Database management systems for blood bank applications

P.A. MOREL

Abstract: Blood banks have a need for efficient, long-term storage of records and quick access to the stored information. Database management systems make it easy to retrieve and review large amounts of data. They provide such functions as data entry, sorting capability, search and find capacity, report production, calculation and graphic capacities, programming, and the relating of fields in one file to those in another file. Privately developed programs can be shared by blood banks. A program for managing an inventory of frozen blood units is offered in this paper.

Most blood bank laboratories have now acquired microcomputers and with them some sort of software that allows staff to do "word processing." For those who have not yet been exposed to the time-saving capabilities of the word processor, it is recommended that word processing should be the primer for introduction to the use of a microcomputer. I have never met anyone who would willingly return to a typewriter after using a word processor for writing articles or preparing laboratory manuals. Many of us are also familiar with "electronic spreadsheets" and have many applications for these programs in our laboratories. But no other software lends itself so well to the needs of the blood bank laboratory as does the simple, well-designed "database" system.

Database management systems

Blood bank laboratories are often overwhelmed by paper accumulated in the generation of records and by the requirement for long-term storage of those records. At the same time, they must maintain a capacity for immediate access to the stored information. Database management systems are ideal for organization and long-term storage of records and other written information. Data that are stored in such a system are easily accessible to the user. Individual pieces of data may be extracted from the database as desired, with or without the entire set of data.

Description of terms

Before the capabilities and applications of various database management systems are discussed, there is a need to define some of the terms that will be used.

An electronic database is similar to data storage in a filing cabinet. Each drawer in the cabinet may hold all the data related to a particular area. For example, the top drawer in our cabinet may contain all the test results for antigens other than ABO and $Rh_o(D)$. The drawer may be labeled "Phenotyped Donors" or "Special Donors," but let's call it our "Rare Donors" file. We know that all the donors in the drawer are not rare, but if enough testing has been performed, some of them have uncommon phenotypes. Each test result in the file was attributed to one donor and was placed on the donor's record. If the donor had been tested for more than one antigen, each test result was placed in a separate space, or field, on that donor's record. We now have described a file of rare donors, containing a record for each donor, with test results, donor's name, or other demographic information written in a separate field for each bit of data.

We have stored a great deal of information in our drawer containing the "Rare Donors" file. The usefulness of this information depends on how it can be retrieved. If the records in the file are stored alphabetically or chronologically (both popular ways of arranging manually stored records), each record must be examined, for example, to find donors who have been typed as negative for the c, E, K, and Jk^a antigens, in order to provide blood for an immunized patient. If the records are stored in a more organized fashion, within the drawer there may be a manila folder containing only records for R^1R^1 donors. This would allow us to provide donors after examining substantially fewer records. A file stored in an electronic database would be more easily accessed than either of these manual files. We would simply request that the file be searched for those records showing a " − " sign or "NEG" in the c, E, K, and Jk^a fields, and request that a report be printed of the retrieved records. A computer-based record-keeping system, or database management

system, provides superior storage, organization, and retrieval functions.

By making it easy to retrieve and review large amounts of data, a general-purpose database management system is probably a good match for the needs of most blood bankers. The more complex database systems can access two or more files at once; these are called relational database management systems. It is up to each of us to decide how files need to be stored and accessed and whether or not a single-file data manager will be adequate for the job. A single-file database manager that is inexpensive ($89.00 by mail order), versatile, and easy to learn is called *Reflex*. As a tool for getting the most out of this program, there is an excellent text called *Mastering Reflex* by Robert Ericson and Ann Moskol (Sybex Inc., Berkeley, CA, 1986). A number of other database managers are reviewed in the articles cited in the reading list at the end of this article.

Functions provided by a database management system

Database managers all provide the following functions:

1. **Data entry.** There must be a screen that allows you to enter, edit, alter, add, or delete data items.
2. **Sorting capability.** This feature allows you to arrange file records in different ways, e.g., alphabetically or chronologically.
3. **Search or find capacity.** The search function allows you to find and retrieve records that match specified data in one or more fields.
4. **Report production.** This capability is very important to most blood bankers; it enables you to print neat groups and subfiles of information.
5. **Calculation and graphics capacities.** These are included in some database managers such as *Reflex*.
6. **Programming and creating macros.** Programming languages built into some database managers permit the user to develop macros. These make it possible to execute a long series of formatting or calculating instructions with a few keystrokes.
7. **Relating files.** Relational database management systems such as dBase can automatically relate fields in one file to specified fields in other files.

Sharing privately developed programs

As each of us develops competence in the use of a database manager or other software and goes on to make blood bank applications with our programs, we have the opportunity to share our specialized applications with others. We cannot legally exchange copies of commercial software packages, but may offer copies of privately developed applications to others who have purchased the same package. A stand-alone, individually developed program may also be offered to fellow blood bankers. I have written and am willing to share such a program for managing an inventory of frozen blood units. It was written in PC-Basic on an IBM PC, and the file will hold as many as 1,600 donor records on one data disk. The program is best described by discussing each of the menu or data entry screens.

```
88-08-12══════════ F R O Z E N   B L O O D   F I L E ══════════00:19:56


              A)      REVIEW/EDIT
              B)      SEARCH MASTER FILE
              C)      SELECT FILE
              D)      SORT FILE
              E)      PRINT FILE
              F)      RETURN TO DOS


                              SELECT
MASTER.DAT
```

FIGURE 1. Main menu screen for the frozen blood inventory program.

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88-08-12══════════ FROZEN BLOOD ══════════00:20:41
Donor Last Name:                          First Name:
  Soc. Sec. No.:                          Birth Date:
        P. No.:                           Donor No.:
 Donation Date:                                Use:
     Recipient:                               Race:
      DEC Code:                                HbS:
           ABO:                                 Rh:
Freezer Section:                           Comment:
                         PHENOTYPE
  C:    E:    c:    e:    M:    N:    S:    s:    U:    Lea:    Leb:    Pl:    K:    k:
  Fya:  Fyb:  Jka:  Jkb:  Jsa:  Jsb:  Lua:  Lub:  Other:

MASTER.DAT Records:  301     <INS>Add      <DEL>Delete     <ESC>Menu    302
```

FIGURE 2. Data entry screen for the frozen blood inventory program.

Figure 1 depicts the MAIN MENU screen for the database manager called FROZEN BLOOD FILE. The person using the file may select from the functions listed. REVIEW/EDIT (A) allows the user to see the DATA ENTRY screen pictured in Figure 2. The FIELDS on this screen hold data items for one frozen blood RECORD. Here, data may be entered, edited, changed, or deleted. The record itself is generated from this screen and rec-

ords may also be added or deleted by pressing the insert [INS] or delete [DEL] key. All the records are stored in the Master data file (MASTER.DAT) FILE. Selection B from the main menu searches the master data file on any fields for specified criteria. The selected records are placed in a newly created file called NEWFILE. Selection C allows for the selection of either the MASTER FILE or the NEWFILE for review, sorting, and/or printing. The SORT (D) will sort on any of several fields also, arranging the records alphabetically by donors' last names, chronologically by dates of donation, etc. Printing occurs when (E) is selected. Complete records, including all clerical data, may be printed, or a more condensed version, handy for people on call to take with them may be generated. Anyone interested in obtaining a copy of the FROZEN BLOOD FILE program may write to me at PO Box 206, San Bruno, CA 94066. My daytime telephone number is (415) 493-2200, ext. 2212.

Phyllis A. Morel, MSc,MT(ASCP)SBB, Associated Blood Bank Consultants, Box 206, San Bruno, CA 94066.

Reading List of Database Manager Reviews

1. Bales SA, Shifman MA. Database programming for laboratory applications. Lab Med 1987;18:256–8. (General Information)
2. Fanning T, Fanning R. Organizing. In: Brand S, ed. Whole earth software catalog. Garden City, NY: Quantum Press/Doubleday, 1984:78–93. [Reviews file managers such as PFS:File, PFS:Report, PFS:Solutions, Offix, PC-File III, Personal Card File, DB Master (for the Apple) and Versaform; and more sophisticated database managers such as DBase II, R:Base 4,000, Condor III, Infostar +, ASAP Five, Sequitur, and Superfile]
3. Sotomayor M. Easy to relate. PC World 1985;3:126–41. (Reviews Powerbase, Six and Infoscope)
4. Urschel W. Data management. PC World 1987;5:236–47. (Reviews Paradox 1.1, PFS:Professional File, Q&A 2.0 and askSam 3.0)

This list is far from comprehensive. There are many database management packages and many reviews found commonly in the microcomputer or personal computer publications such as *PC World*. The bibliography in IMMUNOHEMATOLOGY often contains references to articles that review database managers.