Over the past several years, a variety of computer projects have been implemented within the Department of Obstetrics and Gynecology of the University of Tennessee College of Medicine, in Memphis, Tennessee. Using a DEC minicomputer and original programming, we established one of the largest perinatal data systems in the country. We also designed and implemented a major financial/administrative program now running on our IBM mainframe computer. In addition to these "big computer" projects, we recently developed a microcomputer system to provide ancillary computer support in other areas.

This microcomputer system has been very productive, in spite of a modest budget. Over the past three years, we have developed several practical applications based on microcomputers. Many of these projects serve multiple functions in the areas of research, administration, and clinical care. One such project is our automated obstetrical log-book (Fig. 1).

The automated log-book is a good example of a practical application of the microcomputer in clinical medicine. Because of the simple, straightforward design, we were able to implement the entire project within 2 months. Currently, this automated log-book is a principal source of data for a variety of projects, including our obstetrical quality of care review program. In addition, it provides important administrative data and supports several prospective clinical investigations.

The purpose of this report is to describe the design and implementation of our automated obstetrical log-book. Although this is an obstetrical project, the same procedure may be used to computerize other log-books as well.

**Hardware (Equipment)** The project hardware consists of an Apple II computer with dual 5 1/4" floppy disk drives, a monitor, and an Epson MX-80 printer. Replacement cost for this equipment is approximately $3,100 based on current list prices. Recently, we have expanded the system by adding a 13 megabyte hard disk drive (list price $3,500). This device, although clearly not an essential component, has substantially improved the efficiency of the project.

**Software (Programs)** Our log-book project is based on several interactive commercial programs including: DB Master (data base management), Daisy (statistics), and Visiplot (graphics). Although each of these products is a useful enhancement to the system, only the database management package is essential to our operation.

**Warmware (Personnel)** No "computer professionals" are employed on this project. The entire system was designed and implemented by the primary author, who is a physician with no formal training in computer science. Initially, our regular secretarial staff entered all the data. Recently, however, we hired a data entry clerk who spends 4 to 6 hours per week on this project.

**Database (Information Set)** We collect a basic set of 40 items of information on every patient delivering at our institution (over 7,200 per year). This is supplemented with additional information on selected cases. However, the maximum number of items per patient is limited to 100.

**Information Flow (Gathering the Data)** A 3 by 7 inch "hospital billing slip" serves as the principal source of information for our uncomplicated cases. It is the same document on which our regular "paper" log-book is based. Using 3 forms specifically designed for this project, additional information is collected on selected cases. A special 2-page form is completed by the residents whenever a cesarean section is performed. Postpartum problems and neonatal complications are also reported on special forms. This information is added to the existing database on a daily basis.

**Database Creation (Setting up the Program)** The design of the database had to conform to the limitations of the DB Master program. Therefore, we were restricted to 100 items per patient. Database size (i.e., number of patients), however, was not a problem, since the program can accommodate up to 65,000 records per database.
The initial "programming" of the database took only 2 hours, and allowed immediate, full implementation of data entry. However, the design and creation of the reports was a more difficult and time-consuming process, which was accomplished in stages during the course of the project.

Quality Control (Maintaining accuracy). The information processed by the computer is checked for accuracy in several ways. First, we routinely screen our files for missing data. When omissions are identified, we abstract the information from the original medical record and reenter the proper data. We also cross-check for accuracy by comparing our data with the paper log-book maintained in the labor and delivery suite. Finally, in a retrospective fashion, specific items are compared to the data in our large, minicomputer-based perinatal data system.

RESULTS

The entire system was designed and implemented within 2 months. Although we have continued to refine and enhance the system in subsequent months, the basic operation of the project has remained the same. Even the comprehensible output. In addition to these look-up codes, the report generation program has several other useful features. It allows the liberal use of comments, such as units of measure, within the body of reports rather than just in column headings or footnotes. It also can perform calculations on the data and print the results within the report. Finally, the report generator has rudimentary statistical capabilities, including totals, mean and standard deviation for all numeric entries.

Nevertheless, the power and flexibility of this report system have some accompanying drawbacks. Because of its complexity, considerable experience is needed before all of the features can be fully utilized. More importantly, the use of these features can greatly increase the time it takes to generate the reports. For example, it takes two to three hours to print a complete 55-page, 650 patient monthly report. Fortunately, since this refers only to computer usage time, our personnel are free to pursue other activities while the print-outs are in progress.

The primary output from this system is the log-book printout generated each month. The cases for each physician are listed separately, in order of the type of delivery. This report contains virtually all the information included in our hand-written log-book, printed in a clear, comprehensible fashion. Figure 2 is a representative segment of our first monthly print-out.

Other reports are designed to support specific projects, such as our quality assurance program. Each week we generate a list of all cases with poor outcome and all cases with certain avoidable complications. The print-outs summarize the pertinent clinical data and identify the nurses, residents, and faculty responsible for patient management. To support prospective, clinical investigations, we label the computerized records of each patient enrolled in a study. This permits statistical comparisons between study patients and our general population, as well as comparisons among the different study groups.

DISCUSSION

Our automated log-book was easier to implement than most of our previous microcomputer projects. The design and implementation phase lasted for only 2 months and was accompanied by very few problems. This accomplishment was made possible by several factors relating to the project design.

First, the application was simple and straightforward. Nor were we trying to compete with the much larger perinatal database already functioning at our institution. Our goal was merely to complement both of these systems with an easily accessible, up-to-date source of information which could support several new and useful applications.

Another important factor contributing to our success was the decision to use a commercially available database management package. Although we have the capability and experience to write our own programs, this alternative approach would have required much more time and effort. With our database management package, we were able to complete the initial programming in one day and immediately begin routine data entry. This would not have been feasible with a system based on original programming.

Finally, perhaps the most important factor contributing to successful implementation was our experience. We have been working with this equipment for over 2 years now, and are very familiar with its capabilities and limitations, as well as the details of its operation. We are also aware of the strengths and weaknesses of our personnel. Thus we were able to design a system which was most compatible with our existing resources.

The method of computerization described in this report could work equally well with other microcomputers, or even min- or mainframe computers. However, the scarcity of comparable database management packages is a major limiting factor. Most database programs for these larger computers are expensive (over $10,000) and difficult to use. Although there are a few exceptions (such as File Manager), these programs are generally unsuitable for individuals with limited computer experience.
With the continuing improvements in computer equipment and programs, the selection process is becoming more and more difficult. Nevertheless, considering the present state-of-the-art both in hardware and software, we believe that the microcomputer/database combination is still the most appropriate approach for small applications such as the automated log-book.

CONCLUSIONS

Our basic concept was to take a well-organized, manual record-keeping system and improve it with computerization. The hand-written procedural log is a good example of such an existing manual system. It contains a wealth of useful information and usually has well-established data collection support. Thus, the log-book is in many ways an ideal candidate for computerization.

REFERENCES


