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Construction of a medical record database for radiology with ADABAS

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In order to manage medical records of radiology, a management system had been developed in our department since 1972, using a large scale computer installed in Computing Center of our university.[1),2)] The main functions of the management system were as follows;

1) Data preparation by minicomputers installed in our department and loading these data to the large scale computer to maintain the database.
2) Production of key word files and link files for general data handling.

Since then, this homemade system has worked in our department without much troubles for 10 years. However, increasing data, user and usage required new functions such as control of updating by multi-users, security and modification of the database. Such requirements made us to determine to transfer our data to a more

formal database management system (DBMS), a relational one. In this study, some considerations on our experience of construction and usage of our medical record database using a relational DBMS 'ADABAS' will be reported.

1. Hard and softwares

To construct our medical record database, we prefered ADABAS which was installed in the HITAC system of the Computing Center. The host computer has almost 200 TSS terminals, two of which are installed in our department. Two independent minicomputers and several microcomputers which can be connected to the center as the intelligent terminals are used for data entry, editing and data processing.

2. Data flow of our database

Data flow of our database is shown in Fig. 1. All of raw data which are the primary informations for the database are input to the minicomputers. The stored data are delivered to the Computing Center monthly via paper tape to update the database. Various kind of routine out put such as annual (or monthly) reports are processed by the administrator of the database. Although users usually refer only to these out put sheets, they can access the database through the TSS terminals by themselves.

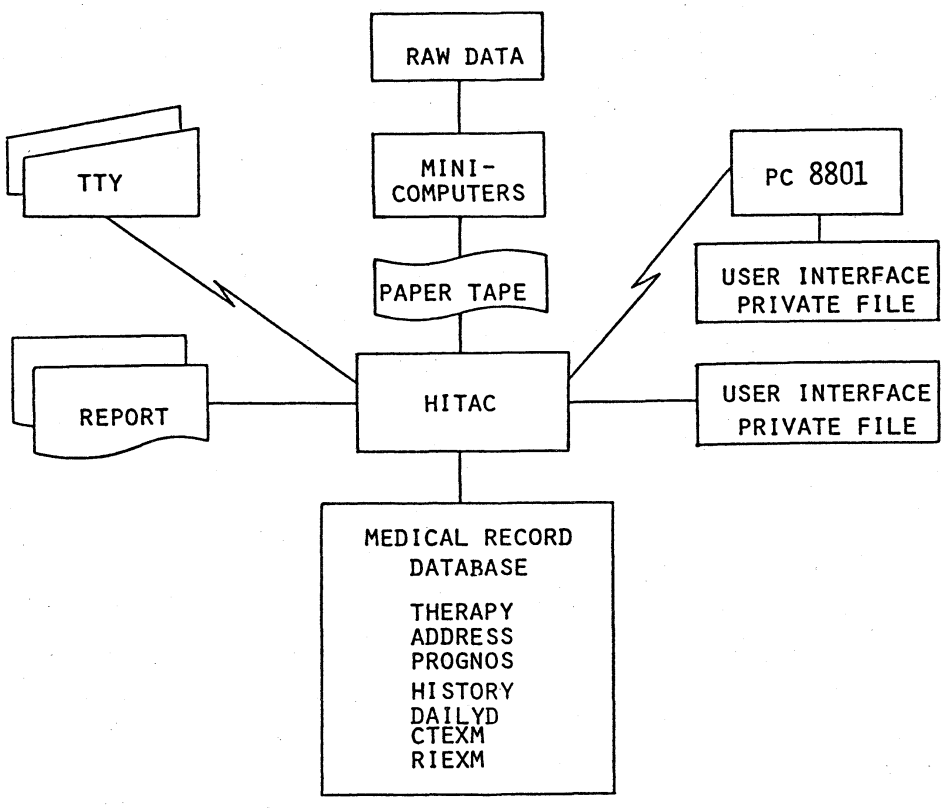

Fig. 1 Data flow of the database

Besides the database, our users possess their own files which may be called 'private files' against the database.
Two kinds of interfaces which connect these private files to the database were created for convenience of the users.

3. Stored data

As shown in Table 1, seven files of which five are for therapy and one each for computer tomographic and radioisotopic diagnosis

are defined in the database. In addition, several kinds of data dictionary files are stored in the database. Accumulation of stored data shown in Fig. 2 represents that the growth of informati is remarkable in the recent several years.

Table 1 Files of the database

File Name	No. of Fields	No. of Records
THERAPY	81	14594
ADDRESS	11	5198
PROGNOS	29	37308
HISTORY	30	3965
DAILYD	94	5198
CTEXM	38	14257
RIEXM	124	9658

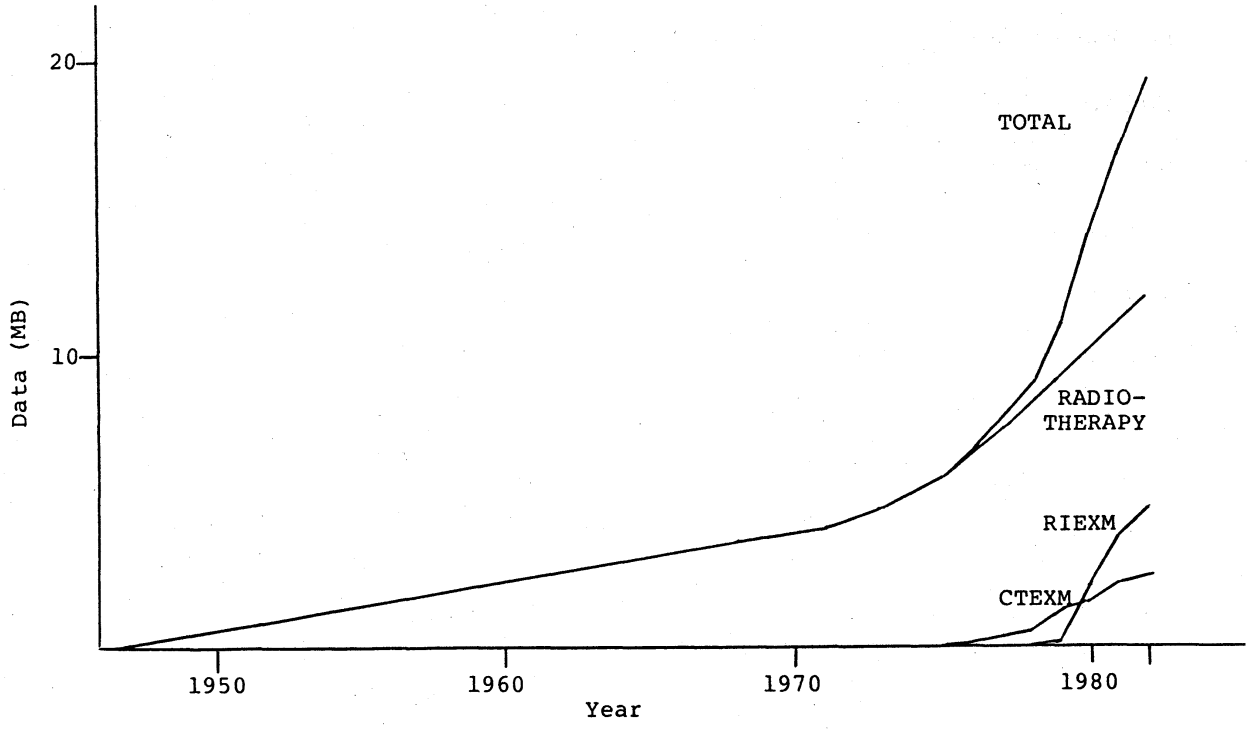

Fig. 2 Growth of stored data

4. For active use of the database

According to our experience of the previous homemade database, we are convinced that the important conditions for active use of a database are followings.

1) Every user can easily operate without knowledge of database.
2) Every user can access a database at any time and from any place (terminals).
3) Data should be reliable and have enough details for users' purpose.

If these are achieved, the number of users as well as access frequency will increase. And this active use of a database will make each record of the database more reliable. Informations to be stored in the database are selected and coded by authorized rules. The data in the database, however, are usually not sufficient for all purpose. That is why users have to keep their own files for their specific theme of research. Media of these files are usually floppy disc of personal computers. These files are, therefore, considered to be the complement of the database.

5. User interface

The user interface, 'HELLO' has following three functions;

1) Information retrieval from the database and data processing on some selected records.

2) Supporting of private file creation.

3) Guidance to users about the operational procedures of the database.

The user interface consists of subcommands shown in Fig. 3. Users can operate the database by input the word 'HELLO' at first as shown in Fig. 4.

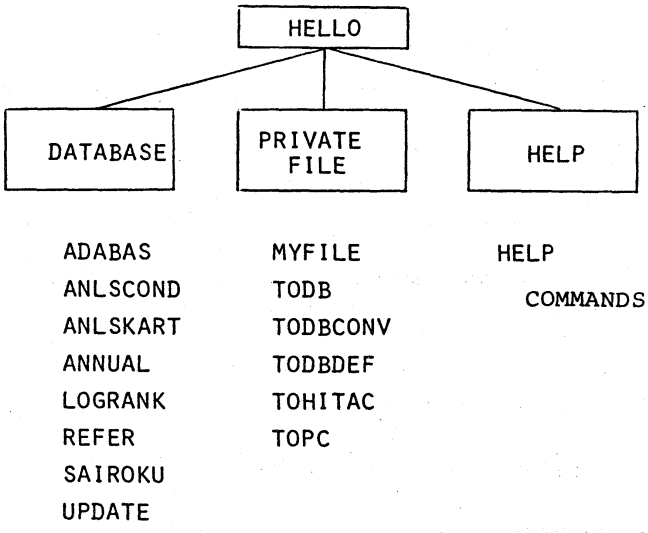

Fig. 3 User interface, 'HELLO'

```
HELLO
----------------------
TABLE OF COMMANDS
----------------------
.
      ADABAS
.
      ANLSCOND
      ANLSKART
      ANNUAL
      LOGRANK
      MYFILE
      REFER
      SAIROKU
.
      TODB
      TODBCONV
      TODBDEF
.
      TOHITAC
      TOPC
.
      UPDATE
----------------------
      HELP
      STOP
----------------------
IF YOU WANT MORE DETAIL ON COMMANDS INPUT 'HELP'
IF YOU WANT INTURRUPT PROCESSINGS OF THE COMMANDS INPUT BREAK(INTRPT) KEY
INPUT COMMAND!
```

Fig. 4 Execution of 'HELLO' command

In order to use personal computer (PC8801) as intelligent terminal, another user interface, 'COMTSS' was made.[3] Under 'COMTSS' not only 'HELLO' command but also two other commands for file transfer between PC8801 and HITAC can be used.

6. Management of private files

Characteristics of private files comparing that of database are followings.

1) The owner and administrator of the private file is user himself.
2) Some parts of private files might be created only for temporary use.
3) Dynamic coupling of a private file to other files in the database should be performed.

As operation of data definition of ADABAS is rather complicated for general users, private files are managed at outside of the database. Definition of items in private file is performed by 'MYFILE' subcommands.

Items of private files created in this way should include chart number which is used to link records to the database. These definitions are noted at the top of the file as shown in Fig. 5. Private file is managed by file name, 'MYFILE.user-name' as a non ADABAS file, so ordinary editing function of HITAC is available.

Private files stored in floppy discs of personal computers can be processed in the same way by addition of data definition

at the top of the file and chart number for cross reference.

MYFILE.KAMADA

```
    12
CHAR;CHART NO
TXX ;NEW T
NXX ;NEW N
MXX ;NEW M
SXX ;NEW S
NKDS;NECK DOSE
RECS;REC SITE
RECT;REC TIME(M)
CMPL;COMPLICATION
OPE ;ADJVNT OPE
RTST;RADIOTHERAPY SITE
RTDS;RADIOTHERAPY DOSE
CHAR   TXX NXX MXX SXX NKDSRECSRECTCMPLOPE RTSTRTDS
730734   2   0   0   24000   2   4   1   2   0   0
730521   1   0   0   15000   0   0   1   0   0   0
801766   1   2   0   35000   0   0   1   2   0   0
790104   3   1   0   26500   1   6   0   0   15000
790480   2   1   0   26500   0   0   1   0   0   0
```

MYFILE.MIZOE

```
     5
CHAR;CHART NO
FLY ;FLUPY
FLM ;FLUPM
FLD ;FLUPD
STAT;STATUS
CHAR   FLY FLM FLD STAT
801776  82   5  31   0
801547  82   4  26   0
802860  81   7   3   8
802663  82   5  24   0
802290  82   3  15   0
```

Fig. 5 Examples of private file

In the case of loading private files to the database, we prepared several subcommands stated below. A unique file with common format in which all private file is to be loaded is defined by the administrator of the database. A private file created is converted to a work file with common format at first (TODBCONV), then it is loaded to the database (TODB). Data definition of a private file for the database is produced using the top region of the private file. Consequently data dictionary of private file is stored in the database as shown in Table 2.

Table 2 Data definition in private file

A unique file defined by DBA STANDARD	Examples of private file	
	MYFILE.KAMADA	MYFILE.MIZOE
OWNER	NAME	NAME
CHART	CHAR	CHAR
L01	TXX	FLY
L02	NXX	FLM
L03	MXX	FLD
L04	SXX	STAT
L05	NKDS	null
L06	RECS	null
L07	RECT	null
L08	CMPL	null
L09	OPE	null
L10	RTST	null
L11	RTDS	null
L12	null	null
L13	null	null
L14	null	null
L15	null	null

7. Application programs

Considerable number of application programs have been develop in FORTRAN for clinical research. The results such as survival analyses, displays of time sequential data and so on have been already reported.[1),2)] Linkage to the ADABAS database of these programs were accomplished by ADAMINT (data manipulation language of ADABAS). These source programs and linked load modules are managed outside of ADABAS database. Programs written in NATURAL (user language of ADABAS) can be stored in data dictionary file of ADABAS database.

8. Discussion

Main functions of medical record database are storage and retrieval of medical information, moreover another important function is supporting analysis and evaluation of the data derived from patients treated or diagnosed. Such proper evaluation of clinical data is thought to contribute progress of medicine.

Our medical record database has been maintained for these 10 years and used effectively in patient registration, analysis of clinical trials and report filing system. Since 3 years ago, increase of stored data as shown in Fig. 2 required a more formal database management system (DBMS) in order to efficiently manage our database. Loading our data to new database system ADABAS

was performed. Data definition language (DD/L, ONLINEDD offered by ADABAS) can be operated under TSS and production of data definition for loading and retrieval is produced by utilities of ADABAS. Concerning DD/L, some considerations will be stated below. When numerical records were loaded as binary data, it was impossible to execute range search of the fields in user language (NATURAL). This problem can be solved by production of another type of data definition module (DDM). As a result, two or more types of DDM are produced to a single file. Users must have responsibility in the selection of DDMs to be used. Data dictionary is recognized to be very effective in recording documents of the database such as contents of files, fields, programs and so on. However, no consistency between of real content of the database and data dictionary is retained. For example, description in security fields under DD/L, do not give any effect on real setting of security level. In other case, defining coupling files, even when those files are not coupled yet, no warning is presented. We need the guarantee of consistency between the real database and the content of DDM at any time.

According to our experience of database, we recognized the requirement of private files besides database is rather strong. This is caused by the fact that records stored in database are not enough for their purpose and our users keep their own files to complement the database. So far modifications of database by the private files are limited to addition and substitution of records

or fields. At present these addition and substitution is allowed only for temporal modification of database, not permanent. For such usage of database, we prepared a user interface 'HELLO', by which efficacy of database was fairly improved. Another user interface 'COMTSS' controls personal computers as intelligent terminals of HITAC in Computing Center. In our department, variou kinds of microcomputers are installed for data processing, verification and control of many medical equipments. Mutual usage of data stored in these computers may become one of the biggest problems in our database system in future.

References

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2) Ito, S. & G. Irie: A database management system for medical records of radiotherapy. Proc. 7th ICCR (1980),313.

3) Ito, S.: User interface 'COMTSS' controlling personal compute (PC8801) as an intelligent terminal. Center News of Hokkaido Univ. Computing Center 14-6(1982),5. (in Japanese)