Training Faculty in Bangladesh to Use a Microcomputer for Public Health: Followup Report

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This work was supported in part by the United Nations Fund for Population Activities, No. BG/79/P11.
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Synopsis

In 1984 the Western Consortium for the Health Professions, Inc., under contract to the United Nations Fund for Population Activities (UNFPA), began a project to assist Bangladesh's National Institute for Preventive and Social Medicine (NIPSOM) in establishing a microcomputing capability. The project's goal was to enable NIPSOM to become self-sufficient in the analysis by microcomputer of health, population, and family planning data; program evaluation; and policy activities.

Lack of a local microcomputer infrastructure demanded that a local team of experts be developed to run the system described in a previous report. Five NIPSOM faculty members—three of whom had taken the workshop held when the system was first installed—were assigned to a computer committee, which was responsible for the computer's well-being.

Six months after the microcomputer system was installed, a second 2-week workshop was given. The consortium's consultant facilitated the development of a basic microcomputer course, which was taught by four members of the computer committee to an additional eight NIPSOM faculty members. Emphasis was placed on developing local self-reliance and the need to overcome obstacles imposed by the lack of local hardware and software support systems. A strategy is proposed for the successful introduction of microcomputers in developing countries.

COMPUTER TECHNOLOGY IS RAPIDLY becoming available throughout the developing world. Although public health workers have not always had ready access to computers, recent price reductions for microcomputers have made them attractive tools for research investigators and governmental officials alike. Coupled with the availability of durable, inexpensive microcomputers has been the development of more modestly priced statistical software. As was pointed out by Dixon and Britt, the developing countries have researchers of great talent who can contribute innovative approaches to analysis once they have access to computers (*1*).

The transfer of microcomputer technology has been promoted by governmental and international agencies for agricultural and health-related projects in developing countries (*2*). Yet problems arise both in the choice of equipment in the computer system (hardware) and programs that run the system (software), as well as in the training of people to use the equipment properly (*3*). As was recommended by Schware and Trembour, training programs need to be developed that are oriented to practical applications and easy hands-on use and experience (*2*). The continued development of such a training program at the National Institute for Preventive and Social Medicine (NIPSOM) in Dhaka, Bangladesh, is the subject of this paper.

In a previous report, Frerichs and Miller described the introduction of a microcomputer system at NIPSOM, the main institute in Bangladesh responsible for preparing physicians and other postgraduates for work in public health (*4*). The NIPSOM faculty felt that microcomputers would facilitate research in health, population, and family planning; permit timely analysis of data for assessment of needs and development and evaluation of policies and programs; and assist with internal management of the institute. To assist NIPSOM in this effort, the United Nations Fund for Population Activities (UNFPA) awarded a contract to the Western Consortium for the Health Professions, Inc., based in San Francisco.

The effort's first stage was designed and conducted by the consortium's consultant (Frerichs), of the University of California at Los Angeles (*4*). This first stage encompassed the selection and installation of hardware and software, as well as a 2-week workshop in November 1984 on the analysis of health, population, and family planning data by microcomputer. NIPSOM's microcomputer system, based on an IBM portable personal computer, was fully described in the earlier report on this project (*4*).

Fifteen NIPSOM faculty members participated in the first workshop. Five core trainees in that group had an additional 2 hours per day of personalized instruction and hands-on experience with the system. At the end of the 2-week course, these five advanced trainees were able to

- design a research data collection form,
- create a data base using the PFS:File program, a simple data base management system (*A*),
- convert the PFS:File to an American Standard Code for Information Interchange (ASCII) file and clean this file with EDLIN, the IBM line editor (C) and
- write the appropriate program control statements to analyze the data set using two BMDP statistical programs: 1D (simple data description) and 4F (two-way and multiway frequency tables) (*C*).

The core trainees were also able to produce graphs of their results using PFS:Graph (*A*).

In June 1985, Gould was sent to Dhaka by the Western Consortium to conduct a second workshop. The purpose of this report is to describe how the system had been used over the first 6 months following its installation, the design of specific activities of the second workshop, and a 15-month followup by a member of the NIPSOM faculty. Further suggestions for the introduction of microcomputers in similar countries are also offered.

Six-Month Followup

System use. Following the initial workshop in November 1984, three of the five advanced trainees and two faculty members who had not attended the first workshop were assigned to the new NIPSOM computer committee, which was responsible for the computer's well-being. Committee members had keys to the room where the computer was housed. Because the computer system was viewed as expensive and exotic, its vulnerability to damage was uncertain ("maybe if I hit four keys by accident it will destroy itself . . ."), and the cultural tendency was to blame whoever last used equipment that malfunctioned, committee members usually worked in twos. Unfortunately, their fixed transportation schedules and workloads frequently made it difficult for two members to work together at the computer, especially after hours.

During the 6 months following the first workshop, the computer was used almost daily by one member of the computer committee. Perhaps Bangladesh's first "hacker" (often described as a person with talent and creativity who is able to push beyond the presumed limits imposed by specific computer hardware and program limitations), Dr. B. mastered both the BMDP 1D and 4F programs, designed the microcomputer data analysis for a study of anemia and parasitic infestations, and assisted a colleague in the computer analysis of a study that related techniques of dental hygiene to oral pathology. Other members of the computer committee initiated studies that relied on the microcomputer's analytic capabilities and became proficient in the use of PFS:Graph to produce graphs for students and colleagues.

During the 6 months after the first workshop, Dr. B. also mastered both PFS:file and PFS:Graph (applications programs that were selected in part because they are easy to learn and have clearly written documentation). In addition, several other members had also developed competence in the basic operations of those two programs. Dr. B. and several other committee members became extemely familiar with the BMDP progams and learned to write complex control statements (instructions that describe the variables to be analyzed and the analysis requested) quickly for the sophisticated BMDP programs.

Although the basic disk operating system (DOS [*B*]) operations were well understood, the documentation materials provided by IBM are not designed as self-study primers for beginners. Thus, DOS skills had not moved beyond those basic operations acquired during the first workshop.

Techniques taught during the first workshop were modified by the computer committee to reduce drastically printer paper consumption, and several more efficient input strategies were also developed. The original training emphasized the use of data collection sheets on the computer

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screen to enter data. The rationale for this procedure was that persons unfamiliar with a computer would have an easier time entering the data this way in a "screen sheet" rather than line by line using commas or spaces between the variables. With increased sophistication, however, the original entry method was modified so that tabular lists of numbered variables could be entered directly. The variables were then named during the BMDP program statement.

Further innovative work would have gone on were it not for the inability of the committee members to use—try as they might—a third program in the BMDP library, BMDP 2D (detailed data description). This frustration severely hampered further experimentation and self-development. The first step in implementing the BMDP program was to copy the program from a backup floppy library disk to the computer's "working" hard disk, a step that unfortunately did not work because of an error on the backup floppy library disk. Having only limited experience with troubleshooting, the committee members assumed that they were not performing this procedure correctly rather than considering the possibility that the backup library copy of the disk containing the program was damaged when the program had been transferred from the original disk. Future introductory courses must simulate and resolve common troubles, as well as define the vulnerability of the system to such errors as turning devices on and off in the wrong order and hitting multiple keys.

Equipment. The computer committee was pleased with the system and experienced no hardware problems during the first 6 months of operation. In a city notorious for its unstable electrical output, the Topaz Ultra-isolator (*D*) 220–110 voltage transformer (which also protects the computer from voltage spikes) and the Topaz voltage regulator (*D*) (which protects the computer from brownouts [unusual declines in electrical current]) have performed without problems. Word of the NIPSOM system's reliability has influenced the design and purchasing decisions of several agencies working in Bangladesh that plan to develop a microcomputer capability in the near future.

User's guide. During the first workshop, Frerichs prepared a step-by-step synopsis of hardware and software operations covering all basic steps, from turning on the computer to editing BMDP output (using IBM's EDLIN) prior to printing. This written guide was an invaluable tool. Unfortunately, the document did not describe how the system was "wired together," how the Topaz electrical regulators were modified, how the hard disk had been partitioned, and how the original BMDP programs were copied on a disk and then copied on backup floppy disks using the backup procedure (notes regarding many of these issues were, however, written onto the system's individual factory source documents). Unified documentation of this sort is essential in a technologically less developed country to resolve system malfunctions and to encourage the modification and improvement of hardware or software.

In summary, the initial workshop and training session described previously was considered successful (*4*). This activity included the system configuration, equipment and software selection, 2-week training workshop, and step-by-step guide to obtaining BMDP analytic output (starting with instructions on how to turn the computer on). What remained was to proceed to stage II.

Enhancing Computer Literacy

The second stage of learning centered around another workshop and personalized instruction of individual faculty members. The computer committee wanted to promote increased computer literacy in its institution. Over 2 days a strategy was formulated that could best meet the expectations of the committee within the framework of a 2-week workshop. Three goals were established: (*a*) that eight more NIPSOM faculty members become familiar with basic microcomputer techniques and be given the opportunity to explore how the computer could be applied to their specific areas of research and teaching, (*b*) that four members of the computer committee become competent in developing and teaching a basic microcomputer course that would accomplish goal *a*, and (*c*) that members of the computer committee learn how to use all BMDP programs.

To meet these objectives, the workshop took the following form. From 7:30 to 8:30 a.m., advanced consultation was given. From 8:30 to 12, the basic computer course was conducted, and from 12:30 to 3:30 there was an instructor's workshop when the curriculum was developed, exercises and demonstrations were practiced, the day's course was critiqued, and more advanced techniques were introduced.

Basic computer course. The instructors, who were four of the committee members, named the course Comptran.A85 to identify it as the first computer training course taught by NIPSOM faculty in 1985. Following a 1-hour lecture given by the visiting consultant, the participants divided into two sections, each consisting of two instructors and four students. One section remained in the classroom for discussion while the second group went to the computer room. After 90 minutes the sections would switch. The 90-minute computer session began with a 15–20-minute demonstration. Each section's two instructors would alternate the role of the demonstrator on a daily basis. Each student was given a maximum of 15 minutes to complete the class exercises. We quickly learned that it was important to have the fastest typists do the exercise first and to limit keyboard time strictly to 12–15 minutes. Several students had no keyboard experience and initially typed at 7–10 words per minute.

Within the section each instructor worked with two students. Often an instructor would conduct a discussion with his or her two students while the other two students and their instructor were working on the computer.

With some exercises all four students might rotate onto the computer several times during a 90-minute session. Using this design, four students represent the maximum number that can be given a satisfactory experience with two instructors and one machine during a 90-minute session.

The course was initially taught in English, the official academic language in Bangladesh. During the computer and discussion sessions it became apparent that transfer of technical information was greatly facilitated when the instructors and students spoke Bangla, the national language. The committee decided that the consultant's daily lecture should be given in English and that the computer-discussion session should be in Bangla. Although the use of Bangla in a workshop involving an English-speaking consultant was contrary to usual practice, it was extremely efficient. Further, it emphasized that Comptran.A85 was a microcomputer course being conducted by Bangladesh faculty. Because specific exercises and demonstrations were developed and practiced during the afternoon workshop for instructors, Gould was able to observe, detect difficulties, and facilitate when necessary, even though he could not understand the instructional language.

In designing the workshop with the computer committee and in speaking with various members of the NIPSOM and Western Consortium staff, a difficult problem came to light. In Bangladesh, knowledge, ability, and wisdom are tightly linked to academic level. Senior scientists are expected to be superior to junior scientists. Because the junior faculty participants had the most experience and familiarity with typing and hands-on mainframe computing, there was serious disruption in the academic hierarchy. In addition, Dr. B., who had become quite proficient at basic microcomputing, was a junior member of the faculty, and there was a sense that he was not being adequately used by senior scientists as a resource because to do so would represent a loss of face.

It became important to emphasize that the person with the most hands-on experience with computers is an important resource who can teach in minutes routines that might otherwise take hours to learn. It was stressed to both the course participants and the NIPSOM directors that in developed countries it was common for senior faculty to consult juniors with respect to the *technical* aspects of computing, and that such requests were quite different from asking for advice on experimental design, data interpretation, or how to conceptualize the implications of results.

A related problem that had to be overcome was appearing incompetent in front of peers and juniors. It was important to stress that learning from one's mistakes was a expected part of becoming proficient in microcomputing. And just as typing skills would improve with practice, mistakes understood would lead to solid ability. In workshops and lectures, making mistakes and slow typing were treated as being normal. This attitude allayed anxiety, quelled frustration, and created a sense of cameraderie that helped transcend the boundaries of academic hierarchy.

Course curriculum. The previous workshop and teaching materials served as important models. In designing Comptran.A85, the computer committee

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Course Curriculum for Comptran.A85

Session 1. Introduction

Lecture: 1. Computer hardware and software 2. Examples of applications programs
Demonstration: hardware, turning the system on and off
Practice: "Donkey" game

Session 2. Keyboard

Lecture: 1. Review of system components 2. Bits, bytes, nomenclature 3. Keyboard
Demonstration: keyboard
Practice: using the keyboard

Session 3. File design

Lecture: 1. File design 2. Group designs a participant file for the course.
Demonstration: creation of Comptran.A85 with PFS:File
Practice: students type in their data.

Session 4. Data format, basic DOS commands

Lecture: 1. Review difficulty in sorting Comptran.A85 file because of lack of a standard data entry format 2. Agree on standard format 3. Basic DOS commands
Demonstration: basic DOS commands
Practice: students correct their records using standard format for Comptran.A85 file.

Session 5. File design, introduction to BMDP data format I

Lecture: from data collection form to PFS data file to BMDP program
Demonstration: adding new variable and updating the PFS file
Practice: 1. Basic DOS commands 2. Updating individual record in Comptran.A85

Session 6. File design, introduction to BMDP data format II

Lecture: 1. Review of session 5 2. Design of individual research data forms
Practice: individuals create a PFS:File for their date form and enter simulated data for five records.

Session 7. File management

Lecture: backing up, redesigning, updating, sorting, and printing a file
Practice: backing up file, adding 2 new variables, updating, adding 5–10 new records, printing, and backing up the expanded file.

Session 8. Data analysis with BMDP I

Lecture: 1. Converting PFS to ASCII 2. Clean up 3. Writing your BMDP program
Practice: each participant performs the steps described previously on his or her data set.

Session 9. Data analysis with BMDP II

Lecture: review of session 8 and problems encountered
Practice: 1. Running BMDP program 2. Printing results

Session 10. Introduction to graphs

Lecture: 1. Review of problems encountered in session 9 2. Use of PFS:Graph
Demonstration: various types of graphs
Practice: each student creates a graph using his or her BMDP results or simulated data

felt that the faculty members were well versed in research methodology and that the course should focus solely on use of the microcomputer. The step-by-step manual used in the previous workshop was felt to be excellent. One limitation was that it used a single demonstration data set that focused primarily on factors that contributed to neonatal mortality. Thus, the analysis was of primary interest to an epidemiologist but not necessarily to a health services administrator, environmental specialist, or persons in other related disciplines.

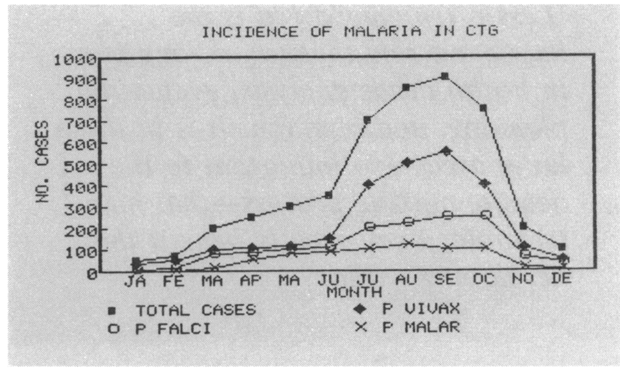
To overcome this perceived limitation, all Comptran.A85 participants built step-by-step manuals addressing a typical research problem in their own area of expertise. The manual consisted of a combination of handouts ("How to Turn on the Computer," "Keyboard," and "DOS Commands") and the students' own work (their design of a data collection form, the hard copy of their own data file, their BMDP program to analyze the data, and the program outputs). It was hoped that this approach would provide an analytic "template" for a research project in each participant's area of interest. With this in mind, in order to make the template more generalizable, the committee developed exercises to give experience in altering the initial file design (by giving more variables, for example). To obtain a certificate that recognized the successful completion of basic microcomputer training, each participant had to complete a start-to-finish example based on his or her own prototype research design. The titles of the students' projects follow:

1. the epidemiology of lathyrism,
2. the prevalence of filaria,
3. the etiology of diarrhea in children,
4. nutritional blindness and diarrhea,
5. analysis of pretest results,
6. drug production in Bangladesh,
7. prevalence of hypertension, and
8. prevalence of malaria in the city of Chittagong.

An overview of the curriculum developed for Comptran.A85 is presented in the accompanying box. Although all participants had some experience with preparing data for mainframe computer analysis, only three could type. Sessions 1 and 2 were devoted to developing keyboard skills. Following an orientation to the hardware, all participants played the IBM game "Donkey." The session 3 classroom exercise was to design a data base on the course participants. Students typed in their own entries. That evening the faculty reviewed the file and identified all differences in format. For example, a date might be entered as Nov. 12, 1985, 11/12/85, or 12/11/85. The students' data files were then sorted by the computer on the basis of birthdates, professional degrees, and other characteristics, and the unsuccessful results were used as a starting point for a class discussion on the importance of a standardized input format. After the class decided on a standard format for the class data base in session 4, each student corrected his or her own record. This exercise promoted practicing the search, update, and print functions of PFS:File, as well as improving basic keyboard skills.

In session 6, each participant had to developed a prototype research project in his or her area of expertise and design a data collection form with three variables. Participants worked in pairs, with one participant serving as a data clerk to identify ambiguities in form design or data input format. Each participant then used PFS:File to create the file structure and produce a hard (printed) copy of the data collection form. A backup copy of the file was then made on a floppy disk.

Typical graph produced by a student using simulated data



Session 7 was on file management. Basic DOS procedures such as format, copy, erase, and rename were practiced by creating a practice file and having each student copy the file to a disk in another drive, compare the files, rename the new file, and erase the original.

The students then added simulated data for five records in their research file. They modified the file by adding 2 additional variables, searching and updating the original 5 records, and adding 5–10 more records. After performing several simple sorts, the students used the PFS print function in session 8 to create an ASCII file and edited the file using IBM's EDLIN.

In sessions 8 and 9, each student wrote programs to run BMDP 1D and then ran the data and printed the results. To facilitate writing the BMDP program statements, a simple worksheet was developed describing each variable. All steps described previously were documented and, with appropriate computer printouts and class handouts, assembled into a personalized step-by-step manual.

As a finale to their analysis, each student created a graph in a particular research area using PFS:Graph (see figure). This final aspect of the workshop gave each student a graph that could be shared with friends as well as colleagues to demonstrate that they had learned some valuable basic microcomputing skills.

Instructor's workshop. Each afternoon Gould met with the computer committee to review the day's course activities, plan the goals and exercises for the next sessions, and practice the demonstrations to be used in the workshops.

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Although the consultant facilitated development of the course and gave a daily lecture, the computer committee—now the computer faculty—taught both in the discussion groups and at the computer, and performed all computer demonstrations. At the conclusion of the workshop, these four faculty members were able to conduct independently a basic course in microcomputing.

Intermediate microcomputing workshop. Designing and preparing for the basic course allowed members of the computer committee to review and extend their computing skills. File management, the creation of data files, and the use of the other BMDP programs were emphasized. File management skills were essential because they had not been discussed in detail in the first workshop. To conserve diskettes during the 6 months following the initial workshop, unnecessary files had not been taken off the hard disk, and important research data files had not been backed up on floppy disks. Discussions on file management also addressed estimating file size and determining storage capacity.

PFS:File provides an excellent utility for creating a format (that is, data base) in which information derived from data collection forms can be stored and subsequently manipulated by computer. However, many of the faculty were eager to process tabular data that had been prepared for mainframe computer analysis. The data were from previous collaborative work as well as from research in progress. Several rapid ways of building tabular data files were learned and, in anticipation of future needs, merging of files was also practiced. The DOS command "COPY CON" worked quite well when building a file from a tabular data set.

Developing the capacity to build files rapidly from data collected locally that had been previously run on a mainframe computer allowed us to demonstrate the power of the microcomputer. Using a sample of several hundred cases, the computer committee was able to obtain results consistent with those from the mainframe. This data base was also used to practice several of the more complex BMDP programs. Committee members felt that they would have no difficulty in running the remaining BMDP programs.

By the end of the course and the workshop, several participants were beginning to plan the analysis of previously collected data, and several new data bases were being created and analyzed. Additional word processing, data base, and spreadsheet software had been ordered from a Dhaka vendor, and arrangements were made for instruction in the use of these packages.

Long-term followup. In February 1986, some 15 months after the microcomputer was first installed at NIPSOM and 8 months after the second workshop, we receive a letter from Dr. B. In it, he described his current mastery of all the BMDP programs brought to Dhaka for the initial workshop (*4*), the writing of a new HELP program for beginning students, and the availability of additional software that had been purchased by NIPSOM (Lotus 1,2,3, Wordstar, DBASE III, and General Ledger). Most revealing of all, however, were two items of lesser note. The first was a rather complicated graphic seal or emblem at the top of the letter that had been programmed on the computer to include several lines of Bangla script. The second was a Basic program Dr. B. had enclosed in the letter with the instructions that, upon running it, the national flag of Bangladesh would appear on the monitor and, simultaneously, the computer would play the national anthem. Clearly the computer as a tool had been mastered.

Discussion

We are often asked about the wisdom of introducing computer technology in one of the world's poorest countries. Arguments against high technology in such settings range from absence of infrastructure to support the technology adequately to the diversion of desperately needed funds into costly showpieces with limited popular benefit. It is important to realize that in the health field high technology has been used in two different areas.

In clinical settings, high-technology techniques such as microchemical analysis, intensive physiological monitoring, life support, and computer-assisted imaging systems have become essential components of tertiary medical care. Less often considered is the important role that technology plays in health needs analysis, evaluation, planning, and research. It is in these latter areas—so important to the decisionmaking process—that high technology can greatly benefit the developing world. Because of its low cost, high reliability, and ability to run several powerful mainframe analysis systems such as BMDP, SPSS, and SAS, the microcomputer is emerging as an important public health tool in both developed and developing countries (*5–13*).

The major challenge to the introduction of microcomputers in developing countries is not with potential users. For example, in our workshop the participants had all collaborated during their careers in projects that used mainframe computers for data analysis, and they were actively engaged in project areas that they felt could greatly benefit from the availability of a powerful microcomputer. The primary challenge to the successful introduction of a microcomputer in a developing country is the lack of a local hardware and software support system. In developing countries, personnel and institutions are available that facilitate the installation, adjustment, and repair of the computer system's mechanical components. These groups also provide easy access to training and consultation. In the absence of such support, however, care must be taken to do the following:

1. Computer systems must be chosen carefully for their durability and for the long-term availability of parts and repair facilities. Each system must be assembled and extensively pretested prior to being moved on site. Attention must be paid to maintaining a nondestructive thermal and electrical environment (*4,11,12*). Complete "how-to" documentation must be provided on the system's configuration (that is, a detailed inventory of the system's components and the hardware and software connections between components).

2. Training workshops must develop independence in students. Standard troubles must be simulated on-site and troubleshooting procedures learned with hands-on training. Self-instruction manuals must supplement system and program applications manuals that may not be sufficient for self-instruction, although they are authoritative and comprehensive references. Tutorial programs for such basics as typing as well as for learning applications programs must also be provided.

3. Finally, a team of local experts must be developed quickly. Our project demonstrates that it is possible to do this with two workshops. In the first workshop a computer committee is established. A biostatistician, a researcher with ready access to data, and a promising user should be assigned to the committee along with one or two other members. Using the initial workshop as a model, the committee and a consultant then design a second course to be taught to potential users. The consultant acts as a facilitator and lecturer, with most teaching by the computer committee.

References

1. Dixon, W. J., and Britt, P.: The future of statistical analysis: small computers and the developing countries. Bull Int Stat Institute 51, Book 3: 22.3–1 to 22.3–5, 1985.

2. Schware, R., and Trembour, A.: Rethinking microcomputer technology transfer in Third World countries. Sci Public Policy 12: 15–20 (1985).

3. Munasinghe, M., Dow, M., and Fritz, J., editors: Microcomputers for development: issues and policy. Computer and Information Technology Council of Sri Lanka-National Academy of Sciences, Washington, DC, 1985.

4. Frerichs, R. R., and Miller, R.: Introduction of a microcomputer for health research in a developing country—the Bangladesh experience. Public Health Rep 100: 638–647, November-December 1985.

5. Beaver, M. W.: The use of microcomputers by community physicians. Public Health 98: 173–178, May 1984.

6. Finer, N. N., and Fraser, A. J.: Neonatal data base and automated discharge summary using a personal computer and proprietary software. Pediatrics 76: 269–273, August 1985.

7. Carpenter, T. E.: Epidemiologic modeling using a microcomputer spread sheet package. Am J Epidemiol 120: 943–951 (1984).

8. Kholy, A. E., and Mandil, S. H.: Micocomputers and health improvement in developing countries. WHO Chron 37: 163–165 (1983).

9. International Statistical Programs Center: Considerations for use of microcomputers in developing country statistical offices. U. S. Department of Commerce, Bureau of the Census, Washington, DC, 1983.

10. Bouckaert, A., et al.: Microcomputers for field studies in epidemiology: an experience in southern Italy. Methods Inf Med 22: 210–213 (1983).

11. Bertrand, W. E.: Microcomputer applications in health population surveys: experience and potential in developing countries. World Health Stat Q 38: 91–100 (1985).

12. Case, R. P.: Microcomputers in the field. Byte 9: 243–250 (1984).

13. Dean, A. G.: EPIAID. Byte 10: 225–233 (1985).

Equipment

A. Software Publishing Corporation, 1901 Landings Dr., Mountain View, CA 94043.

B. IBM Corporation, 445 S. Figueroa, Los Angeles, CA 90071.

C. BMDP Statistical Software, 1964 Westwood Blvd., Suite 202, Los Angeles, CA 90025.

D. Topaz, 9150 Topaz Way, San Diego, CA 92123.