

# **A Development of Life Aids Coordination System (LACS)**

Manabu Yamaji<sup>1)</sup>, Kazunari Ishida<sup>2)</sup>, Akira Sakaguchi<sup>3)</sup>, Toshizumi Ohta<sup>4)</sup>

<sup>1)</sup> University of Electro-Communications, Graduate School of Information Systems

(yamaji@ohta.is.uec.ac.jp)

<sup>2)</sup> Matsue National College of Technology, Department of Information Engineering

(ishida@it.matsue-ct.ac.jp)

<sup>3)</sup> University of Electro-Communications, Health Administration Center

<sup>4)</sup> University of Electro-Communications, Graduate School of Information Systems

(ohta@is.uec.ac.jp)

## **Abstract**

In this paper we outline a system for organizing medical care information in everyday life, the LACS (the Life Aids Coordination System). The LACS is intended to support parents in making decisions concerning the care of children suffering illnesses. We felt that such a system would have value because recently the exchange of information and knowledge among parents may not be as frequent as it was in our society in the past, due to a decrease in the average number of children in families.

This paper demonstrates the necessity for medical information in everyday life, and the important role that our system, which connects a patient and a doctor, can play. The system focuses their decision-making processes, and uses a reasoning process, a file of case histories, and home pages on the Internet, to provide information and knowledge. The LACS could also promote the sharing of information and knowledge among parents, and act as a sort of cyber commons.

## **1. Introduction**

This is an outline of a system for organizing medical care information in everyday life, the LACS (Life Aids Coordination System). The LACS is intended to support parents in making decisions concerning the care of children suffering from illness. We feel that such a system can be of value because information and knowledge exchange among parents may not be as frequent in our society in recent times as it has been in the past, due to the decrease in the average number of children in families.

This paper shows the necessity for medical information to be provided in such a way in everyday life, and the importance of the system, which connects a patient and a doctor. The system focuses their decision-making processes, and uses a reasoning process, a file of case histories, and home pages on the Internet to provide information and knowledge. The LACS could also promote information and knowledge sharing among parents, and act as a sort of cyber commons [Ohta 1997].

The system generates a new shared space within the electronic space of a network, for the exchange of information and knowledge generated by individual experience. This is what we mean by a cyber commons. Recent research has shown that when a social dilemma is formulated as a boundary satisfaction problem for computer simulation [Shinba and Ohta 1997], the structure of the problem can be resolved and a technique for its solution identified [Yamamoto and Ohta 1999]. In this research a system intended to provide a form of social support is built on the basis of these ideas.

## **2. Environmental change**

In this research we are concerned with parents caring for children, from the newly born, to those six years of age. We are here concerned with such environmental changes. This chapter describes medical care information in everyday life, changes in the childcare environment, and changes in the information environment.

## **2.1. Medical care information in everyday life**

Medical care in everyday life is the judgment and corresponding actions of common people who are dealing with the ill. Medical care information in everyday life is the information that is needed in such situations. This is not the same information as is required in hospitals or by doctors. Information on the hospitals in the neighborhood, the diseases that are going around, and the measures which should be taken are the important items of information for the parent who is making decisions concerning the care of a child who is suffering, or may suffer, illness [Yamaji, Ishida and Ohta 1998].

We will now consider when parents use such information. When their child contracts a serious illness, the parents take the child to hospital. How do the parents, however, make decisions concerning the care of a child when the child shows signs that may or may not indicate illness? In such a situation, parents have to make a personal judgment. The parents need information to help them to deal with such a situation.

The purpose of decisions in such a case is to cure the child's illness, if the child is, in fact, ill. However, if the child is seriously ill, doctors will actually cure the child's illness. Parents, however, need to deal with the situation until the child can receive medical examination. That is, when a child shows symptoms of illness, parents need to determine the right thing to do.

## **2.2. Change in childcare environment**

In recent years, the environment in which children are raised in Japan has changed. Changes include the declining birth rate, the rise of the nuclear family and of nuclear families with two working parents, and the breakdown of relational structures within the neighborhood for many families.

In the Japanese society of the past, most children were reared in large families with their mother constantly present as a full-time housewife. Parents had access to the accumulated knowledge of their parents and relatives. Since the child's mother would be a full-time housewife, at least one parent was able to spend a great deal of time with the child and thus to readily perceive small changes in the child's appearance. However in the Japanese society of the present day, when a child is sick, parents have to cope with various aspects of the situation in isolation. Naturally, they will encounter many situations that exceed their ability in terms of experience and knowledge. Suitable information is needed so that they can do the right thing as much as possible, during times when it is hard to contact medical institutions, such as at night and during holidays.

## **2.3. Change in information environment**

The informational environment has changed greatly, especially because of the development of networks, and particularly of networks such as the Internet. Digital information was once exchanged among medical institutions via leased lines. This situation is changing, as it has entailed high costs and highly standardized procedures. Not only was such a system closed to the public, small hospitals and remote hospitals also tended to be excluded. However, the development of the Internet greatly reduced the costs of introducing digital information distribution systems. Information exchange on the Internet also allows lay people as well as medical people to participate in medical information systems. A staggering volume of information is available. The change in the informational environment is revolutionizing methods of communication. The use of e-mail etc. and the sharing of databases is leading to communication without geographical constraints. How should a communication system in which computers are used be established? Numbers of users of 'informational tools' for communications are increasing, so this question needs to be answered. The change in the informational environment brought about by the Internet has brought with it a great deal of medical information. Information is commonly collected on the Internet by using search engines. However, there are many problems with search engines. It is difficult for users to choose good keywords so that appropriate information is immediately obtained by using a keyword search [1][Sumita and Miike 1996]. A directory structure focuses on the systematization of information[2] so is not necessarily a good concept for every user [Takeda 1996]. A system which uses information to integrate information, for example, by and in classification and extraction [Takeda 1996], and a decision support system [Fujimoto et al. 2000] are needed so that the information on the Internet can be used effectively. Information can also be distributed, of course, by establishing a home page. However, this is not a trivial task for parents who are not experienced with computers.

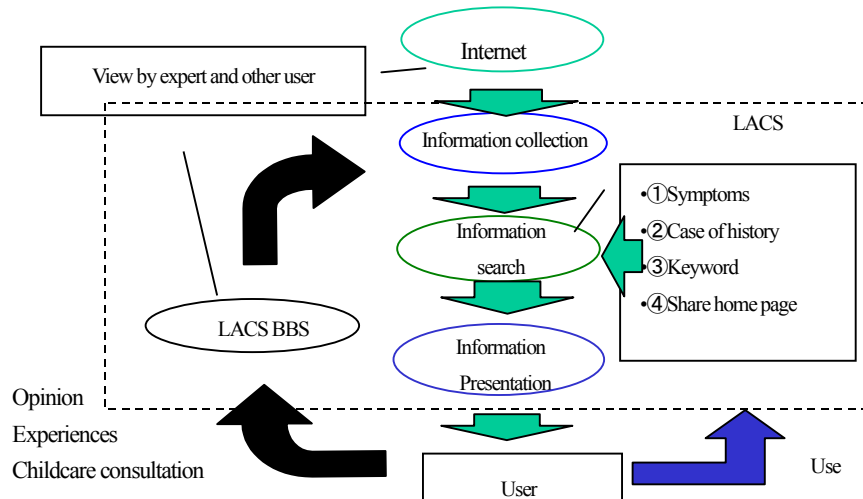
## **3. The Life Aids Coordination System (LACS)**

In this research, we outline a Life Aids Coordination System (LACS), which is for the quick and exact provision of information.

### 3.1. Outline of LACS

We have built a system which acquires information from the Internet so that parents can find the explanation for symptoms a child may be showing. The following fig.1 gives an outline.

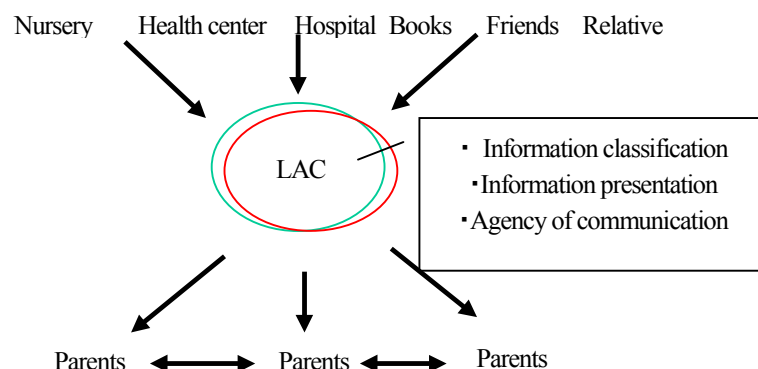
Sources of information on the Internet are used as a basic unit. Firstly, the system collects information and makes an index. The user then searches the information and makes decisions on the basis of the information found. The user can also obtain more detailed information by sending a query to a doctor's home page by mail, etc. Furthermore, sharing information among users then classifying it for storage on interoperable home pages, as a kind of BBS, creates a new form of organization. The information is collected by LACS so that there is a full guide to the content.



### Fig.1 Outline of LACS

### 3.2. Concept of LACS

This system provides information to support parents in making decisions to cope with a child's illness. Organized information is needed so that exactly the right decision can be made. However coordination is required because most of the parents involved will not be medical specialists. It is difficult for parents who don't have knowledge and experience to collect and arrange, that is, to organize, information. Fig. 2 shows the concept of LACS.



### Fig.2 Concept of LACS

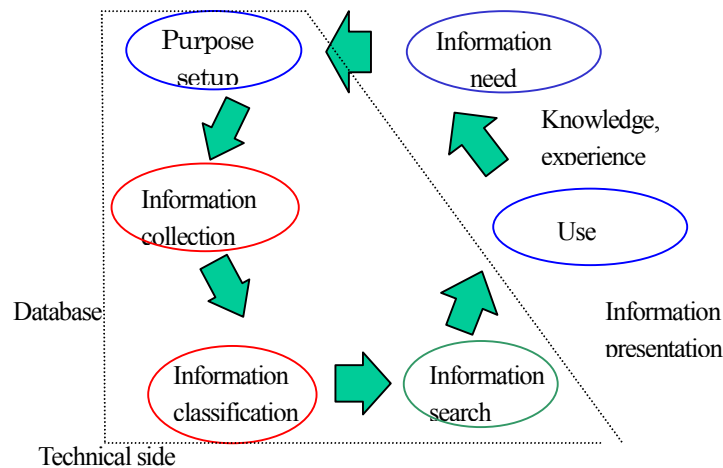
In this system, the coordinator (Life Aids Coordinator, LAC) collects information from nurseries, health centers, books, relatives, acquaintances, etc. The coordinator organizes information by applying a decision-making system to the individual contributions from users. In this way, the information can be accurately classified and thus be retrieved quickly. The coordinator also mediates communications between users. The background against which this system is needed is the flood of information that has been rising since the development of the modern informational environment. In this environment, it is difficult for those who don't have the necessary knowledge and experience to make correct decisions. The real-time publicity and informational environment that can be provided by the Internet is a pre-requisite for LACS. An accessible environment for users is also necessary so that many people may participate in LACS.

### 3.3. Organizing information

In this article, we will define the collection and classification of information to provide the right information at a given time as ‘organizing information’.

There is a great deal of information on the Internet. We cannot use information effectively by merely using a computer. For example, applying heuristic rules to the information can take a huge amount of time. There will also be various situations in which the parents cannot make correct decisions.

The concept of organizing information is shown in the figure below.



### Fig.3 Concept of organizing information

LACS organizes information twice during the processes of collecting and arranging information. A keyword search is first used to make an index from the collected information. The user then classifies and shares the information on the given home page. LACS uses a name-of-disease decision tree to determine the name of a disease as part of its goal-clarification process. LACS also uses the keywords to collect, classify, and present further organized information. New knowledge and experience is thus generated for users whenever they refer to LACS. LACS includes search technology in consideration of the informational needs of users. Organization of medical care information is essential so that it can most fully be used in everyday life.

### 3.4. Coordination

The user needs some knowledge of pediatric medical care and experience with Internet searches. Sharing the information and experience which individual users have obtained is a good way of collecting information that parents will want, and the ways of obtaining the information also need to be shared. Coordination among users is essential. Since knowledge is shared among users, we can use the emerging methods of organizing information and knowledge.

Coordination is the adjustment of individual capabilities and contributions for a common purpose. There is some existing research in this area. Active Notebook [Torrance 1995] employed two levels of classification, at the level of the group and at the level of the individual user. Such a method of classification will, however, change with the user's intentions and viewpoints. The coordinator must mediate the sources of information and the classification methods used by parents who are users. Lin and Ohta [1997] have shown that the production and distribution of information is being moved to a brokerage-transaction type of model by the development of the Internet. This again shows the importance of the coordinator, and, in LACS, we thus employ a coordinator.

### 3.5. Processes of medical care decisions in everyday life

We will now consider how parents make decisions regarding a child's illness, and the two kinds of decision that are made: decisions by members of the public and decisions by doctors.

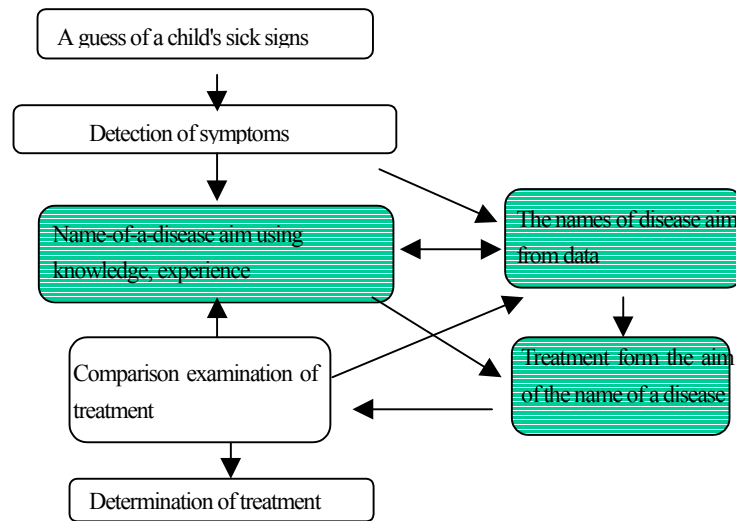
In this research, we have adopted Kimura's [1988] model for the decision-making process in medical care in everyday life.

Fig. 4 The model for the process of medical care decisions in everyday life.

Research on how doctors make diagnostic decisions also exists [Fukui 1988]. This process is different from that which is available to members of the public, because of the doctor's necessarily greater degree of knowledge and experience. Expert systems

may provide the most suitable way of mechanizing medical diagnosis in hospitals etc., since their processes are essentially adoptions of those used by doctors, or are at least intelligible to doctors. A true generalization of a doctor's decision-making processes is impossible and importance is attached to the imitation of specialists who actually exist, so true creative decision-making is, of course, not possible [Kaihara 1991]. The difficulty of maintenance and reuse of information prevents the wider development and use of such systems [Mizoguchi and Ikeda 1999]. Parents use their experience, knowledge, and observed and other data to heuristically determine the name of a child's illness and the appropriate action. However, when knowledge and experience is limited, the search range will be narrow. Reference to external sources of data, such as books, requires much time and labor. Parents can also misjudge situations because of unreliable or confused memories, and their knowledge can seldom be truly appropriate.

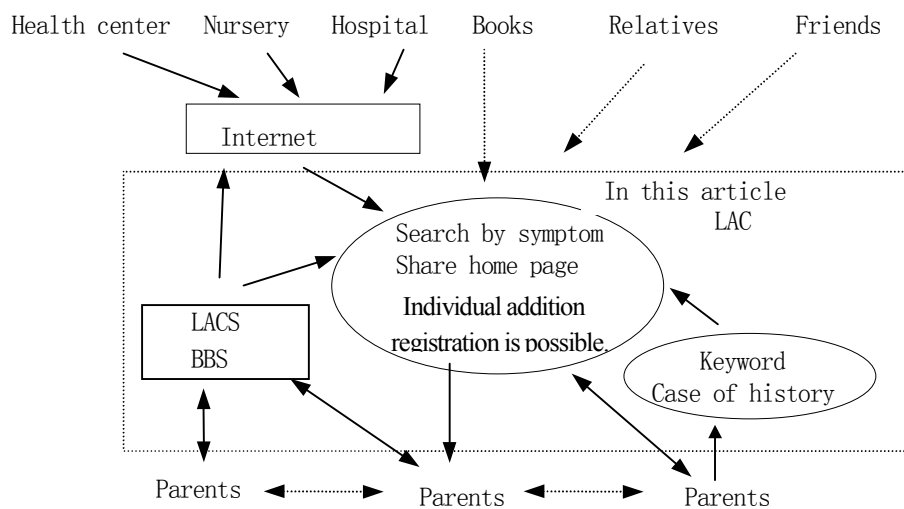
Suitable information is needed so that decisions can be made. To efficiently obtain pertinent information, the use of LACS to collect and arrange information is needed.



**Fig.4 The model for the process of medical care decisions in everyday life**

### 3.6. Position of this research in LACS as a whole

In this work, we have implemented a system which focuses on the organization of information. Its position in LACS as a whole is shown in Fig. 5.



**Fig. 5 Position of this research in LACS**

We have implemented a system for the organization of information on the Internet. In this work, we were not concerned with coordination among users, but we were concerned with the role of the coordinator. That is, we have not considered the emergence of new methods of organizing information and knowledge by communications among users. This is shown by short dashed line. This is a subject for future work.

#### 4. Implementation of LACS

We have implemented a system for the organization of information on the Internet. LACS is shown in Fig.6.

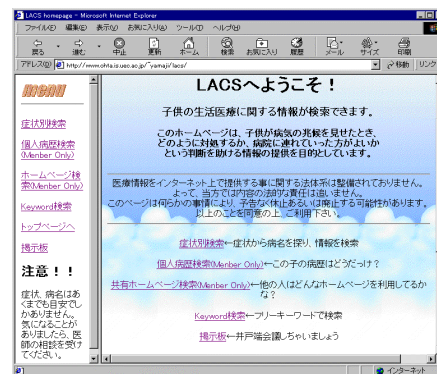


Fig.6 A Screen of LACS (Version in Japanese)

##### 4.1. Search by symptom

The problem with searching by keywords is the difficulty of determining good keywords. We have defined keywords as the names of diseases for this search. We created a disease determination tree that operates in terms of symptoms that parents without special knowledge can easily judge (also see Benesse's work [1998]). Parents can determine the reason for a child's illness by using this tree and a keyword search (Fig. 7).

##### 4.2. Case of history Search

By searching a file of case histories, parents can more quickly obtain information on a child's illness. This file contains information on illnesses from which children have suffered in the past, and the remedial actions which were taken. Parents can register the major symptoms, the doctor's diagnosis, remedy, and relevant homepages. Fig. 8 shows the facility for a search of case histories.

##### 4.3. Keyword search

In LACS at present, we have mainly collected information about children's medical care from home pages on the Internet. A pediatrician, a health center, a self-governing body, etc, can manage a homepage in such a way that its information is reliable. We investigated and collected the content of homepages by using the free "wget" software. We made an index of the collected information by using the free "Namazu" search software. Users can perform a keyword search on full text information (Fig. 9) by using the free "KAKASHI" software which allows morphemic analysis.

##### 4.4. Search for share home page

A problem with keyword searches is that the contents of home pages are not shown. Users can classify and register home pages

that they have used in the past. This classification is according to the date of the most recent update to the home page, its location, the name of the illness, its symptoms, remedial action, and previous experiences. In this way a great deal of information can be classified in, and shared among users of, LACS (Fig. 10).

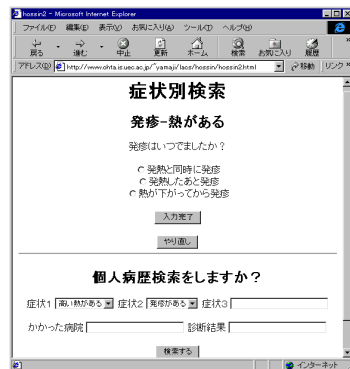


Fig.7 Search by symptom (Version in Japanese)

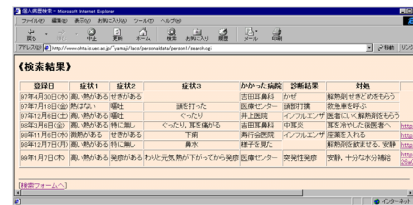


Fig.8 Case of history Search (Version in Japanese)

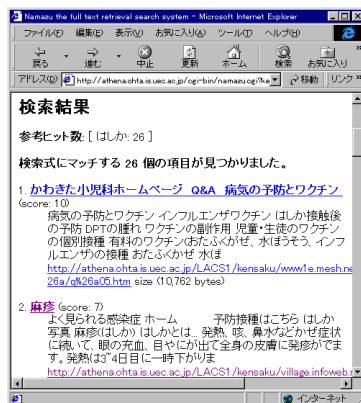


Fig.9 keyword Search (Version in Japanese)

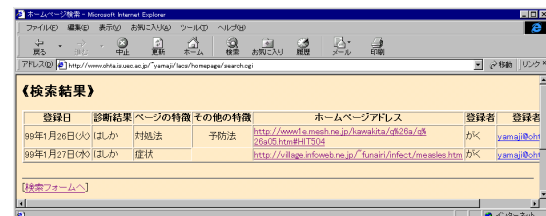


Fig.10 Search for share home page (Version in Japanese)

#### 4.5. Information flow

The four search layers are organically connected by the exchange of the symptoms and names of illnesses (Fig. 11).

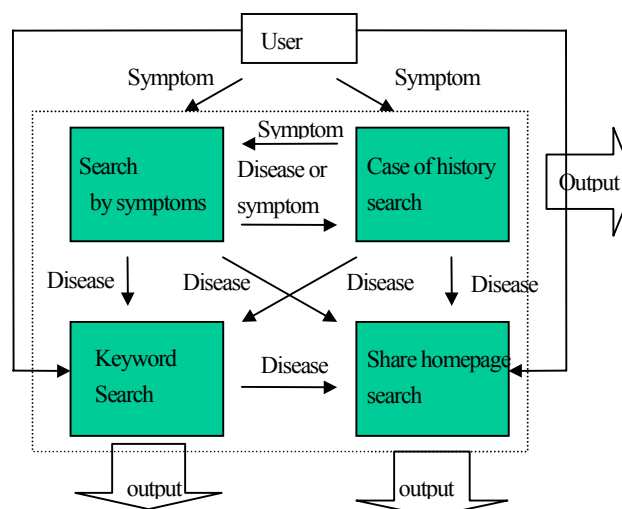


Fig.11 Information flow

The four search techniques together thus compensate for the faults of individual techniques, and take advantage of their advantages. LACS compensates for the difficulty of determining keywords by the searches by symptom and for case histories. LACS can provide further detail in classification by its search for a shared home page. LACS can thus be said to provide a more effective search process. Parents are also involved in the process of judgment of suitable actions. Parents were also found to recognize a typical child's symptoms in LACS.

#### 4.6. BBS

LACS uses standard information sources on the Internet as the basis of its searches. However, the information which parents need, such as hospitals in the neighborhood, and what is going around and the right actions to take, is not usually available over the Internet. We built a notice board so that users could freely exchange and share opinions, in order to capture information that is spreading by word of mouth. Fig. 12 shows the BBS.

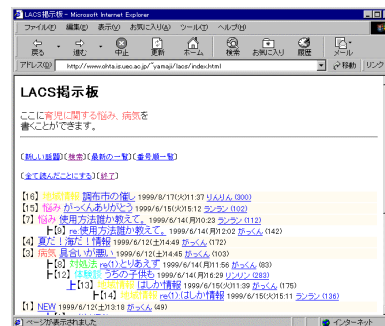


Fig.12 BBS (Version in Japanese)

### 5. Evaluation to LACS

We had parents use LACS then complete a questionnaire. The questions were intended to evaluate whether parents were able to get satisfactory answers by using LACS, whether LACS was easy to use, and problems with LACS. The evaluation of the purpose and effect of electronic media such as LACS by information technology is difficult. It must be evaluated on the level of its function within a social system [Muller 1997].

We set up such a situation with ten housewives with childcare experience as the subjects. All had experience with computers and the use of the Internet. We created a home page from which they used the system for two weeks, and they then completed a questionnaire. We thus obtained an evaluation of our approach to the organization of information.

#### 5.1 Evaluation to organizing information

Here are some results of the user evaluation of the search function of the system we implemented. Most of the users had found it difficult to use books etc. to find the information they required (7 persons), or had had a similar experience with other data sources (3 persons). However, most users found that our system made reference easy, and that access to multiple data sets made it easy to judge the child's illness (6 persons).

Users also expressed the opinion that they could better understand a doctor's explanations. They could better understand the doctor's judgment, and better perceive points on which they wished to question the doctor, for example in terms of possible complications, and the remedy for the child's illness. Until now users have only had access to a vague consultation with the doctor have not been able to discern the important points. Users also felt that they could quickly obtain correspondences between the important sets of information when children suddenly became sick.

Users also expressed a feeling of freedom in that they did not have to worry about a child not, in fact, being ill, as they did when consulting relatives or friends. The questionnaire indicates that LACS collects and arranges information in a way that provides users with the organized information which they need.



## 6. Discussion of LACS as a cyber commons

LACS is aimed at parents who have a common concern in that they all have to worry about a child's illness at some time. The inducement for the user to participate is the offer of organized information to help in such situations. The user contributes by sharing knowledge, either by posting it on the BBS, or sending it to the shared home page.

A coordinator is required to maintain and develop LACS by the renewal of its information, and the maintenance and development of system environment. The home page is the chosen point for the renewal of information in LACS. An index to the information on the home page is updated periodically. We will now need to further examine how the information sent by users should be treated, and the coordination of users to identify reliable home pages as information sources. The maintenance and development of the system environment is also being improved, on the basis of users' opinions.

## 7. Conclusion

This research has shown the difficulty and necessity of the collection of medical care information for use in everyday life. In response to this necessity, we have developed and implemented a system for organizing information, LACS. We had a group of parents use a prototype version of the system, then issued a questionnaire and held interviews to collect their opinions, as an evaluation of our work thus far.

A system based on the coordination of users, and the provision of a more comfortable information space for users are two possible directions for our work in the near future.

## REFERENCES

- [Benesse 1998] Benesse Corporation: Encyclopedia of Children's illness: Benesse, 1998. (in Japanese)
- [Fukui 1988] Fukui, T.: Clinical Decision Making: Igaku-syoin Ltd., 1988. (in Japanese)
- [Fujimoto et al. 2000] Fujimoto, k., H. Kazawa, H. Sato, A. Abe and K. Matsuzawa: DSIU System: Decision Support for Internet Users: Journal of Japanese Society for Artificial Intelligence, Vol.15, No.1, 2000. (in Japanese)
- [Kaiharu 1991] Kaiharu, S.: New Evolution of Diagnosis System: Mathematical Science, No.214, pp26 - 31, 1981. (in Japanese)
- [Kimura 1988] Kimura, Y.: An introduction to Management Informatics, in K.Asai, (ed.) Modern management Informatics, pp9-36, 1988. (in Japanese)
- [Lin and Ohta 1997] Lin, J., T. Ohta: On an Evolution Process of Inter-organizational production distribution information network: Journal of the Japan Association for Society Informatics, Vol.9, No.1, 1997. (in Japanese)
- [Mizoguchi and Ikeda 1999] Mizoguchi, R., M. Ikeda: Ontology Engineering: Journal of Japanese Society for Artificial Intelligence, Vol.11, No.1, pp559-569, 1997. (in Japanese)
- [Muller 1997] Rolf Muller: Coordination in Organization, Cooperative Knowledge Processing, Springer, 1997.
- [Ohta 1997] Ohta, T., et al.: Dynamism of Social Informatics, Fujitsu Institute of Management, 1997. (in Japanese)
- [Shinba and Ohta 1997] Shinba, H. and T. Ohta: A Simulation Approach based on an Interaction Model of Agents, Journal of the Japan Society for Management Information, Vol.6, No.2, pp.33-50, 1997. (in Japanese)
- [Simon 1996] Simon, H. A.: The Science of the Artificial (3<sup>rd</sup> ed.), MIT press, 1996.
- [Sumita and Miike 1996] Sumita, K., S. Miike: Intelligent Information Retrieval: Journal of Japanese Society for Artificial Intelligence, Vol.11, No.1, pp10-16, 1996. (in Japanese)
- [Takeda 1996] Takeda, H.: Network Enhanced Intelligent Information Integration: Journal of Japanese Society for Artificial Intelligence, Vol.11, No.5, pp680-688, 1996. (in Japanese)
- [Yamaji, Ishida and Ohta 1998] Yamaji, M. K. Ishida and T. Ohta: Organizing Information with Case of History and Processes of Medical Care Decisions in Everyday Life: The Japan Association for Social Informatics, Proc. of 13<sup>th</sup> Annual National Meeting of Japan Social Informatics, p227~232, 1998. (in Japanese)
- [Yamamoto and Ohta 1999] A Study of Social Dilemma in an Information Space and Emergence of Cyber commons, Journal of the Japan Society for Management Information, Vol.8, No.1, pp.67-87, 1999. (in Japanese)

[1] goo: <http://goo.ne.jp>

[2] yahoo!: <http://www.yahoo.com>