its own one and install it to the UMIN OASIS server. In the Internet era, these information resources of UMIN are important, or even indispensable, to make the most use of the Internet infrastructure. I think that these resources can be also called information infrastructure in the new Internet era. From this point of view, UMIN can be considered to have evolved into indispensable national information infrastructure for the Japanese medical community.

I believe that national information infrastructure for academic activities similar to UMIN would be beneficial for any academic field in any country. The reasons might be as follows:

1. National cost for information resources

From a national point of view, it is not efficient if each academic organization develops and maintains similar, but separate information resources independently. Thus, national information structure will reduce the national cost for information resources in total.

2. Standardization

By common application software, standardized data formats and user interface are determined and shared among a given academic field. In Japan, as most medical-related academic societies have adopted the UMIN ELBIS online abstract entry system for academic meetings, its data format specification for abstracts and their bibliographic information has become the de facto standard in medicine.

3. Reliability and security

In order to assure reliability and security sufficiently, much labor and expenditure are needed. Thus, building many small information centers for each purpose or institution would be inefficient.

I discuss some important factors that I believe necessary in order to develop UMIN or similar national information infrastructure as follows:

1. Business strategy

National information infrastructure should not put priority on preparation of digital content itself, but on simple application software for collecting and providing it. Digital content is usually more various and expensive than application software. For its development, marketing and risk analysis are very important. Thus profit-making business is more suited to its preparation.

2. Publicly authorized, non-profit organization

A publicly authorized, non-profit organization is desirable for the development of national information infrastructure. It is difficult for a private company to develop such infrastructure

because of the difficulty in gaining the participation and charge-free cooperation of the academic community. Even if a private company could develop such infrastructure, it would be very costly to the academic community.

3. Multiple purposes

Individual users, academic societies, research groups, etc., can use UMIN information infrastructure for multiple purposes, including research, education, and clinical practices. This is more efficient than developing different independent information centers for different purposes.

4. Single discipline

Information infrastructure for academic activities should be developed for a single academic discipline such as medicine, or a few closely related ones. Researchers in different academic disciplines are usually much different in way of thinking and sense of values. They do not go together well in managing a common information center.

ACKNOWLEDGMENT

I wish to thank those who work, and have worked, for UMIN for their efforts. I express special thanks to the UMIN Center staff for its support.

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Takahiro Kiuchi was born in Kisarazu City, Chiba, Japan in 1962. He received an M.D. degree from the Faculty of Medicine, the University of Tokyo, and a Ph.D. degree in medicine from the Graduate School of Medicine, the University of Tokyo, in 1986 and 1996, respectively.

From 1986 to 1987, he was a trainee physician with the University of Tokyo Hospital. Then he enrolled in a course in medical informatics at the Graduate School of Medicine, the University of Tokyo in 1987 and left it in 1991. From 1991 to 1996, he was an instructor of the Department of Epidemiology and Biostatistics, Faculty of Medicine, the University of Tokyo. Since 1996, he has been the Director of University hospital Medical Information Network (UMIN) Center, the University of Tokyo Hospital. He was also an assistant professor of the Faculty of Medicine, the University of Tokyo in 1996, and has been an associate professor since 1997. His current research interest is application of information technology to clinical medicine.

Dr. Kiuchi has been a member of the Japanese Association of Medical Informatics since 1988, and the American Medical Informatics Association since 1998.

OASIS for Online Distribution of Academic Information in the Japanese Medical Community

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Abstract

OASIS is a member-only homepage hosting service with a member list retrieval system, member mailing list service, and several application software services developed for academic societies, etc. by UMIN (University hospital Medical Information Network), Japan. In order to use OASIS, more than thirty Japanese academic societies have registered all their members to UMIN, which is the primary reason for the large number of medical professionals registered to UMIN. Using OASIS, academic societies can offer Internet-based, member-only information services to its members at low cost. As for the merit for each individual researcher, only one UMIN ID is required, which enables access to all the member-only homepages of academic societies of which the researcher is a member. I believe that OASIS has contributed greatly to promoting online distribution of academic information in the Japanese medical community.

Keywords:

Internet; academic information

Introduction

OASIS is a member-only homepage hosting service with a member list retrieval system, member mailing list service, and several application software services, initiated in 1998 by UMIN (University hospital Medical Information Network), a public medical network organization in Japan [1-4]. In order to use this service, many academic societies, etc. in Japan have registered all their members to UMIN, which is the primary reason for the large number of medical professionals registered to UMIN. As the registered user accounts can be used for many purposes, such as online data entry for clinical trials and epidemiological research, etc., OASIS is considered the most basic and important service among all the UMIN information services [5-7].

In this paper, I present an overview of OASIS and discuss its significance and role for promoting online distribution of academic information in the Japanese medical community. Technical characteristics of OASIS information system are also discussed.

Background

UMIN from its establishment to the mid-1990s

UMIN was established in 1989 as a common network computer center for national university hospitals in Japan, funded by the Ministry of Education, Science, Culture, and Sports (currently renamed to the Ministry of Education, Culture, Sports, Science, and Technology.) [8]. At the time of its establishment, UMIN provided its information services only to national university hospitals, using its own closed private network. The initial UMIN system did not become popular because of its unfriendly character-based interface, limited number of available terminals, absence of attractive digital content and application services, etc.

In 1995, UMIN initiated its Internet-based information services and thus was made available to all the medical professionals in Japan. Thanks to the initiation of the Internet-based service, the number of users rapidly increased. However, the purpose of most new users was only to use an Internet electronic mail service of UMIN. At that time, there were many institutions that had not started their own electronic mail services yet. Other UMIN services were not very popular because there was no attractive killer digital content or application software. Before long, each institution would come to set up its own electronic mail service. Then, UMIN electronic mail users would gradually switch to the services of their own institutions.

In the mid-1990s, many people in the world believed that distribution systems of goods and information would be dramatically changed with the popularization of the Internet and that existing traditional businesses would be mostly replaced by new network-based ones. As for the medical field, many net ventures were established around the world aiming at information services for medical professionals. The usual business strategy of these ventures then was to solicit as many users as possible, using much attractive digital content, and to obtain an overwhelming share of the market in the early stage [9]. They believed that higher market share meant less cost per user, and tried to increase their market share even further. Thus the net ventures spent huge money to achieve initial domination. UMIN did not have enough budget to purchase expensive digital content, and could not sell such content online without legal revision because UMIN was a government-funded organization.

Japanese academic societies in the mid-1990s

In Japan in the mid-1990s, although a considerable number of academic societies had open homepages of their own,

there were only a few that had member-only homepages for their members, and all of them were still experimental. All information services of academic societies such as journals, newsletters, member lists, etc. were delivered to their members, using paper-based materials via ordinary mail. However, it was anticipated that all information services of academic societies would eventually be distributed online to their members via the Internet in the future. Some academic societies began to examine how to provide member-only information services to their members via the Internet. However, the additional cost necessary to initiate Internet-based information services was a serious problem for them. Until the termination of paper-based information services, both online and paper-based services would have to be carried out simultaneously. While the cost for printing did not change significantly even if the number of printed materials decreased, considerable expenditure was necessary to initiate an online information service, including hardware, software development, system and user management, etc.

Basic idea for developing OASIS

If UMIN had not been used gainfully by many medical professionals, then there would have been no significance in its existence. As UMIN did not have sufficient funds to purchase or develop digital content, the remaining measure left for its survival was to develop a scheme whereby third parties put their digital content on the UMIN web servers and offered it to their service targets. In other words, UMIN had to be a vehicle to mediate digital content from its suppliers to medical professionals. In medicine, much useful digital content has been developed by academic societies. Especially in Japan, medical academic journals have usually been published by academic societies, and not by commercial publishing companies. I thought that UMIN and academic societies could take up each other's slack. UMIN could offer server hardware, application software, and system management service to academic societies, and academic societies could put their digital content on the UMIN web servers for their members. The OASIS information service was originated from this idea.

Overview of OASIS

Hardware

The OASIS information system is made up of four servers, namely a WWW server (Dell PowerEdge 6450 with 4 CPUs, 2 GB memory, and 100GB storage), database server (SUN Fire 280R with 2CPUs, 2GB memory, and 100GB storage), upload server (Dell PowerEdge 2550 with 2CPUs, 1GB memory, and 100GB storage), and mailing list server (Dell PowerEdge 6450 with 4CPUs, 4GB memory, and 100GB storage). Until December 2001, HP-UX-based servers with less performance had been used. As OASIS software modules and its related software run under any UNIX or UNIX-like operating systems with minimal porting effort, there are many options for hardware platforms.

Software

OASIS software modules, other related software modules, and their relationships are presented in Fig. 1 [2-4, 7]. Software modules developed by UMIN are written mostly in PERL 5 and partially in C language. Other software modules are freeware in PERL 5 and C language, except the database management software, namely Oracle 8.1.7. Some academic societies install their own software modules to OASIS WWW servers and use them in addition to the application software provided by UMIN.

All operations of academic society secretariats and individual members are carried out using web-based interfaces, except the HTML uploading operation for a member-only homepage. Secretariats of an academic society can add new members, delete existing members, and update information of existing members, using the OASIS member list management system. If they alter their member list, then the member lists for the member list retrieval system, homepage access list management system, and mailing list management system are also altered accordingly (Fig.2). Note that the homepage access list management system and mailing list management system can be also used independently of OASIS.

Members of academic societies in medicine and its related fields are qualified for UMIN registration, and thus OASIS user academic societies are authorized to issue UMIN IDs by themselves. When a new member is admitted to each user academic society, a society secretariat issues a new UMIN ID (unless the member already has one) to the member and adds its membership authority to the new or previously existing ID. Using the member list retrieval system, each society member can search other members by keywords concerning their name and affiliation. Retrievable member information includes name, affiliation, email address, telephone and fax number, etc. UMIN mail addresses of members are used in a society member mailing list. Thus email messages from an academic society are sent primarily to the members' UMIN email addresses. Each member can use the UMIN email server directly, or specify other servers for email forwarding, using a Web-based interface. Even if they lose the received messages, they can read them because the messages are usually archived in the member-only homepage provided by OASIS.

For a security reason, homepage maintainers cannot upload HTML files, etc. directly to the OASIS web server. They upload them first to the upload server. Then, the uploaded files are automatically copied to the OASIS web server every hour.

Usage statistics

The number of registered UMIN users is currently more than 158,000. Now the majority of Japanese medical doctors have UMIN accounts. The stepwise shape of the bar graph shows intermittent batch registrations of members of large academic societies (Fig. 3).

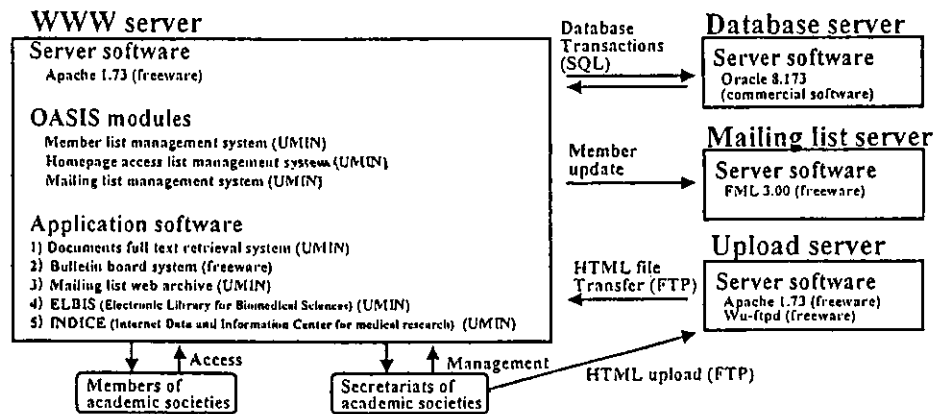


Fig. 1. OASIS software modules, other related software modules, and their relationships

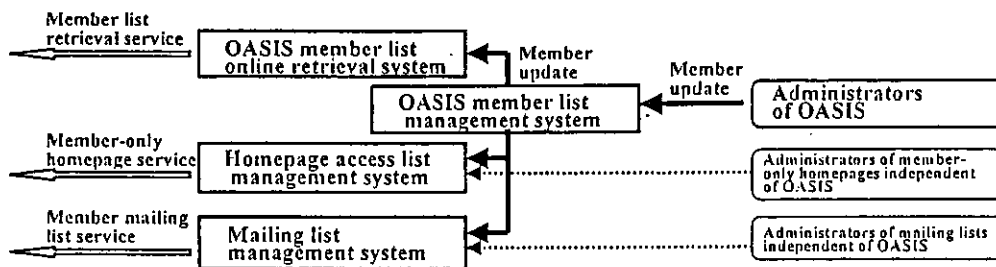


Fig. 2. Automated member update procedures

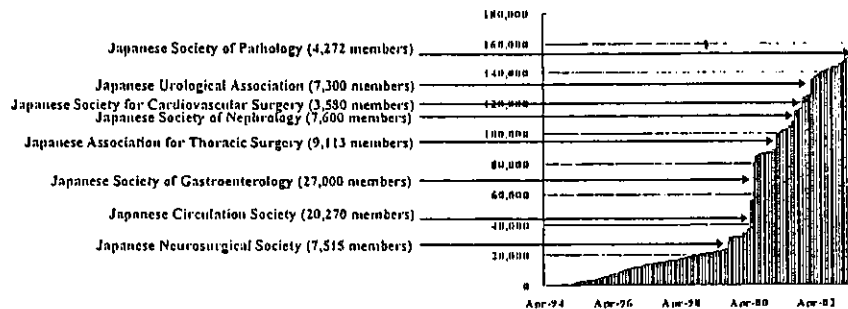


Fig. 3. The number of medical professionals registered to UMIN

The batch registrations account for more than sixty percent of UMIN registered users. More than thirty academic societies use OASIS for providing their member-only information services for their members. Only a few academic societies do not use OASIS, and issue their own IDs and passwords to all or part of their members for their own member-only information services. In the past, at least two academic societies gave up issuing their own IDs and decided to use OASIS.

Discussion

Significance and roles

It would be inefficient for each academic society to have its own hardware, to develop its own software, and to manage its information system and user accounts solely by itself in order to initiate its member-only Internet-based information service for its members. The application software necessary for each academic society does not vary very much, and thus it can be shared among many academic societies. Using OASIS, each academic society does not have to spend its budget on server hardware, application software, and system and user management. So each society can use more of its budget for preparing digital content for its members. In