

ORIGINAL

## The development of a pollen information system for the improvement of QOL

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**Abstract:** The Kochi Prefecture Japanese Cedar and Cypress Pollen Information System (P-Net Kochi) was established in 1991 on the initiative of the Pharmaceuticals and Sanitation Division to improve the quality of life of people in Kochi Prefecture, particularly patients with pollinosis. Kochi Prefecture has the highest forests percentage (84%) in Japan. In addition, 40% of the population of the prefecture is concentrated in Kochi City. The average pollen count at 10 observation points an one year was about 20,000/cm<sup>2</sup> during the observation period, but it exceeded 110,000/cm<sup>2</sup> in 1995, when it was also high nationwide. Kochi Prefecture organized a system to promote people's understanding of pollinosis in connection with environmental problems, and to enlighten people on appropriate preventive measures. The system has been improved in the rapid and efficient transmission of information over the years with technological advances. The introduction of an automatic monitoring system not dependent on human labor and the support of the users proved to be indispensable for the maintenance of the system. *J. Med. Invest.* 48 : 198-209, 2001

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## INTRODUCTION

Recently, Japanese cedar pollinosis, a major factor in air pollution, has come to affect nearly 20% of the Japanese population (1), and deterioration of their QOL has become a social issue. Its onset at lower ages has also been suggested (2). About 84% of Kochi Prefecture is covered by forests, and, according to the data of the Kochi Forest Bureau, about 21% of the field area of the prefecture consists of privately owned cedar forest, and about 48% by cedar and cypress forests combined. The Kochi Prefecture Japa-

nese Cedar and Cypress Pollen Information System was established in January, 1991 to improve the QOL of pollinosis patients by letting them understand that "pollinosis is a self-manageable disorder" and providing them with information concerning preventive methods and appropriate treatments. The system was developed secondarily in the whole country as a public organization according to the investigation of Kochi Prefecture. It was also very important to promote people's understanding that pollinosis is the most striking example of a relation between the environment and allergic disorders. This article reports the background of the development and the future of P-Net Kochi, which has provided varied information concerning cedar pollinosis directly or through mass media (such as television, radio, newspaper) for more than 11 years.

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## Background of the development of P-Net Kochi

The suspended cedar and cypress pollen counts are determined by the Durham sampling method, i.e. collecting pollen using a glass slide coated with petrolatum, staining the slide, and counting the pollen. In Kochi Prefecture, information covering such a wide area had never been provided on a daily basis before or without interruption. A new system was developed with the understanding that its establishment would be a turning point from the conventional pharmaceutical administration dependent on regulations by law to a scientific administration focused on environmental problems. The development of the system was prompted by two factors. The first was the limitation of pharmaceutical administration in the early 90's based on the Pharmaceutical Affairs Law. The patient may have better contact with pharmacies if the pharmacies play advisory roles in addition to giving an explanation of drug effects. The second was an urge to create an environment in which people understand pollinosis as an allergic and self-control disorder. In 1990, 'The Life Fund' sponsored by the Kochi Newspaper invited contributions of articles on this subject, and my paper attracted the attention of a judge from the Kochi Prefectural Government, who made inquiries on the contents and feasibility of such a system. The prefecture secured a national budget for the project, and assumed it as a prefectural project. Being commissioned by the prefecture, I started detailed evaluation in cooperation with my colleagues, and established a system for pollen monitoring, drafted a program, made arrangements for guidance in pollen counting by experienced clinical examination engineers of the National Hospital, and requested cooperation with the mass media. The pollen information system was named Kochi Prefecture Japanese Cedar and Cypress Pollen Information System, nicknamed P-Net Kochi ("P" standing for "pollen"), to make the system popular among the people in Kochi Pref., and to incorporate similar systems for the collection and distribution of pollen information that was expected to be established as a network covering a wide area for exchange of information among such systems under the same name. We used the term "cedar and cypress", because the cedar and cypress have a common antigen (3, 4). Distinction between cedar and cypress pollen was impractical, because the observers were not fixed, were able to allot only limited time for daily observation, and operated in shifts.

## Details of the system composition

### *1. System composition between 1991-1997*

The observations were made daily at 10 public health centers and 2 medical institutions in the prefecture except on Sundays and national holidays from January through April each year, and the information was provided to the inhabitants of the prefecture via mass media. The contents of information were the state of cedar and cypress pollen dispersion, temperature, wind direction, wind velocity, and precipitation. The meteorological data were AMeDAS (Automated Meteorological Data Acquisition System by NTT\*) data at 8 observation points near the public health centers purchased daily from the Kochi Branch of the Japanese Meteorology Association through fax. The observation points were 10 public health centers and 2 medical institutions (National Higashi Kochi Hospital (presently National Kochi Hospital) and Kochi Nokyo General Hospital). The observation period was 24 hours a day (9:00 a.m.-9:00 a.m.) generally from January through April, and the data were provided as the pollen count/cm<sup>2</sup>. As for the data on holidays, the mean value between those was used. The data at each observation point were first transmitted to the Pharmaceuticals and Sanitation Division of Kochi Prefecture by telephone at about 9:30 a.m. and were input with meteorological data into spreadsheet software, which displayed the pollen count and meteorological data at each point. Furthermore, a weekly chart was prepared, sent to NTT halo dial\*, F-NET\*, and the Kochi Branch of the Japan Meteorology Association between January and April, and were made available to users through F-NET at a particular fax number. Between February and April, simple comments concerning the state of pollen dispersion and preventive measures in daily living were made by a staff member (initially the staff of the Pharmaceuticals and Sanitation Division only) on the basis of the weather conditions of the day and knowledge about pollen dispersion. Material, which was a map of Kochi Prefecture on which the wind direction, pollen count, and comments were indicated, was prepared with a word processor and was sent to the mass media and NTT halo dial. This was for the convenience of some mass media that carried our material directly. Cedar and cypress pollen are counted by the method of the Committee for Standardization of the Measurement of Air-Borne Pollens and Pollen Information. Concerning the risk level of pollinosis, the alarm range was set tentatively at 10/cm<sup>2</sup>/day or higher in 1991,




Table 1. System composition

Investigation item	pollen dispersion number, temperature, wind direction, wind velocity, precipitation, number of patients with pollinosis*
Investigation point	pollen counts : 10 public health centers, 2 medical institutions weather : 8 AMeDAS points near public health center
Kind of information	
For press	
Contents	comment corresponding to the pollen count measured at ten public health centers and wind direction at 9 : 00 a.m.
Usage	each press release by F-NET*, NTT halo dial*, FAX from the beginning of February.
For general	
Contents	pollen counts at ten public health centers and two cooperation medical institutions and AMeDAS data : temperature, wind direction, wind velocity, precipitation at 9 : 00 a.m.
Access	Telephone service 0888-73-8600* #8886* 9 : 00 a.m. - 8 : 00 p.m. (only by touch tone) NTT F-NET number 182 • #284088825286901#* Web, CTI
OS	MS-DOS* Windows NT Server 4.0+ServicePack 4
Application	Lotus1-2-3*, Ichitaro*, Hanako*
Language	macro*, MS-DOS BASIC* (for making graphs of pollen counts of various points and the weather), ASP, Java and JavaScript
DB	Oracle Workgroup Server 8.04

## Note

\* is currently used. - MS : Microsoft Co. IIS4.0 : MS internet Information Server 4.0 ASP : Active Server Pages. Microsoft, MS-Windows, MS-DOS, ASP, and IIS are registered trademarks in the United States of Microsoft Corporation and other countries. Lotus1-2-3 is the registered trademark of Lotus Development Corporation in the United States and other countries. Oracle Workgroup Server is the registered trademark of Oracle Corporation in the United States and other countries. Trademark, which contains Java and other Java, is the trademark of United States Sun Microsystems, Inc.. Ichitaro and Hanako are registered trademarks of Justsystem Corporation in Japan.

but the following 3-level criteria derived from the relation between the results of patient surveys and the pollen counts have been used since 1992.

Safe	(0 count/cm <sup>2</sup> )	
Attention	(0-30 count/cm <sup>2</sup> )	
Precaution	(31- count/cm <sup>2</sup> )	

## 2. System composition after 1998

With the increased the use of the Internet, we began to distribute our information through an information web site of Kochi Prefecture in 1998. Distribution of pollen information at web sites has become common nationwide (Table 2) to the advantage of exchange of information with patients and alleviation of their symptoms (5). In 1999, the data of pollen counts were stored in a database created on a newly purchased server, and a system to pro-

vide information on demand vocally and by fax, in addition to a web site, was introduced by means of CTI\*. The pollen counts began to be sent to the pollen information page of the Homepage for Healthy Living/Virtual Health City of Kochi Prefecture from web terminals, leading to a reduction in the staff's duty of answering telephone inquiries. As Internet users increased rapidly, and as automatic distribution of information through fax and telephone became possible by CTI, we stopped providing information through NTT F-NET and halo dial in January, 1999, and the mass media and the homepage became the primary channels for transmission of our information. CTI is a computer with built-in audio board and switchboard that converts defined sentences to synthetic voice and fax, and sends them to the users on demand. Users can request the service by sending a pre-determined 3-digit number by operating telephone keys (pulse or tone signals ; INS\* 4×2=8 lines available). In 1998, data files on the web server were named by the date (e.g. 119990221.TXT), data were prepared sequentially using ASP+VBScript in such an arrangement as pollen count-temperature-wind direction-wind velocity-precipitation-repeat, and the

Table 2. Pollen dispersing information homepage list (prefecture presents)

Hokkaido	<a href="http://www.iph.pref.hokkaido.jp/">http://www.iph.pref.hokkaido.jp/</a>
Niigata Pref.	<a href="http://www.pref.niigata.jp/hokanken/kafun_t.html">http://www.pref.niigata.jp/hokanken/kafun_t.html</a>
Toyama Pref.	<a href="http://www.fes.pref.toyama.jp/pollen/pollen_2.html">http://www.fes.pref.toyama.jp/pollen/pollen_2.html</a>
Ishikawa Pref.	<a href="http://www.pref.ishikawa.jp/ringyo/kafun/">http://www.pref.ishikawa.jp/ringyo/kafun/</a>
Gunma Pref.	<a href="http://www.pref.gunma.jp/">http://www.pref.gunma.jp/</a>
Nagano Pref.	<a href="http://www.nagano-eikouken.or.jp/">http://www.nagano-eikouken.or.jp/</a>
Saitama Pref.	<a href="http://www.pref.saitama.jp/a04/bd00/kafun.htm">http://www.pref.saitama.jp/a04/bd00/kafun.htm</a>
Tokyo	<a href="http://www.metro.tokyo.jp/index.htm">http://www.metro.tokyo.jp/index.htm</a>
Shizuoka Pref.	<a href="http://www.siz.saiseikai.or.jp/jibika/kafun.html">http://www.siz.saiseikai.or.jp/jibika/kafun.html</a>
Gifu Pref.	<a href="http://www.pref.gifu.jp/s11223/kafun/">http://www.pref.gifu.jp/s11223/kafun/</a>
Aichi Pref.	<a href="http://www2.pref.aichi.jp/kafun/index.html">http://www2.pref.aichi.jp/kafun/index.html</a>
Mie Pref.	<a href="http://www.medic.mie-u.ac.jp/kafun/">http://www.medic.mie-u.ac.jp/kafun/</a>
Oosaka Pref.	<a href="http://www.iph.pref.osaka.jp/topics/etc/kahun.html">http://www.iph.pref.osaka.jp/topics/etc/kahun.html</a>
Hyogo Pref.	<a href="http://www.iph.pref.hyogo.jp/users/info/k-hoken/pollen/pollen.html">http://www.iph.pref.hyogo.jp/users/info/k-hoken/pollen/pollen.html</a>
Tokushima Pref.	<a href="http://www.pref.tokushima.jp/">http://www.pref.tokushima.jp/</a>
Kochi Pref.	<a href="http://www.med.net-kochi.gr.jp/">http://www.med.net-kochi.gr.jp/</a>
etc.	

staff member in charge checked the data input using a browser with JavaScript, registered them temporarily on the server, and sent the temporary data to the server of Kochi Prefecture using application software written in Visual Basic. At this time, pollen maps, graphs, and tables were created using Java and JavaScript. Modifications were made in 1999, and the data came to be preserved in the database Oracle 8.04. Data registration was accomplished with ASP+VBScript+JavaScript (parameter check), and data display with ASP+VBScript+JavaScript (parameter check) +Java (parts of map and graph display), resulting in acceleration of operations. Data were checked by the mass media through the web, although they were still partly distributed by fax, which could now be sent directly from the computer. Table 1 summarizes the investigation methods, methods for distribution of information, the contents displayed and the language and OS used. Fig. 1 shows former screen of application and present Web screen. Fig. 2 shows a flowchart of information distribution.

Each public health center temporarily registers the pollen count data on the temporary registration screen by inputting them in the form on the browser. At this point, the data cannot be read from outside. The Pharmaceuticals and Sanitation Division analyzes the meteorological data and the state of pollen dispersion, input comments including cautions for prevention, prepares the text for CTI, registers the temporary data as public data to be presented (Fig. 3).

For users, the information was shown on the initial page as icons corresponding to pollen counts near the observation points with the wind direction. The actual pollen counts and AMeDAS data were shown

below as a list. When the cursor is brought to a given observation point, the pollen count at the point is automatically displayed. As mentioned above, there are 3 icons, with the safe icon, attention icon, and precaution icon indicating pollen counts of 0, 1-30, and 31-, respectively. The overall evaluation of pollen counts was shown as a figure of whale icon, which symbolize Kochi Prefecture (Fig. 4). The overall evaluation was defined as Level 0 when there was 1 or more precaution icons, Level 1 when there were 2 or more safe icons, Level 2 when there were 4 or more safe icons, and Level 3 when there were 6 or more safe icons and no precaution icon.

Past information can also be reviewed, and the data of a given period (within 5 consecutive months) and a given region selected on the browser are displayed as a line graph. In addition, all the information including National Kochi Hospital and Nokyo General Hospital is displayed as a weekly report by selecting a suitable day in the calendar. There is no particular problem in the responses to the above maneuvers during the pollen season even through low-speed lines because of the small volume of images and the high speed of the server (Fig. 5).

\*NTT : Nippon Telephone & Telegraph \*halo dial : Information service by the operator of NTT \*F-Net : fax delivery service of NTT \*CTI : computer telephony integration \*INS : Information Network System, ISDN service of NTT

## Report of current state

The latest software versions are currently being

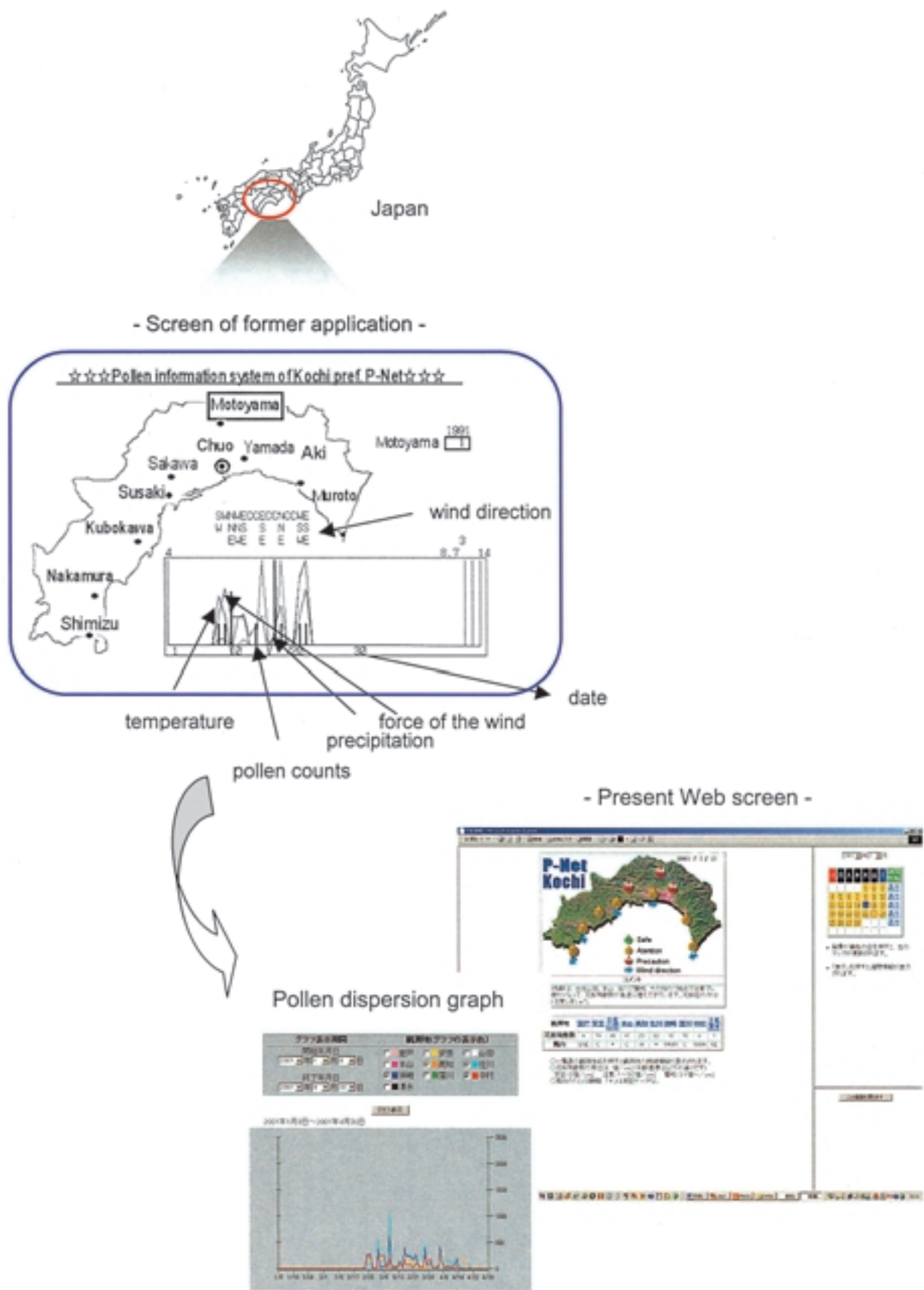
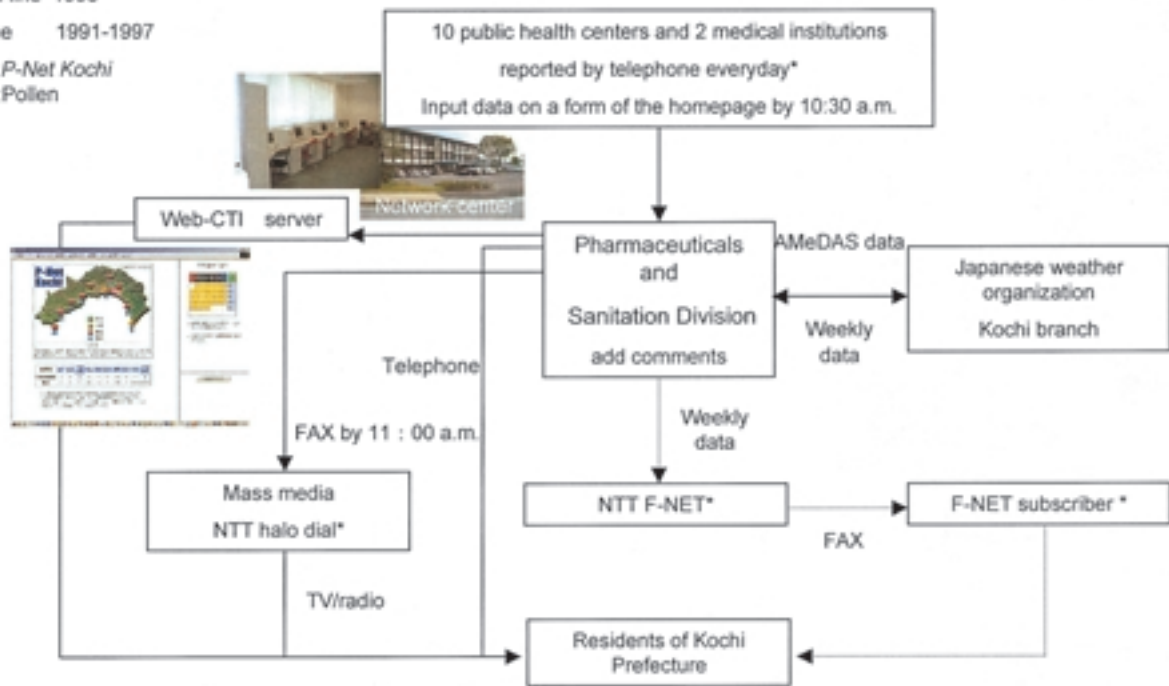


Fig. 1

Flow of Pollen Information

Unbroken line 1998-  
 Dotted line 1991-1997  
 Nicname:P-Net Kochi  
 P :Pollen



Dotted line and \* currently used

Fig. 2

introduced into ten public health centers. The information is input in the form on the homepage, and National Kochi Hospital and Kochi Nokyo General Hospital use the telephones to report the information. The person in charge concentrated on input and data reduction before the introduction of this new system and was constantly busy in operation because all the data was reported by telephone. After the new system was introduced, the operator was able to concentrate on the comment making. Since the fax was able to be sent directly from the computer, the time for printing was saved. Moreover, because the Internet technology was used, the time for the maintenance of the application is unnecessary. Since the icon for the number of dispersions and the wind direction is displayed including past information by an easy operation on the homepage and the number of dispersions can be displayed in the form of graph in a time series, this system became user-friendly. In addition, users who had not joined the Internet can obtain information from CTI. However, we recognized that residents found it difficult to locate the telephone number of CTI though a magazine containing this information that had already been issued. The process was improved by the new

system which introduced information other than that of the pollen dispersion number measurement.

DISCUSSION

Information of pollen dispersion has become periodically available, although the staff members in charge had difficulty in explaining how the information should be utilized, because they had no experience of being routinely engaged in such a task. The residents and pharmacies also initially felt it difficult to effectively utilize the information because of the lack of experience. In those days, much of the information distributed by the prefectural authorities was simply numerical raw data. Since the pollen information derived from public health centers has been processed into more understandable forms, the public and pharmacies have accepted them as part of their common knowledge. It is particularly worth mentioning that people began to use pollen information as an everyday resource. In addition, diverse methods were used to transmit the information including fax and telephone services as well as providing information via the press. Since the information was

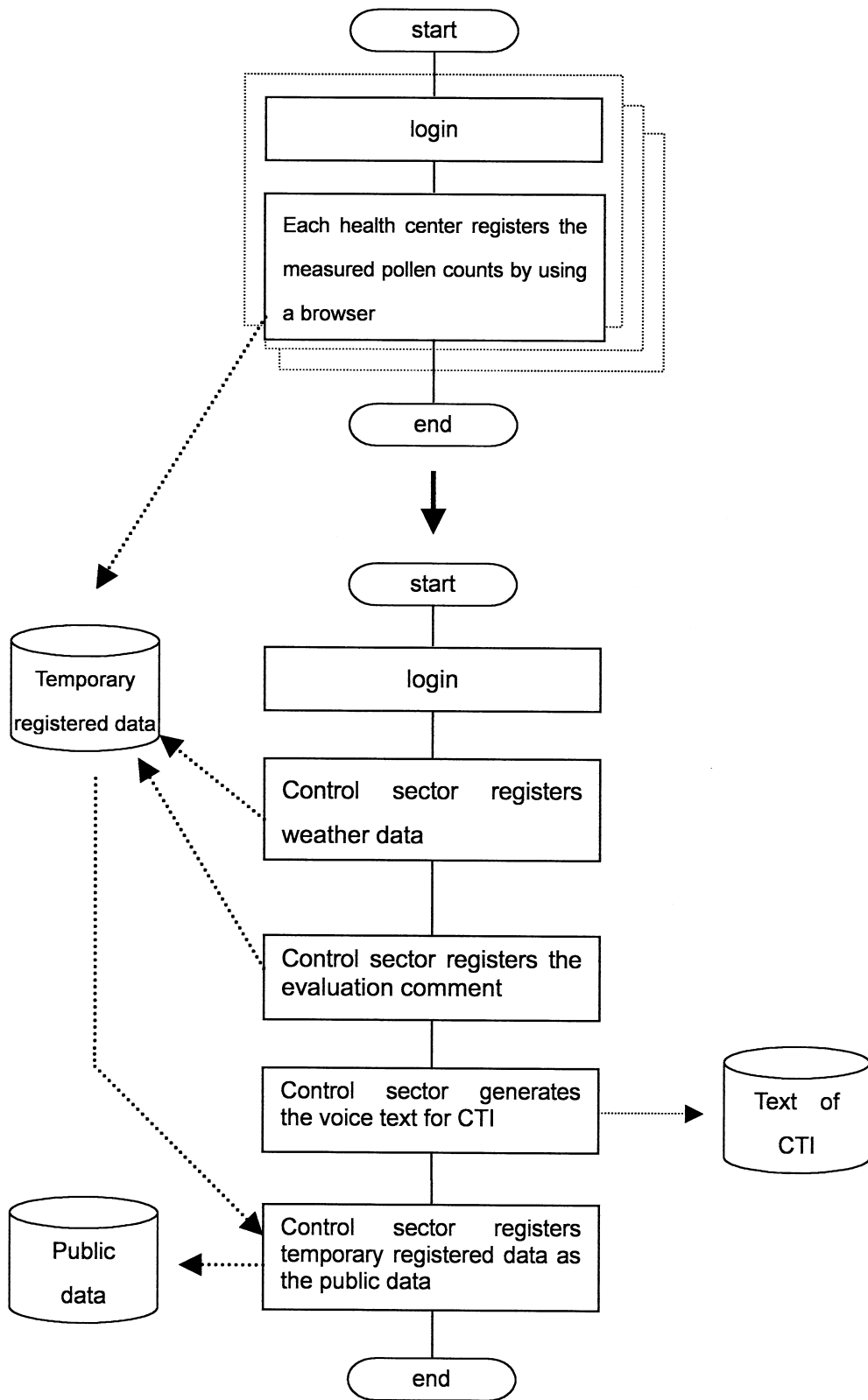


Fig. 3 Pollen data register processing



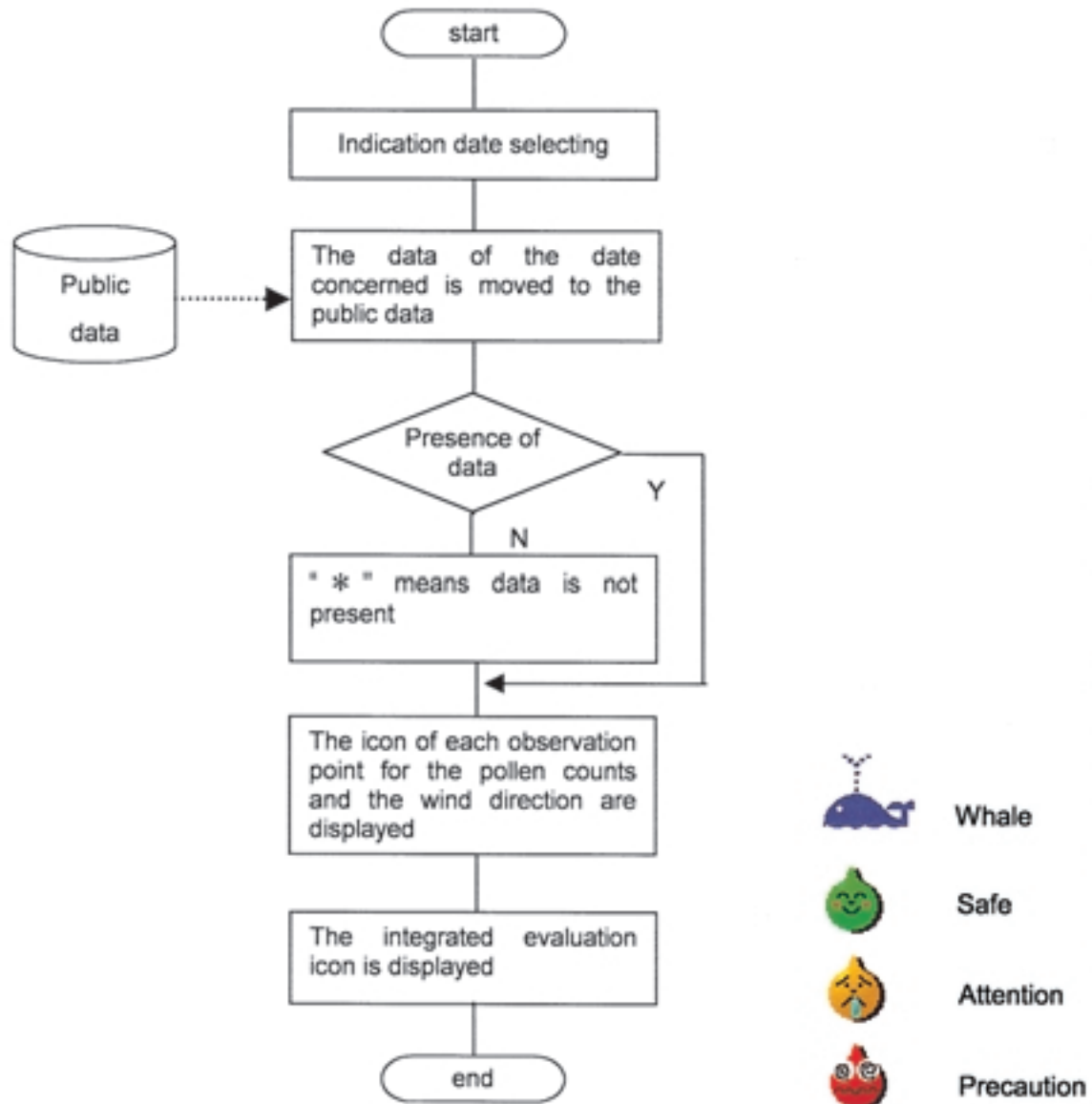


Fig. 4 Display pollen dispersion situation map

provided in such a manner that it could be utilized by anyone, it was processed and presented for the objectives of each user. This was considered to be similar to the current trend of information disclosure. Moreover, the administration used to consider that information distribution was simply transfer of what they were doing and what they knew, but they began to realize that it is important to provide information in such a manner that it contributes to improvements in the QOL of the residents, who are the end users, by learning to utilize it as knowledge useful in their living. Pharmacies realized the importance of utilizing diverse local information other than expert knowledge for conducting consultations and guidance on a scientific basis. For example when drivers of transport companies were substituted and that they drove via routes outside the pollen-dense areas, the

staff members in charge of pollen information distribution began to realize that their task was directly affecting the residents. The residents understood that information closely related to them improve the quality and convenience of their living. According to readers' letters to newspapers, pollen counts may be regarded as simple numerical data by their providers, but their changes exerted marked psychological effects on their recipients, so that it was learned that providing information as objectively as possible was important. Subsequently, washing information and ultraviolet ray information began to be released in the prefecture. Until pollen information came to be issued, pollinosis was scarcely recognized even at the clinic in the prefectural office building sponsored by the civil servants' union; it used to be considered "persistent sneezes" or "chronic cold". Rag-



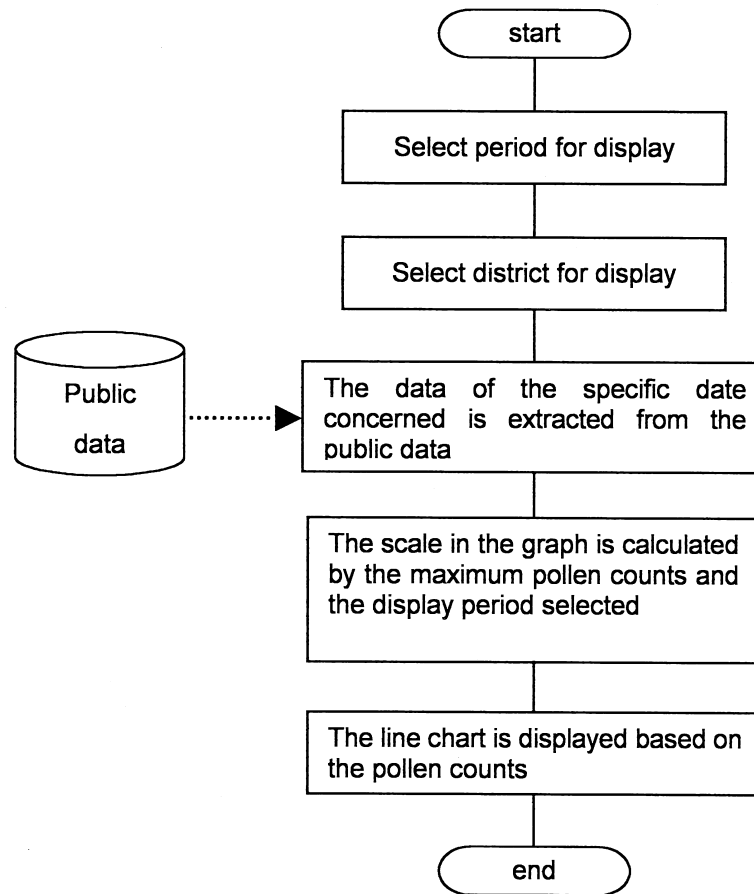


Fig. 5 Display pollen counts transition graph

weed pollinosis was known, but cedar or cypress pollinosis was hardly documented. However, as pollen information became available through television, radio and newspapers, the media began to feature pollinosis in their programs and articles, leading to a gradual spread of the awareness that pollinosis is a condition related to air pollution occurring in the context of environmental problems and that it can be prevented. That is, pollinosis came to be recognized as “an environmentally-induced disease”. Also, providers of information were required to sufficiently explain how such information should be utilized as knowledge useful for living.

For the field observers, who are the source of the information, experience was needed to distinguish cedar and cypress pollens from other pollens particularly during the middle and late periods of the pollen season, because the shape of pollen is affected by the weather and is not necessarily spherical, but it was learned that the distinction was possible if observations were started at the beginning of pollen dispersion. Since experience is needed for this judgment, we sampled flower buds of cedar, prepared slides of typical pollen, and used them for training

staff members at public health centers to improve the precision of field data. Since the measurement was performed daily by staff members who had their regular administrative duties, a shift system was employed. One person was assigned to this task for 1 hour per day. There were problems such as the measurement was difficult on rainy days, that rigid conformity to the deadline was required for the report of the results, and that the observers lacked the perception that they were directly involved in the information service. Strict observance of the deadline was accepted as unavoidable for regular release of information assigned to this section, but as pollen counting was made by a limited number of staff members, we immediately faced difficulties when complaints from residents were made. The staff members of our section in charge of data collection and processing were required to deal with the residents and mass media.

It was necessary to transmit accurate information quickly in an easy-to-understand form. Frequent inquiries made by the residents were “Isn’t the information that appears in newspapers one day late?” and “The information of the day is not the informa-

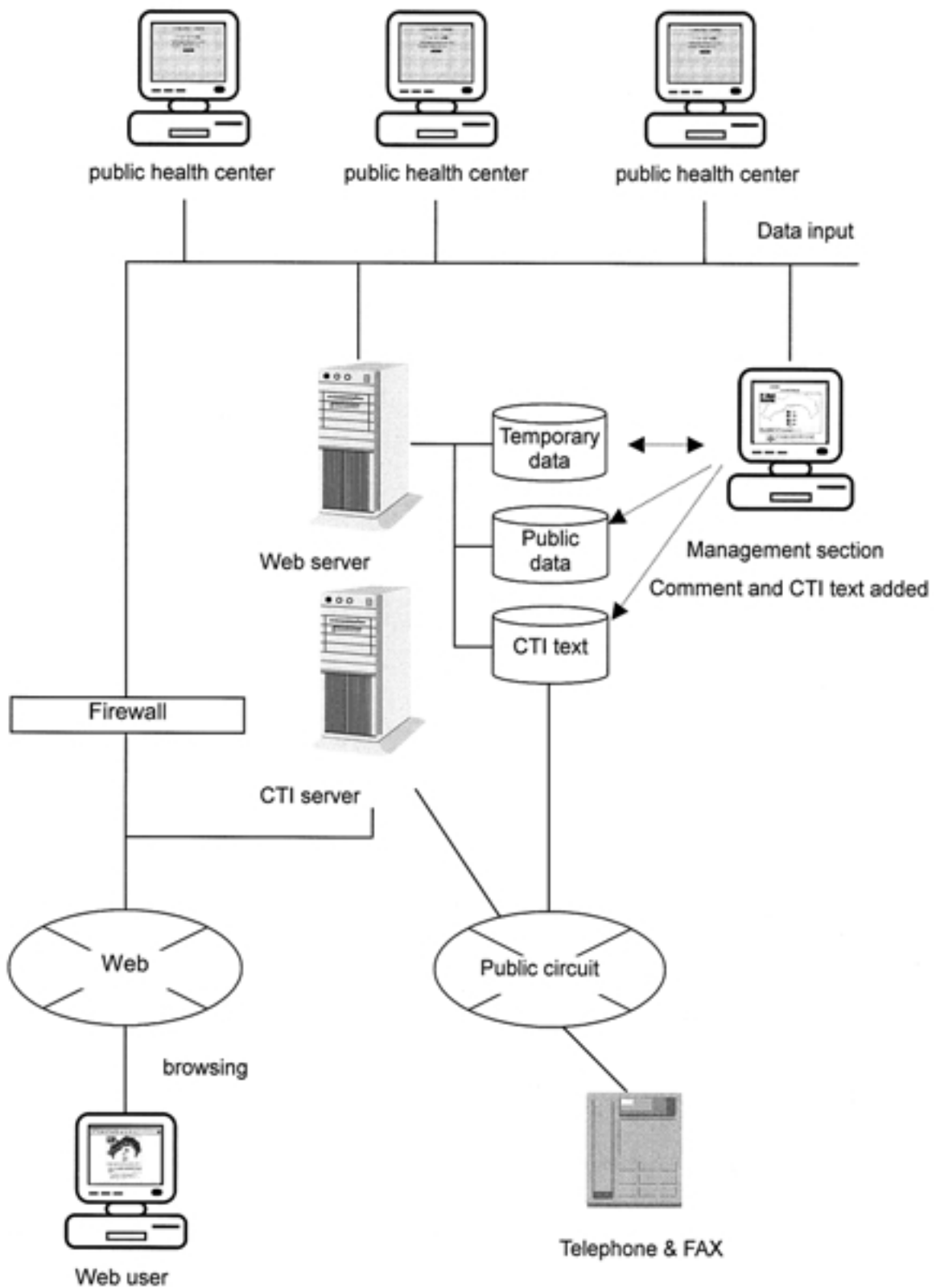


Fig. 6 Relation between CTI server and WWW Server

tion of the present time.” We could only respond to these inquiries by saying, “Please use the information as a reference and take preventive measures based on your judgment.” From the mass media, there was a request for a prediction of pollen dispersion for the entire season before the beginning of our information release. At first, we only had data for nationwide prediction, but as Director Itoh (then) of the Forest Experiment Station, Kochi Prefectural Government was investigating male flowers of standard cedar trees at more than 10 temples and shrines in the prefecture, we were able to predict the total pollen dispersion of the next season following his instructions.

After the system was established, the interest of the mass media increased, and we received many questions about treatment and prevention from patients. We expected that patients would obtain information primarily from medical facilities, but they directed their interest in more detailed features such as points of attention in daily living. Therefore, they became more enthusiastic and motivated toward pollen counting, and public health centers with limited human resources began to obtain cooperation from clinical technicians and public health nurses in addition to the staff related to the Pharmaceuticals and Sanitation Division. Presently, information is collected and transmitted, and the system is improved and managed, primarily by the Pharmaceuticals and Sanitation Division.

The homepage was the method of convenient information transmission to the residents accessed by a large number of users, with 15,000 requests having been made in March, 2001, which was the peak of the season. However, during the past 11 years, a total of 10,000 person • hours were allotted to the measurements, indicating that pollen counting is a very labor-demanding task. Moreover, a delay of 2 days in newspapers, and a delay of 1 day even by television and the web, is inevitable for the release of pollen information. Although prediction of pollen dispersion by means of simulation has been attempted (6), this problem is expected to be solved by installing automatic pollen counters (using laser diffusion light or ultraviolet rays), which have recently come into practical use, at various monitoring points.

In the course of system development, we recognized that the understanding of residents is necessary to continue a public system, and to spend funds for upgrading to analyze the accumulated data to reduce the information issued to the residents. The stored data showed some results such as precaution

zones of pollen counts of pollinosis, a close association between the pollen count and the weather in July of the previous year (7-9), the wind directions where pollen scatters most, and the total cedar pollen count correlated closely with the flower-bearing index (10, 11). These results were used to make the comments each day and to forecast the number of pollen dispersions of the next year.

Finally, we obtained knowledge to improve the system, which were as follows :

1. The sharp age sense is necessary to make lasted system,
2. The ability to apply the current technology is important to realize a system which moves well,
3. The idea based on social knowledge is necessary to make a practicable system.

Systematized physical infrastructure and human organizations are needed to collect information and distribute it daily without failure for improving the QOL of residents. The release of pollen information through the web is expected to undergo further developments as a new style of regional health protection service that provides information related to health and living customized for the needs of local residents.

## Plans for the future

This article presented the circumstances of the system development, the introduction of the system composition and the roles played by P-Net Kochi during the past 11 years for the improvement of the QOL of pollinosis patients. To transmit information efficiently and to steadily maintain the system, a well-organized management system, sound concepts, and the support of users who effectively utilize the information are required. To provide information rapidly, sufficient installation of an infrastructure such as automatic counters are considered to be necessary. If the information obtained by automatic counting is transmitted to the web via the Kochi Prefecture Intranet, which connects public facilities in the prefecture by optic cables, real-time release of information becomes possible. In addition, information that will be obtained by the automatic counters calibrated by the conventional method will reduce manpower. Systematization using currently available technology is considered to be very important.

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