UMIN - Concept, History, and Current Status

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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

U MIN 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 interoperation 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, 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.
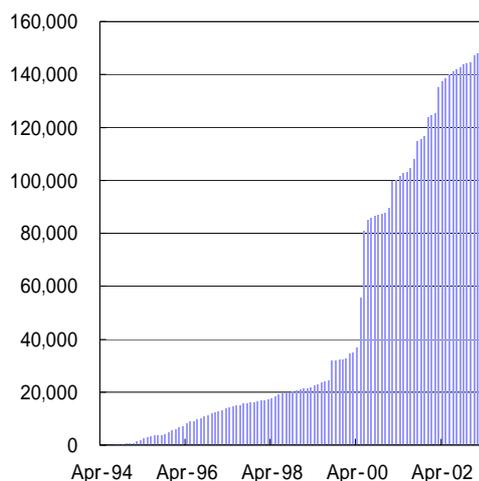

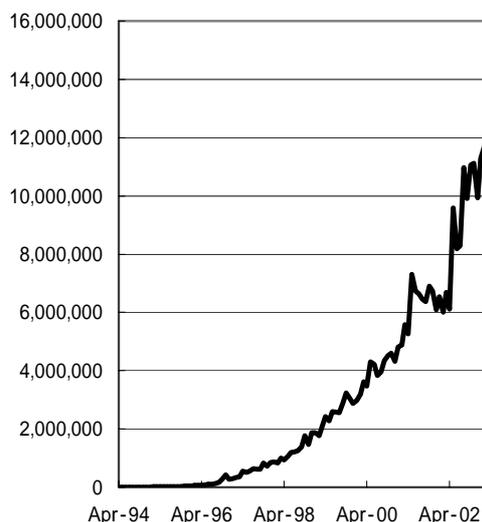Fig. 1. The number of registered medical professionals

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 *The Internet and global health*	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	
Medical term dictionary for hospital clerks	Database developed by Hokkaido University Hospital	**Limited**
E. Multipurpose		
Communication		
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**
Homepage hosting service		
Open homepage hosting service	Application service	**Open**
OASIS (Member-only homepage hosting service)	Application service	**Limited**
VOD hosting service	Application service	**Open/Limited**
Databases		
Research organizations and hospitals database	Developed by the UMIN Center	**Open**
MINCS-UH broadcasting programs database	Database developed by MINCS-UH member hospitals	**Open**
Collection of biomedical web sites	Developed by the UMIN Center	**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.

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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 Biostatics, 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.