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FEASIBILITY STUDY
AT THE DISTRICT LEVEL
OF A
MANAGEMENT INFORMATION SYSTEM
FOR
MALARIA CONTROL

A Report Prepared By PRITECH Consultant:
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1.0 SUMMARY DESCRIPTION OF THE SCOPE OF WORK

1.1 The contractor is to carry out a brief feasibility study of a USAID proposal to computerize the collection and analysis of malaria surveillance data at the district level. A feasibility study was undertaken in October, 1983 on existing data analyzed at the Central Office of the National Malaria Eradication Programme (NMEP) in New Delhi. The study recommends automating the analysis of these data to strengthen NMEP's use of the data for malaria control.

1.2 The contractor will examine the present and potential use of malaria surveillance data from their source at the primary health center (PHC) level to the district, state and national levels. Emphasis will be made on the collection and use of the data at the district level.

1.3 The contractor will prepare a systems proposal for a management information system for malaria control in India based on the national-level feasibility study of 1983 and the contractor's district-level study.

2.0 PURPOSE OF THE FEASIBILITY STUDY

2.1 USAID is in the process of designing the Biomedical Support Services Project due to be obligated in July, 1985. USAID has proposed to provide the Ministry of Health and Family Welfare with better epidemiological surveillance methodology as a component of this project. The malaria control program has been identified as the most appropriate Indian communicable disease control program on which to test the application of computer technology.

2.2 Malaria was chosen for the following reasons. Malaria is a serious health problem in India. The disease is retarding the economic and social development of the country by debilitating the work force, directly or indirectly causing infant deaths, and contributing to spontaneous abortions. The reported malaria incidence in India rose sharply from about 0.1 million cases in 1965 to more than 6.4 million cases in 1976. Since 1976, intensive malaria eradication measures, including the spraying of the insecticide malathion, have brought the incidence level down. In 1983, 1.9 million cases were reported. But malaria control has been setback in recent years by multiple vector resistance to insecticides, drug resistance of the parasite, and factors associated with India's changing ecology. Approximately 95% of the population of India is exposed to the risk of malaria. Malaria has been and remains a threat to the quality of life of the Indian community. The Indian malaria control program has more than 20 years of surveillance data available for studying new methodologies of control and management.

2.3 The purpose of this feasibility study is to assist the project paper designers by preparing a technical implementation plan by which to establish a management information system for malaria control.

3.0 METHODOLOGY

3.1 Orientation. A review is made of the 1983 feasibility study conducted at the national level at NMEP. Discussion are held with USAID Health and Nutrition staff. A visit is made to the national health offices concerned with malaria control.

3.2 District field trip. A district is chosen for examination of malaria control activities. The malaria control program staff are visited at PHCs, at the district malaria office, and at the state health offices concerned with malaria control and USAID health projects. Malaria surveillance data is examined at PHCs in tribal and nontribal areas, and at the district malaria office.

3.3 Problem definition. The nature of the problems to be addressed by the proposed change in system design are defined at the PHC and district levels. The existing system is examined by tracing the flow of data from their source to their analyses by health operations management and policymakers.

3.4 Alternative systems. Alternatives to the existing system are generated. These alternatives examine computer applications that have the potential to offer problem solutions. The feasibility of these alternatives are determined focusing on the anticipated impact of the alternatives on the malaria control program. The benefits and liabilities of the alternatives are weighed.

3.5 Systems proposal. A master plan is proposed based on the most feasible problem solutions identified by the district-level feasibility study and the 1983 national-level feasibility study. The organization of the plan follows the general AID Handbook 3 guidelines for project paper component design. The plan includes an illustrative budget for implementing the management information system for malaria control.

4.0 SUMMARY OF OBSERVATIONS AND FINDINGS

4.1 Orientation. Dr. Rogers Beasley, Chief, Health and Nutrition, USAID, Dr. P. Diesh, Malaria Advisor, USAID, and Dr. Larry Cowper, Regional Malaria Consultant, S&T, USAID/W discussed the objectives of USAID with respect to the feasibility study. The discussions emphasized AID's intent to collaborate with the GOI to demonstrate the application of computer technology to epidemiological surveillance methodology. It was suggested that once the technology is proven useful in the control of malaria that the methodology might be readily expanded to control other diseases.

4.2 Dr. Beasley, Dr. Diesh and the contractor discussed the feasibility study with Dr. Mohindar Singh, Director, Central Bureau of Health Intelligence (CBHI). CBHI has been given the mandate of developing and maintaining a national information database on all aspects of health information. The bureau is using mainframe computer technology to assist it in meeting its objectives. The group's discussion focused on AID's proposal to test the application of microcomputer technology on a vertically oriented communicable disease control program. The proposal was described as an opportunity for USAID to collaborate with CBHI in the testing of computerized epidemiological surveillance technology designed to support the efforts of CBHI. CBHI provided USAID with a description of the types of information on malaria processed by the bureau.

4.3 Dr. Diesh, Dr. Cowper and the contractor discussed the feasibility study with Dr. G.K. Sharma, Director, NMEP. The discussion emphasized that the scope of the management information system for malaria control proposed by USAID had expanded from the national scope, as analyzed in 1983 at NMEP headquarters, to the broader scope including computerization of surveillance data at the district level. Dr. Sharma expressed his interest in pheripheral district-level information, but urged the USAID representatives to begin the implementation of the national level computerization plan. He felt that the lessons learned in implementing the national-level management information system would be an essential preliminary phase to the development of a district-level system. Dr. Cowper and Dr. Diesh concurred with this view.

4.4 District field trip. Gujarat has a higher average incidence of malaria than other Indian states. Panchmahals district is a less-developed area where USAID has been invited by the GOI to collaborate in developing improved health services. This district was identified as the site for the feasibility study. Dr. Diesh and the contractor visited the district for four days.

4.5 Dr. Kachchia, State Project Officer for USAID projects, escorted the AID representatives to the District Malaria Office at Godhra. Discussions were held with Mr. Shiekh, District Malaria Officer and Dr. J.C. Patel, Assistant District Project Officer for USAID projects. The objectives of the feasibility study were received by the government officials with enthusiasm. The group examined malaria surveillance data at the District Malaria Office and at five PHCs. Piplod and Goghamba were PHCs visited in tribal areas. Malav, Jumbogoda and Shrivrajpur were PHCs visited in nontribal areas. The group met with the Medical Officers of each PHC. Laboratory technicians, malaria spraying supervisors, and recordkeepers assisted the medical officers in explaining the surveillance data maintained by each PHC. The group was shown data collection forms, registers, and diaries containing raw data. Compiled and analyzed data was shown in tables, charts, graphs and maps. After visiting the PHCs, Dr. Diesh, Dr. Kachchia and the contractor discussed the feasibility study with Dr. O.P. Gupta, Director, Health Services and Medical Education, Ms. Gawdi kumar, Dy. Secretary, Health and Family Welfare and Mr.Pujara, State Entomologist. These officials unanimously showed interest in the USAID proposal and pledged state-level support to the effort.

5.0 BRIEF DESCRIPTION OF THE MALARIA CONTROL SYSTEM

5.1 For more than two decades, India has conducted epidemiological surveillance to assess the malaria situation in the country and to control the disease. Malaria surveillance data consists of three major types of data: case detection, chemotherapeutic treatment and insecticide spraying.

5.2 Case detection data are derived from blood smear examinations of fever patients. Positive blood smears are classified by type of malaria infection: P. vivax, P. falciparum and others. Then four indexes are calculated to be used as parameters to assess the malaria situation. The annual blood examination rate (ABER) is the proportion of blood smears examined to the population. ABER is an index of the intensity of epidemiological investigations. In India, it is assumed that when ABER is below 10% that the population sample size on which the other indexes are calculated is too small to provide an accurate epidemiological picture. The parasitic annual incidence (API) index is the ratio of positive malaria cases detected to the population (expressed per 1000 population). API is directly proportional to the incidence of malaria in a community. API levels are used to classify the malaria situation in India in controlled, average, serious and crisis regions. As a general norm, spraying activities are intensified in areas where the API is 2 or more. The national API for India for 1979-1980 was 4.6 The target set by NMEP for 1980-1985 was to bring the national API to 2.7. The slide positivity rate (SPR) is the proportion of positive cases detected to the number of blood slides examined. SPR is used to crosscheck the validity of API. The slide falciparum rate (SFR) is the proportion of P. falciparum cases detected to the number of blood slides examined. P. falciparum is the most serious type of malaria infection in India and requires expedient action for control. SFR is used to indicate regions of high P. falciparum incidence.

5.3 Chemotherapeutic treatment is administered in the form of presumptive treatment when blood smears are collected from fever patients and in the form of radical treatment when malaria has been detected. Data are collected on the administration of radical treatment. A mild 5 to 14 day course of primaquine is administered against P. vivax to destroy the asexual hypnozoites in the patient's blood. Since relapses of vivax malaria usually occur several months after the first infection, radical treatment is effective even if not administered within the first few days of the outbreak of fever. A strong single dose of primaquine is administered against the gametocytes of P. falciparum. The gametocytes have a short half-life of only about 2 1/2 days which means they die out naturally in about 2 weeks in a patient that can survive without treatment. But a delay in radical treatment threatens healthy individuals of the community who are at risk of being infected by transmission through anopheles mosquitoes. Delayed radical treatment against P. falciparum has no beneficial effect on control of the disease.

5.4 Spraying insecticides against anopheles mosquitoes has been one of the most successful methods of controlling malaria in India. DDT or malathion are sprayed in two or three rounds in areas of high malaria incidence. Spray squads are supervised at the district level to spray regions where the API is above 2. Spraying periods are critically linked to the seasonal life cycles of the mosquitoes.

5.5 Data flow. The malaria surveillance data flows from its source in all villages and town in the country to about 6200 PHCs. At the PHC level, the data are reduced from individual and village information to section, sector, and PHC level data. These data are summarized at the PHC level and sent monthly to the district. A copy of the data is sent directly to NMEP's Central Office to expedite national information collection. In the PHC to district level reduction, the 6200 PHC reports are reduced to 412 district reports. At the district level the four malaria control indexes are calculated for each PHC and the district data is sent to the state. State level indexes are calculated and forwarded to NMEP. NMEP calculates indexes from its PHC, district and state level data to assess the national malaria situation. CBHI collects district-level malaria surveillance data in a parallel effort to assess the overall national health situation.

5.6 The surveillance data and the indexes derived from the data are used for three levels of decision-making. At the national strategic planning level, the information is used by policymakers to lay down national objectives for malaria control. At the management control level, it is used by the directorate of NMEP to determine broad guidelines for the allocation of resources for malaria control. It is also used by scientists at NMEP to assess the most appropriate methodology for malaria control. At the operational level, the information is used by states and districts to manage their resources for malaria control. At the district level detailed planning is carried out for day-to-day supervision of the examination of blood smears, the administration of antimalarial drugs, and the scheduling of insecticide spraying.

6.0 BRIEF REVIEW OF THE 1983 FEASIBILITY REPORT

6.1 In 1983, the Consortium Data Division of T.I. & M. Sales, Ltd., New Delhi, submitted a feasibility report on a management information system for NMEP. (See USAID/HN files: Vijay Bhargava, Report For Information Management System of National Malaria Eradication Programme, T.I. & M., New Delhi, October 1983.) The report made four major recommendations.

6.2 Investigation. Two demonstrations of the use of microcomputer technology to analyze NMEP data were made to get reactions to the concept of automated analysis from the administrators of NMEP. The reactions were favorable.

6.3 System analysis. The source, compilation, reduction, analysis, storage and retrieval of NMEP data were analyzed. It was determined that the backlog of annual reports was substantial and that management information requirements are not being met as efficiently by the manual system as could be expected from an automated system.

6.4 System design. It was determined that microcomputer technology could adequately handle the volume of data required to be processed within the time limits required to provide adequate information for malaria control. The report recommended giving priority to the computerization of epidemiological and material management systems, then expanding the information system to include an early warning system based on climate and geographic location. The report determined that 256 bytes (alpha-numeric digits) of electronic memory space could adequately store the raw epidemiological surveillance data collected for each PHC.

6.5 Management analysis. The report recommended viewing the management information system as a new management approach for three levels of management: selectivity, early warning, and simulation planning. The selectivity approach automatically and efficiently divides the country in crisis, serious, normal and controlled regions. The early warning approach uses geographic and climatic information to predict areas likely to be affected by malaria. The simulation planning approach provides policymakers with a simulated environment within which to test the consequences of 'what-if' conditions.

6.6 Limitations of the feasibility report. The feasibility report was well prepared and the recommendations of the report should lead to an improved management information system for malaria control. But there are areas of the report that would need further development to avoid limitations of the effective implementation of the system. The logical and physical descriptions of the system need to be described more fully and updated to take advantage of the advances in computer technology since the report was written. The feasibility of extending automation beyond NMEP Central Office was not discussed.

6.7 Logical Design. The report recommends using standard software packages to build the information system. The software packages were not identified. The advantages of specific standard packages were not discussed.

6.8 Physical Design. The hardware configuration recommended by the report is no longer the best choice of hardware. The international and Indian computer market now offer more sophisticated technology at lower costs than in 1983. The report recommended an 8-bit microprocessor attached to a 70-megabyte hard disk drive with two input terminals. Current computer configuration options can out-perform the recommended hardware at a lower cost.

6.9 Expansion of the automated system beyond NMEP Central Office. The objective of the report did not include the determination of the feasibility of extending the automation of the management information system for malaria control out toward the periphery of the surveillance system. Since 1983, the development of powerful, inexpensive microcomputers has made it technically feasible for the MOHFW and USAID to study a proposal to extend computerization of malaria surveillance data below the national level, and, specifically, to the district level.

7.0 PROBLEM DEFINITION AT THE DISTRICT LEVEL

7.1 Problems of Information

Problem 1: Unorganized Information. Operational decisions for malaria control are made at the district level. For example, day-to-day decisions are made as to which villages will receive insecticide spraying next or in which villages to increase active blood smear collection. Most of these operational decisions require village-level surveillance information. Village-level information is available at the PHC level but the current manual information system does not provide this level of detail to the district level.

Problem 2: Limited Access to Information. The lack of information for management is the root cause of inefficiencies in resource utilization. The district surveillance information is reported and stored in a large volume of paper files. The manual extraction and summarization of these files is a time-consuming process which becomes more and more difficult as the volume of information stored increases. The volume of surveillance data is so vast that under the manual working system it is difficult to evaluate long-term trends in the data except in the most general terms. Thus, management decisions are currently based on broad averages and norms that often are not sufficiently specific to be effective. The preparation of decision tables, graphs, and charts is not standardized among the PHCs nor at the District Malaria Office. The quality of the visual presentations varies widely from bold, attractive bar charts to untidy, confusing tables.

Problem 3: Relevancy of Data Collected. A series of 12 malaria forms (MF1-MF12, See annexure of T.I. & M. report for details of forms) are used to collect and compile surveillance data for NMEP. Forms MF4, MF5 and MF6 provide district-level summaries of case detection, radical treatment and insecticide spraying, respectively. In general, the forms tend to be excessively comprehensive. For example, the data on mass and contact blood slides on MF4 and mass therapeutic treatment on MF5 are not routinely required. The complete integration of malaria eradication and control activities has led to the collection and processing of some kinds of data which may be too detailed and unfocused to benefit the management of malaria control. The potential of the district malaria staff for effective operations management is reduced when their they become burdened with the processing of excessively detailed, nonessential surveillance data. On the other hand, data relevant to malaria control, such as, climatic conditions, are not included in the series of malaria forms.

7.2 Problems of Responsiveness

Problem 1: Restricted Data Flow. Several bottlenecks restrict the flow of surveillance data from their source to their compilation as indexes for assessment and control. A backlog of blood smear slides collected by not yet examined slows down the flow of data form PHCs to the district. Computerization of surveillance data will not reduce this bottleneck. PHC surveillance reports reach the district within the first 10 days of the new month. At the district, there is a time lag while the data are manually compiled into API, ABER, SPR, and SFR indexes. Only annual indexes are calculated as it would be too great of a compilation burden to calculate floating annual indexes or monthly indexes. Feedback from the state and central level is often too slow and too general for use in operational decisions at the district level.

Problem 2: Rigid Database. District surveillance information is locked into a format limited to the scope of what is practical to collect and compile manually. For example, the information system provides control indexes for PHCs. But the information is not organized in a format that can provide quick responses to specific inquires about ranges of these indexes over specified geographic locations.

7.3 Problems of Accuracy

Problem 1: Inaccuracies in the 'Epidemiological Picture'. In the district studied, the epidemiological data suggested a serious outbreak of malaria in an area where the actual malaria situation was under control. It was determined that erroneous data was the cause of the discrepancy. Data verification is difficult under the present system. Error confidence levels are not statistically determined for the indexes derived from the data. Acceptable levels of inaccuracy have not been established. Under the present information system, it is difficult to determine the validity of the malaria control indexes derived from the raw data.

Problem 2: Weak Trend Analysis. Manual processing restrictions limit trend analysis to general annual comparisons of reduced data. In-depth statistical analyses are difficult to conduct manually. Conclusions drawn from the current trend analyses tend to not be able to accurately account for the dynamism and geo-specificity of the malaria control problem.

8.0 ALTERNATIVES

8.1 This feasibility study of alternatives discusses how the proposed application of computer technology can be used to support malaria control at the district level. First the feasibility of several computerization alternatives is studied. Then the technical feasibility and the administrative feasibility of computerizing the malaria control system is discussed.

8.2 **Feasibility Issue: Manual vs. Automated Malaria Surveillance at the District Level.** The major responsibility of district malaria staff is to monitor day-to-day malaria control activities. The current manual monitoring system does not adequately provide sufficient malaria surveillance information to effectively decide how to use scarce malaria control resources. Computer technology can be used to automate the analysis of malaria surveillance and management data.

Benefits. The major potential benefit of automating malaria surveillance data at the district level is that automation may make it possible to organize the data into a more concise and effective management reporting system. Automation can expand the capability of the malaria staff to more effectively monitor the complex dynamic nature of malaria control at the operational level. Automation can increase the accessibility of the data and clean up data storage problems. It can improve the data flow from the district to the state and national levels, as well as, back to the PHCs. Computerized graphs and charts can be generated in standardized formats. Computerized statistical analysis can be applied to the establishment of acceptable error margins and to carry out trend analyses.

Liabilities. The automation of surveillance data can lead to a serious problem if malaria staff monitor more data than required for sound malaria control The automation should be limited to essential malaria control management data to avoid confusion in the interpretation of computer generated reports. The implementation costs for computer hardware, software and staff training may not provide better malaria control at the district level if the automated system proves to be less reliable and more complex to maintain than the manual system.

Most Feasible Alternative. The application of computer technology has not been tested in India for the type of information system proposed. The most feasible alternative to the manual malaria information control system is to test the application of computer technology by automating

the NMEP Central Office data and the data of one pilot test state. In the pilot test state, automation should be extended down from the state level to the district level to test the feasibility of providing computers eventually to all 412 districts of India. It is not feasible to test computer applications below the district level at the PHC level on grounds that it would be technically and administratively too difficult to provide India's 6200 PHCs with computers.

8.3 **Feasibility Issue: A Centralized vs. a Decentralized Computer System.** A centralized computer system has a central processing unit (CPU) which controls the input and output of data through several peripheral devices, such as, terminals, printers, and electronic storage devices. Information storage is centralized and can be easily shared between all the peripherals of the system through the CPU. A decentralized computer system has several small CPUs each dedicated to its own set of peripherals and own specialized tasks. Information is isolated in each microsystem and is shared between the subsystems by swapping electronic storage media (floppy diskettes, for example) or by establishing an electronic communication network between the subsystems.

The development of computer technology is advancing rapidly toward miniaturization. Today's smaller computers do more but cost less than their larger predecessors. It has, therefore, become feasible to apply microcomputer technology to information systems which would have required expensive mainframe computers if designed only 10 years ago.

Benefits. A decentralized microcomputer system can quickly be adapted to the type of information system needed to control malaria. Current decentralized systems based on microcomputers are less expensive than centralized systems, and yet the decentralized systems have the processing capability to generate the appropriate outputs for the kind of system proposed. A decentralized information system can be implemented over a wide geographic area using several microcomputers. A decentralized system is suitable for malaria control since the information system does not require that data collected in one region be instantaneously available throughout all parts of the system. Microcomputers can be operated by people who are not computer specialists. Only a few weeks of training are required to learn how to operate microcomputer information systems. Microcomputers are more adaptable to extreme environmental conditions that mainframe computers. Microcomputers are easier to maintain that larger systems. When one microcomputer fails, the rest of the information system can continue to function. A malfunctioning unit can usually be replaced by a reserve unit at a lower cost that the combined cost of downtime and circuit board replacement on larger centralized computers. Computer technology development is advancing so rapidly that today's computer becomes obsolete in less than 3 years. A decentralized microcomputer-based information system permits more flexibility in upgrading the system at lower costs than would be possible with a centralized system.

Liabilities. Even though it is not difficult to learn how to operate a microcomputer system, a decentralized microcomputer-based information system requires more people to operate the system than a centralized system. Because microcomputer-based systems are operated by nonspecialists in computers, the implementation of the system is usually the first exposure of the users to computer technology. Adequate training in the basic use of microcomputers must be provided during implementation for the information system to develop successfully.

Most feasible alternative. A decentralised microcomputer-based information system is technically and administratively the most feasible alternative for malaria control. Malaria control is a dynamic process which requires constant monitoring and operational management at the national, state and district levels. A decentralized system is administratively feasible because the staff who would operate and use the proposed system are already in place and working thoughout the nation. The national malaria control program has had high priority in the pattern of investment and expenditures on health for many years. The progress India has made in recent years in controlling malaria is evidence of the strength and vitality of the administrative system supporting the manual malaria control information system. Through NMEP, malaria staff are placed in administrative and operational roles at the national, state, and district levels. It would be administratively feasible for these staff to assume responsibility for the control and operation of the proposed decentralised system. No new staff would be needed to run the automated system. It is feasible to assume that a decentralized system would be readily integrated into the current administrative structure, especially since the automated information system would be tailored to support the current staff in the execution of essential, yet, monotonous and redundant activities.

8.4 **Feasibility Issue: 8-bit vs. 16-bit vs. 32-bit Microcomputers.** Microcomputer technology has advanced through three generations of complexity. The integrated chip that triggered the birth of the microcomputer industry operated with 8-digit binary codes (8-bit codes). The industry standardized on an operating system for 8-bit microcomputers called CP/M, by Digital Research. Thousands of software packages were written for 8-bit, CP/M microcomputers and the technology revolutionized the microcomputer industry by popularizing computers in business, industry and education.

The next generation of microcomputers operated with 16-bit codes at about twice the processing capacity of the previous generation. Microsoft developed an operating system for 16-bit microcomputers which has become the industry standard, MS-DOS. The 16-bit system is now the most popular microcomputer for small and medium business applications. The industry has even standardized on a particular 16-bit microcomputer brand within the last two years, the IBM PC. Software packages written for 16-bit, MS-DOS microcomputers are similar to CP/M packages but offer more sophisticated processing options and operate more efficiently.

The most recent generation of microcomputers operates with 32-bit codes. These new entries, like the Apple MacIntosh, for example, apply the massive processing capability of the 32-bit integrated chip to sophisticated graphic interfaces between the computer and the user. A standard operating system has not emerged yet for 32-bit microcomputers. There is a limited collection of software available for these microcomputers although the library is expected to rapidly expand within a year.

Benefits. All three generations of microcomputers provide software packages with the processing capacity to meet the requirements of the proposed malaria control information system. The major differences among the generations are that the more advanced technology operates more rapidly and with more technical sophistication.

Liabilities. The operating systems for the 8-bit and 16-bit computers, CP/M and MS-DOS, are standardized. Electronically stored data can easily be made accessible to both operating systems through conversion programs. But 32-bit technology is less compatible with 8-bit and 16-bit computers. Sixteen-bit computers cost more than twice as much as 8-bit computers, and 32-bit computers about 50% more than 16-bit systems.

Most feasible alternative. The most appropriate microcomputer for NMEP Central Office is a 16-bit, MS-DOS system. About 2 megabytes (MB) of storage space is required annually by NMEP Central Office for raw data storage of 6200 PHC monthly reports each containing up to 256 bytes of information. A 16-bit microcomputer system with a 10 MB hard disk drive and at least one floppy disk drive can adequately process this volume of data with sufficient remaining space for system software and reduced, historical data for trend analysis. Annual raw data can be archived on about seven floppy diskettes (assuming a diskette storage capacity of at least 300k).

The most appropriate generation of microcomputer systems for the pilot test state is the 8-bit, CP/M system. There are about 18,275 villages in 27 districts in Gujarat. If 256 bytes of information are stored monthly for each village, about 200k of storage space is required for raw data storage of village-level data at each district. An 8-bit microcomputer system with two floppy disk drives can adequately process this volume of data with sufficient remaining space for system software and reduced, historical data for trend analysis. Annual raw data can be archived on about eight floppy diskettes.

About 800k of storage space is required annually for raw data storage of PHC-level data at the state malaria office. (257 PHCs x 256 bytes of information x 12 one-month periods) An 8-bit microcomputer system with two floppy disk drives can adequately process this volume of data. Annual raw data can be archived on about 3 floppy diskettes.

9.5 Feasibility Issue: Customized vs. Standard Software Packages. Customized software is software programming using computer languages, such as, COBOL, PASCAL, FORTRAN or BASIC, to design computer applications for specific tasks. Standard software packages are software tools designed for general computer tasks, for example, word processing or spreadsheet analysis.

Benefits. Customized software can be designed to make the most efficient use of the hardware under its control. Standard software packages can be quickly adapted to a user's requirements. And once adaptations are made, the packages can easily be modified to meet changes in the user's requirements. The resources required to develop an information system using a group of standard software packages are much less than those required to develop a similar customized system.

Liabilities. Customized software requires intensive computer programming resources for design, implementation and modification of the software. Standard package software does not usually use the computer resources it controls as efficiently as a customized package would. Compromises in efficiency are built into the design of standard software packages to afford a greater range of transportability of the packages from one type of hardware to another.

Most feasible alternative. The requirements of the proposed information system for malaria control can be adequately met by standard software packages. These packages will provide design flexibility critical to the successful evolution of the information system. Five types of packages are appropriate for the system: a database management package, a word processor, a graphics packages, a spreadsheet analysis package and a statistical analysis package.

The most feasible database management packages for the proposed system are dBASE II, for the 8-bit systems, and dBASE III, for the 16-bit systems. These popular programs, designed by Ashton-Tate, provide users with English-like commands to control a relational information database. These packages will form the core of the proposed information system for malaria control. Using dBASE, data can be easily entered, sorted, indexed and reported through user-defined prompts to assist novices with commands. dBASE II and dBASE III can share information making it feasible to support the proposed system on a combination of 8-bit and 16-bit microcomputers.

The most feasible word processing packages for the proposed system are Wordstar, for the 8-bit system, and Wordstar 2000, for the 16-bit system. MicroPro's Wordstar has been the most widely used microcomputer-based word processor. The package offers a sophisticated, screen oriented program with menu-aided instructions.

The most feasible spreadsheet package for the 16-bit system is 1-2-3 by Lotus. This package integrates three popular standard packages into one easy-to-use package: spreadsheet analysis, graphics, and database management. The spreadsheet analysis and the graphics capabilities of the package are adequate for the proposed system. The database management capability is not adequate. The package requires the MS-DOS operating system, and is not available in a version for 8-bit microcomputers.

The most feasible spreadsheet and graphics packages for the 8-bit systems are Supercalc 2 by Sorcim and Plotrax/Transplot. These two packages offer most of the same type of options as Lotus 1-2-3 and will run on the CP/M, 8-bit systems.

The most feasible statistical package for the 16-bit system is the microcomputer version of SPSS, called SPSS/PC by SPSS Inc. of Chicago. The program performs statistical analyses and formats reports. Functions include ANOVA, cross-tabulations, correlations and partials, multiple regression with up to ten lag variables, nonparametric tests, t-test, hierarchical log and linear analyses, and frequency tables. The statistical package called Microstat is the best choice for the 8-bit systems. The program is a menu-driven package offering similar but has somewhat less sophisticated functions than the functions of SPSS/PC.

8.6 **Feasibility Issue: Comprehensive vs. Prototype System Design Methodology.** Comprehensive system design methodology initiates system design by determining all the parameters required to achieve the objectives of the information system. The system is then computerized in a single software design phase followed by a single implementation phase. A prototype system design approach initiates system design by determining the parameters to meet the main objectives of the information system. A prototype system is computerized to evaluate the viability of the parameters used. Then the system is expanded and re-evaluated in several system revisions until all of the objectives of the system are met.

Benefits. To design a simple information system, the comprehensive design methodology is a fast and efficient approach. The prototype design approach permits the development of a complex information system to benefit from the lessons learned as the system is implemented and evaluated.

Liabilities. The comprehensive design approach is not flexible enough to successfully accomplish the design of a complex information system. The prototype approach requires more development resources that the comprehensive approach. Each phase of the prototype approach is a gradual processing step that requires development resources about equivalent to the resources required for one comprehensive system design.

Most feasible alternative. The proposed system design is a complex design task. The prototype design approach can provide for the appropriate evolution of the information system from a core of essential epidemiological surveillance information to a more comprehensive resources management information system.

9.0 MAIN CONCLUSIONS: SYSTEM PROPOSAL

9.1 This is a master plan for a microcomputer-based management information system for malaria control designed for NMEP Central Office and one pilot test state. The plan implements microcomputer systems at the national, state and district levels. The master plan is designed as a component of the Biomedical Research Support Project of USAID/India. The plan indicates the objectives of the project component, the inputs, a cost estimate and an implementation plan.

9.2 The objective of the project component is to provide a computerized management information system for malaria control. The component will have two outputs: one automated information subsystem established at the national level and another subsystem established in a pilot test state with microcomputers in each district of the state. The two outputs will be linked together to form an automated vertical epidemiological surveillance information system. The purpose of the project component is to test the application so computer technology to epidemiological surveillance and resources management for disease control. The goal of this project component is to reduce the threat caused by communicable diseases to the quality of life of the Indian community.

9.3 <u>Inputs</u>. The project will provide three inputs: the physical system, the logical system and the resources for system implementation.

<u>Input 1: The physical system</u>. Two microcomputers will be installed at NMEP Central Office. The computers will have the following specifications: a 16-bit central processing unit, 512k random access memory (RAM), a double-sided, double density floppy disk drive, a 10 MB hard disk drive, a monochrome monitor, a keyboard, a dot-matrix printer (132 column), a four-pen plotter, and an A/C voltage stabilizer.

Computer supplies will be provided on installation of the hardware and replenished annually for the life of the project. These supplies will include: 100 double-sided, double density floppy diskettes, 50,000 sheets of fan-folded, perforated stationery, printer ribbons, and plotter pen replacement kits.

Furnishing and equipment will be provided at NMEP to support the two microcomputer systems, including: an air conditioner (1.5 ton), two microcomputer desks, two computer desk chairs, disk storage cabinets, and dust-resistant flooring.

In the pilot test state of Gujarat, two microcomputers will be provided at the state level and one in each of the 27 district malaria offices. Two standy computers will be provided to replace malfunctioning computers under repair. These 31 computers will have the following hardware specifications: an 8-bit central processing unit, 64k random access memory (RAM), two double-sided, double density floppy disk drives, a monochrome monitor, a keyboard, a dot-matrix printer (132 column), and an A/C voltage stabilizer. The following computer supplies will be provided for each system on installation of the hardware and replenished for the life of the project: 20 double-sided, double density floppy diskettes, 10,000 sheets of fan-folded, perforated stationery, and 3 dot-matrix printer ribbons.

Input 2: The logical system. Six software packages will be provided for the 16-bit microcomputers at NMEP Central Office. The software packages will be: the MS-DOS operating system , dBASE III for database management, Wordstar 2000 for word processing, Lotus 1-2-3 for spreadsheets and graphics, SPSS/PC for statistical analysis, and a CP/M to MS-DOS file converting utility.

Six similar software packages will be provided for the 8-bit microcomputers of the pilot test state, The packages will be: the CP/M operating system, dBASE II for database management, Wordstar for word processing, Supercalc 2 for spreadsheets, Plotrax/Transplot (or similar) for graphics, and Microstat for simple statistical analysis. The statistical package will only be made available at the state level to be shared with the district level.

Input 3: System Implementation. The project component will provide two resources for system implementation: information system design and training in the use of the information system.

Information system design. The design of the management information system for malaria control will evolve in an iterative process of design, implementation, evaluation, and revision. The design will be based on innovative research to determine the most appropriate ways to apply computer technology to malaria control. The initial design will be based on the recommendations of the 1983 T.I. & M. feasibility study at NMEP. Lessons learned from the initial implementation of the NMEP subsystem will be used to design the a prototype subsystem at the district-level. As the subsystems mature, design modifications will be implemented that link the subsystems together. Thirty-six person-months of technical support will be provided by Indian microcomputer systems design specialists to implement the project component. The project component will provide for a series of four versions of the information system to strengthen the design process by experimenting with various approaches to applying computer technology to malaria control.

Training in Operations and Use of the Information System. Three kinds of audiences will be provided training about the information system. Health policymakers and the NMEP operations control directorate will be trained in the use of the information system as a health strategy planning tool and biomedical research tool. Thirty professionals will participate in ten one-day seminars about the system. The malaria staff operating the system at the national, state, and district levels, will be given training in the entry of data and the generation of output reports. Six NMEP staff, 4 state malaria staff and about 100 district malaria staff will be provided 20 days of training. The third audience to be provided training will be a wide audience of health professionals involved in research and health administration who might benefit from similar types of information systems. About 50 professionals and administrators will be invited to participate in each of three half-day demonstrations. Seventy-two person-months of technical support will be provided by Indian microcomputer training specialists. The project component will provide for the development of system documentation, audio-visuals and other training materials to enhance the training program.

9.4 Cost Estimate and Financial Plan

The total project component cost is $230,000 over three years. The cost of the physical system, including 2 16-bit microcomputers, 31 8-bit microcomputers and related equipment and initial supplies, is about $100,000. The cost of the standard software packages for the microcomputers is about $28,000. The cost of Indian technical assistance for the implementation of the information system is about $70,000 for three years. The total nonreccurent cost for the project component is about $188,000. About $7,300 is provided each year for four years after the first year of the project to replenish the information system's computer supplies. A cost estimate worksheet is attached as Annex A and summarized below:

	Total
Nonrecurrent Costs	
Physical System	$ 99,550
Logical System	28,270
System Implementation	69,800
Subtotal of Nonrecurrent Costs	187,620
Annual Recurrent Costs	
Annual Replenishment of Computer Supplies	7,280
Subtotal of 4 Years' Recurrent Costs	29,120
Subtotal of All Project Component Costs	226,740
Contingency	3,260
GRAND TOTAL OF PROJECT COMPONENT	230,000

All the nonrecurrent costs of the project component will be met in the first year of the project. All the computer hardware, software, and equipment will be procured and a three-year contract for the technical services of an Indian information system design firm will be signed.

9.5 IMPLEMENTATION PLAN

A prototype design approach will be used to implement the project component in four phases. The first phase of the information system will be limited to essential malaria surveillance information at NMEP Central Office. Then, in four phases, the information system will be expanded to a comprehensive management information system for malaria control at the national level and in one pilot state. The purpose of this design approach is to provide for the opportunity to test and evaluate the application of computer technology to the malaria control problem as the information system evolves. The design and implementation of the information system will be closely integrated with training activities. As the system is developed, microcomputer training will be provided for the malaria staff who will have the responsibility of controlling and operating the system.

An Indian information systems design firm will provide leadership and technical expertise for the design and implementation of the information system. The firm will provide technical support in the adaptation of standard software packages to meet the requirements of the information system. Training specialists will conduct seminars for administrative malaria staff and intensive microcomputer training courses for operational and technical malaria staff. The training specialists and technical writers will prepare system documentation and training materials, including audio-visuals, to enhance these training activities.

All computer hardware, software and related equipment will be procured within the first six months of the project component implementation. The equipment should be handed over to the Indian contractors for testing and installation at the sites of the end-users, as and when needed in the development of the information system. Local representatives for the computer hardware will assist the project component contractors in the installation of the systems as a part of the overall purchase order for the equipment.

Phase 1.0

The objective of the first prototype is to create a database at NMEP Central Office which will serve as a foundation from which the information system can be expanded into a more comprehensive and useful tool for malaria control. Phase 1.0 will be implemented on the 16-bit microcomputer systems at NMEP Central Office. This phase will be limited to essential malaria surveillance data. The specific inputs will be the raw 1984 data reported to NMEP on malaria forms MF4, MF5, and MF6. These forms contain data on case detections, radical treatment, and insecticide spraying. The outputs of Phase 1.0 will be the four malaria control indexes (ABER, API, SPR, SFR) for PHCs, district, state and national levels.

A one-day orientation seminar will be conducted at NMEP to introduce the the potential applications of microcomputers to malaria control to the NMEP directorate and other health policymakers. In a workshop at NMEP, the functions of the microcomputers installed in the office will be demonstrated to staff. As soon as Phase 1.0 is released, twenty days of intensive microcomputer training will begin for the six NMEP staff who will be responsible for operating the information system. During the training sessions, the staff will begin to load 1984 surveillance data.

By the end of the first nine months, NMEP and USAID will evaluate Phase 1.0.

Phase 2.0

The objective of Phase 2.0 is to expand the information system from a data base of essential surveillance data to include resources management information. Issues to be addressed in the design of Phase 2.0 are: the definition of the essential parameters for malaria control, the design of improved malaria data collection and reporting formats, the design of appropriate automated graphs, and the application of automated statistical analysis to malaria control. The parameters for Phase 2.0 will be defined after the evaluation of Phase 1.0 and the scope of the parameters will be limited to the functions of NMEP Central Office.

On the release of Phase 2.0, a one-day seminar will be held at NMEP to demonstrate the system to the directorate. Then, about 50 health professional involved in health administration and research will be invited to a half-day demonstration of the information system to introduce the application of microcomputer technology to malaria control. Training will continue for the technical staff to introduce Phase 2.0.

By the end of eighteen months, NMEP and USAID will evaluate Phase 2.0 and the performance of the Indian firm implementing the information system.

Phase 3.0

The objective of Phase 3.0 is to link the NMEP information system to one district of the pilot state. This phase will provide management information for district-level operations control and will enhance the flow of data from the district to the national level. Phase 3.0 will be implemented on the 8-bit microcomputer system installed at the District Malaria Office in Godhra, Panchmahals, Gujarat. Village-level information will be processed in Phase 3.0 to provide appropriate information for operational decision-making at the district level.

During the development of Phase 3.0, a one-day seminar will be held at the pilot state level for the administrative and technical malaria staff to introduce the functions of the computers to be installed in the state and to demonstrate the capabilities of Phase 2.0. As soon as Phase 3.0 is released, a workshop will be held at the District Malaria Office to introduce the staff to the decision-support capabilities of the information system. Twenty days of intensive microcomputer training will begin for the district staff who will be given the responsibility of operating the computers.

By the end of two years, NMEP, the state and the district malaria directorate and USAID will evaluate Phase 3.0. Recommendations will be made regarding whether it is appropriate to expand Phase 3.0 for to all districts of the pilot state.

Phase 4.0

The objective of Phase 4.0 is to expand the information system to each district of the pilot state and to establish a node of the system at the state level. Phase 4.0 will also provide two innovative approaches to malaria control. This phase will include a simulation model of the malaria problem based on the lessons learned in the development of the first three phases. The model will be designed for use in strategic planning by testing the consequences of 'what-if' conditions on the malaria control problem. Phase 4.0 will also test the feasibility of an early warning system model for malaria control based on relationships between the climatic conditions and the trend of incidence of malaria in a given region.

During the development of Phase 4.0, intensive microcomputer training will be given to the three malaria staff of each district office who will have the responsibility of operating the information system. About 85 people will be trained including four staff from the state office. As soon as Phase 4.0 is released, a one-day seminar will be held at the national and the state levels to demonstrate the capabilities of the new phase. A half-day demonstration will be held for about 50 health administrators and scientists who may be able to apply similar technology to other specific public health problems.

By the end of three years the project component will be completed and an in-depth evaluation of the management information system will be conducted.

10.0 RECOMMENDATIONS

10.1 Action Recommended: It is recommended that USAID initiate a preproject activity to this project component to avoid delays in the implamenation plan that may be caused by delays in finalizing the project agreement, obligating project funds and procuring computer equipment.

The statement of work for the suggested preproject activity follows:

Statement of Work

Objective. The overall objective of this contract is to assist the GOI and USAID/India in establishing the first phase of a management information system for malaria control. A comprehesive information system is designed to be implemented in four phases with funds provided by the Biomedical Support Services Project (due to be obligated in July 85). The first phase of the information system will be limited to essential malaria surveillance information at the National Malaria Eradication Programme Central Office. Then, in three progressively more sophisticated versions, the information system will be expanded to a comprehensive management information system for malaria control at the national level and in one pilot state.

The specific objective of this contract is to implement the first phase of the information system. The first phase is to create a database at NMEP Central Office which will serve as a foundation from which the information system can be expanded into a more comprehensive and useful tool for malaria control.

To establish the database, the contractor shall:

1. provide two 16-bit, MS-DOS microcomputer systems for the development of the database and training of NMEP staff in the use of the database. The systems shall have the following minimum configuration: 512K random access memory, 10 MB hard disk drive, floppy disk drive, dot-matrix printer (with graphics capability, and the Ashton-Tate dBASE III data base management system standard software package . The computers shall be provided for the nine-month period of the contract and will remain the property of the contractor.

2. adapt the dBASE III standard software package to the entry of raw PHC-level epidemiological surveillance data reported to NMEP in 1984 on malaria forms MF4, MF5 and MF 6 and to the generation of reports of the four standard malaria control indexes (ABER, API, SPR and SFR) for PHC, district, state and national levels. The software will be menu-driven from explicit screen instructions. The novice user will not be required to know the command language to run the database system. The contractor shall produce technical documentation describing the specifications of the dBASE III adaptation to the surveillance data.

3. conduct a half-day orientation seminar for a wide audience of health professionals (about 50 people) involved in research and health administration who might benefit from similar types of information systems. The contractor will prepare a 10 minute videotape documentary of the potential application of microcomputer technology to the malaria control problem for use in the seminar.

4. conduct a one-day seminar at NMEP for health policymakers and the NMEP operations control directorate to introduce the potential use of the computer technology as a health strategy planning tool and biomedical research tool. The contractor will produce audio-visual materials for the seminar including overhead projection transparencies.

5. provide 20 days of microcomputer training to each of six technical staff of NMEP to give these staff the capability of entering raw epidemiological surveillance data and retrieving the malaria control index reports. The contractor shall prepare a user's manual for the database to assist the staff in learning how to use the computer system.

6. support and assist NMEP staff trained in loading the information system with all appropriate historical malaria surveillance data at NMEP.

7. prepare two evaluation reports of the implementation of the database: one on the release of the first adaptation of the dBASE III software package and one at the end of the contract period.

Schedule

The activity will begin o/a May 1, 1985 and will be completed in nine months.

Cost Estimate

It is recommended that 9 person-months of senior-level expertise and 18 person-months of middle-level expertise be provided for this activity. The estimated costs for the activity follow:

9 PM senior level @ $1500/mo	$13,500
18 PM middle level @ $1200/mo	$21,600

TOTAL	$35,100

The estimated monthly rates include all technical services for implementation of the database including software adaptation and training activities, the use of two 16-bit, MS-DOS microcomputers dedicated exclusively for the contract activities, and all training materials including the 10-min videotape training documentary, overhead projection transparencies, technical documentation, and user's manuals.

Suggestions for the selection of an Indian contractor to execute the preproject activity.

The success of the preproject activity will largely depend on the availability of an Indian contractor capable of adapting computer technology as specified in the project component to the requirements of the malaria control program. It is suggested that appropriate criteria for selection are that the firm should have:

1. up-to-date technical expertise in the capabilities of microcomputer technology and a demonstrated capability in carrying out the design and implementation of computer-based information systems,

2. a demonstrated working knowledge of the technical scope of the dBASE database command system (a standard software package under which the information system will be designed),

3. the capability to provide the software and hardware required for the for the period of the preproject activity (after which time project-funded computers will be installed),

4. experience in conducting training courses in the use of information systems,

5. a demonstrated interest in transferring computer technology to health-related activities,

6. a demonstrated command of technical writing in English, and

7. an office in New Delhi staffed with adequate expertise to be able to successfully complete the preproject activity within the time limit specified.

Various sources for the required technical support for the preproject activity have been reviewed. It has been determined that one demonstrated a predominant capability for carrying out the contract successfully to the specifications required and in the time frame recommended: the Centre for Development of Instructional Technology (CENDIT), New Delhi. A discussion of the predominant capability of CENDIT as the proposed prime recipient of the contract for the preproject activity follows. Then, there is a discussion of possible alternatives and reasons why the alternatives should be excluded from further consideration.

Predominant capability of CENDIT

The Centre for the Development of Instructional Technology (CENDIT) is an Indian society that has the multidisciplinary capability that is of vital importance to this activity. CENDIT has expertise in management information systems, systems analysis, production of multi-media communication material for dissemination, training of experts and lay persons, and working experience with rural health centers in India.

CENDIT has proven capabilities in these areas. The center has consulted for various international agencies under different projects. Additionally, CENDIT is a non-profit research institution active in the areas of the application of computers for development, media production and training, communication research and development information and research. With the preproject activity being in an area of primary concern for CENDIT, the institute would have an interest in contributing a substantial portion of its collective talent and resources to the successful implementation of the activity and to the long-term project component goal.

CENDIT's efforts in development information and communication have grown out of extensive field experiments. From 1975 to 1983, CENDIT ran an integrated rural development program in a cluster of villages in Saharanpur district of western Uttar Pradesh. Community health was a major component of the project which was supported by the family planning foundation and others. The emphasis of the program was on preventive health and people's participation. In 1983 a separate independent local organization was created to continue CENDIT's work in Saharanpur district.

Dr. Lalit Nath, Head, Centre for Community Medicine (CCM), All India Institute of Medical Sciences (AIIMS) and Secretary of CENDIT, is a consultant for WHO on community health and advises CENDIT on matters relating to health information. The CCM and CENDIT are collaborating to study district level education and management systems for later implementation by the Ministry of Health. CENDIT, CCM and the Indian Council of Medical Research (ICMR) are collaborating with the International Development Research Centre (IDRC), Canada, for maintaining a bibliographic information system for low-cost rural health care and health manpower training. CENDIT is collaborating with ICMR for the production and evaluation of educational software for health, both for the lay public and for professionals and para-professionals engaged in health care delivery. A videotape on iodine deficiency produced with ICMR has already been broadcast over national Indian television. CENDIT is the only institution in the country that contributes to "Development Sciences Information System" (DESIS) which is maintained by IDRC, Canada and has published a volume of indian development related literature entitled, Devindex India.

CENDIT has been appointed as the regional node for INTERDOC (network of NGO documentation entries and development action groups) which involves functioning as a clearinghouse on microcomputer technology. CENDIT contributes to a newsletter for the network focusing on the exchange of experiences in manual and computerized information handling, feasibility studies on computerization, training events, research on information handling techniques and system analysis and evaluation.

CENDIT, under contract from IDRC, has prepared training materials for MINISIS, IDRC's integrated set of information systems. CENDIT trained UNESCO fellows from the Central Scientific and Technical Information Institute (CSTII), in information systems planning, development and implementation with specific emphasis on MINISIS.

In 1984 CENDIT conducted the third ISIS user's group seminar where participants came from libraries, scientific institutions, local business firms, and U.S. government agencies in New Delhi.

The predominant capability of CENDIT is enhanced by the following persons who either work full-time at CENDIT or frequently consult for the center on a project basis.

Mr. Anil Srivastava, Director, was the project director for the Family Planning Communication Study in Saharanpur district of Uttar Pradesh (1974-1979). This study was funded by the Family Planning Foundation. He has been responsible for computerized documentation systems at CENDIT since 1972, and a member of the ISIS Technical Group (UNESCO) that studied information systems using microcomputers. Under the Valletri Agreement he is responsible for providing assistance on microcomputer hardware and software. He was a member of the Task Force on Family Planning Communication which developed the concept of the integrated health worker. Because of this involvement, he studied the working of health agencies and collection and analysis of health data at block and district levels.

Mr. Avik Ghosh, Associate Director and Head of Media Production and Training, is responsible for communication research and program production of film, radio, video and multimedia. He worked as scriptwriter for educational films and producer/director of educational film and multimedia presentations with the Cinema Workshop Division of Trugraph Charts, New Delhi. He was a resource person of the Centre for Education Technology, National Council of Educational Research and Training , on audiotape library projects for schools, 1976-1978. He has produced and directed several film and vidéotape programs at CENDIT on development issues including 'Dohr Bhoj' and 'Will the Salt Reach Padrauna.' He is the co-director for the film 'India: the Riddle of Surplus and Hunger' that was supported by the UN and others. He is responsible for developing a package of educational software on health for para-medical personnel, medical personnel and others, for ICMR and CCM, AIIMS.

Mr. Rajiv Jain, Head of Development Information and Research, was the field coordinator for the project on the study of Family Planning Communication in rural areas. Subsequently, he was the director of the Saharanpur Integrated Rural Development Project and, in that capacity, responsible for the planning and execution of the community health program. He continues to be associated with rural development activities in Saharanpur through the DISHA social organization. At CENDIT, he has been responsible for creating the SALUS and DEVSIS databases and in coordinating the INDIX project which aims at promoting information exchange. He coordinated the case studies of village panchayats under the Madhya Pradesh Social Forestry Project for USAID/India.

Mr. Atul Asthana, Head, Knowledge Engineering Laboratory, has over 4 years of experience in the field of computer science. He holds a B.S. in electronics. He holds an M.S. in computer science from the University of Waterloo, Canada. He has worked on a number of research projects including computer interfaces for handling the human voice, distributed operating system, and assisted in teaching undergraduate courses at the university. At CENDIT, he consults on numerous aspects of computerization including information systems computer graphics and training methods.

Mr. Aditya Ahluwalia, Manager Information Sciences Group, managed the data center at the National Institute of Information Technology (NIIT) and was involved in the design and implementation of a variety of software projects in the areas of financial accounting, administration planning and computer-aided instruction. At CENDIT, he has been involved in designing a number of databases based on the MINISIS DBMS packages from IDRC, Canada. He developed the training material for CDS/ISIS, for UNESCO and conducted a course in information system planning, implementation and operation for UNESCO fellows from Korea.

Mr. Rabindra Nath Khosla, Information Analysis, comes from a background of management and data processing, He has worked with a reputed engineering concern in their Estimation and Planning Department, where he developed a general package for estimation work for bids. The information system was developed on a microcomputer using BASIC and dBASE II computer commands. At CENDIT he has been involved in designed and maintaining databases based on the MINISIS packages.

CENDIT has the capability to provide two 16-bit, MS-DOS microcomputers for the exclusive use of the activity proposed. The institute would also have at its disposal the facilities of its multimedia production studio in which to produce training materials, such as, a training documentary on videotape and overhead projector transparencies.

ALTERNATIVES

CMC Ltd. (formerly, the Computer Maintenance Corporation, Ltd.) has had extensive experience in supporting mainframe computer technology systems. In recent years, they have undertaken microcomputer system design projects (e.g. the British BBC educational computer project). However, the firm does not show a proven capability to complete the type of activity proposed. Since their goals and objectives are much broader

than microcomputer system design, it is felt that the technical resources that they could provide to the activity would be extremely limited. The interest of the firm centers on larger, more complex design projects, many of which are government-oriented and have been in the design and implementation phase for long periods. It is felt that it would be highly unlikely that CMC Ltd. would be in a position to mobilize and complete the activity on time.

ORG Systems and Hindutron have extensive experience in the design of computer hardware and software. These companies are reputed for their innovative applications of indigenous microcomputer technology. However, their technology has usually been obsolete by international standards by the time it reaches the market. And since the firms only offer expertise in customized hardware and customized software, they were excluded from further consideration.

There are many new entries into the Indian microcomputer technology market. Minicomp, Chogule Industries, Bush, Usha and others are assembling IBM-PC compatible microcomputers in a rapidly expanding Indian microcomputer industry. Evaluations of these firms determined that they might, in general, be able to provide the type of hardware required for the activity, but that the software design and training resources of the firms are not yet available to adequately meet the selection criteria above.

10.2 Computer procurement clearance

Action recommended: It is recommended that USAID request M/SER/IRM to specify approved hardware and software that meet the proposed specifications of the project component design. Early clearance for the procurement of the automation equipment for this project component will help to ensure its successful implementation. Delays in obtaining clearance will seriously jeopardize the implementation plan. It is recommended that USAID request M/SER/IRM for suggestion and concurrence for the preproject activity proposed. A draft of a cable to M/SER/IRM follows:

FOR M/SER/IRM

SUBJECT: PROCUREMENT OF AUTOMATION EQUIPMENT UNDER BIOMEDICAL RESSEARCH SUPPORT SERVICES PROJECT (DUE TO BE OBLIGATED JULY 1985)

1.0 AS A PROJECT COMPONENT OF THE SUBJECT PROJECT UNDER DESIGN, THE GOI AND USAID ARE FINALIZING A PLAN TO PROCURE MICROCOMPUTER EQUIPMENT TO ESTABLISH A MANAGEMENT INFORMATION SYSTEM FOR MALARIA CONTROL. THESE MICROCOMPUTERS WILL BE USED TO DEMONSTRATE THE APPLICATION OF MICROCOMPUTER TECHNOLOGY TO EPIDEMIOLOGICAL SURVEILLANCE METHODOLOGY. IT IS SUGGESTED THAT ONCE THE TECHNOLOGY IS PROVEN USEFUL IN THE CONTROL OF MALARIA THAT THE METHODOLOGY MIGHT BE READILY EXPANDED TO CONTROL OTHER DISEASES. FEASIBILITY STUDIES AT THE NATIONAL AND DISTRICT LEVELS HAVE RECOMMENDED SPECIFICATIONS REQUIRED FOR THE INFORMATION SYSTEM. IN GENERAL, TWO 16-BIT, MS-DOS MICROCOMPUTERS ARE REQUIRED AT THE CENTRAL OFFICE OF THE NATIONAL MALARIA ERADICATION PROGRAMME (NMEP) IN NEW DELHI AND THIRTY-ONE SMALL 8-BIT, CP/M MICROCOMPUTERS ARE REQUIRED IN ONE PILOT STATE (GUJARAT). IN THE PILOT STATE ONE COMPUTER IS REQUIRED AT EACH OF THE 27 DISTRICT MALARIA OFFICES AND FOUR ARE REQUIRED AT THE STATE LEVEL. BOTH USAID AND THE GOI AGREE IN PRINCIPLE WITH THIS PROPOSED PROCUREMENT.

2.0 THE TECHNICAL SPECIFICATIONS OF THE HARDWARE ITEMS TO BE PURCHASED FOR NMEP CENTRAL OFFICE FOLLOW :

2.1 TWO 16-BIT MICROCOMPUTER SYSTEMS WITH MS-DOS OPERATING SYSTEM, 512K RAM, KEYBOARD, MONOCHROME MONITOR, 10 MB HARD DISK DRIVE, ONE FLOPPY DISK DRIVE (DS/DD), SUCH AS, THE IBM-PC, COMPAC, OR THE WANG PC AT AN ESTIMATED COST OF DOLS 8000 PER COMPLETE SYSTEM

2.2 TWO DOT-MATRIX PRINTERS (132 CHARACTER), SUCH AS, THE EPSON FX-100, AT DOLS 650

2.3 TWO FOUR-PEN PLOTTERS AT DOLS 1300

2.4 ONE LETTER-QUALITY PRINTER AT DOLS 1700

2.5 TWO A/C VOLTAGE STABILIZERS

2.6 MISC SUPPLIES AND ACCESSORIES INCLUDING FLOPPY DISKETTES, PRINTER RIBBONS AND STATIONERY

3.0 THE TECHNICAL SPECIFICATIONS OF THE HARDWARE ITEMS TO BE PURCHASED FOR THE PILOT STATE FOLLOW:

3.1 THIRTY-ONE 8-BIT MICROCOMPUTERS WITH CP/M OPERATING SYSTEM, 64K RAM, KEYBOARD, MONOCHROME MONITOR, TWO FLOPPY DISK DRIVES, CAPABLE OF RUNNING DBASE II AND AT AN ESTIMATED MAX PRICE OF ABOUT DOLS 1200 MINUS LARGE-QUANTITY ORDER DISCOUNT, IF AVAILABLE

3.2 THIRTY-ONE DOT-MATRIX PRINTERS (132-COLUMN)

3.3 THIRTY-ONE A/C VOLTAGE STABILIZERS

3.4 MISC SUPPLIES AND ACCESSORIES INCLUDING FLOPPY DISKETTES, PRINTER RIBBONS AND STATIONERY

4.0 THE SOFTWARE ITEMS TO BE PURCHASED FOR NMEP ARE: DBASE III, WORDSTAR 2000, LOTUS 1-2-3, SPSS/PC STATISTICAL PACKAGE FROM SPSS INC. CHICAGO, CP/M TO MS-DOS CONVERSION UTILITY.

5.0 THE SOFTWARE ITEMS TO BE PURCHASED FOR THE THIRTY-ONE MICROCOMPUTERS IN THE PILOT STATE ARE: DBASEII, WORDSTAR, SUPERCALC 2, MICROSTAT, PLOTRAX/TRANSPLOT (OR SIMILAR GRAPHICS). IT IS ASSUMED THAT WORDSTAR, SUPERCALC 2 AND OTHER BUNDLED SOFTWARE PACKAGES WOULD BE INCLUDED IN THE BASE PRICE OF THE HARDWARE.

6.0 SINCE THE EQUIPMENT IS EXPECTED TO COST OVER DOLS 10,000 MISSION WOULD APPRECIATE SUGGESTIONS OF M/SER/IRM FOR THIS PROCUREMENT IN ACCORD WITH AID GENERAL NOTICE OF MARCH 12, 1984.

7.0 ALSO, WOULD APPRECIATE ADVICE AS TO THE OPTIONS AVAILABLE TO EFFECT THIS PROJECT-FUNDED PURCHASE (ONCE PROAG IS SIGNED), E.G., SER/COM THROUGH PIO I, SER/IRM, LOCAL DEALER. FYI, THE EXPANDING LOCAL MICROCOMPUTER MARKET NOW INCLUDES REPRESENTATIVES OF WANG, APPLE, HP, EPSON AND LOCALLY ASSEMBLED IBM-PC COMPATIBLE HARDWARE.

8. TO AVOID TIME CONSTRAINTS ANTICIPATED IN THE INSTALLATION OF THE PROJECT-FUNDED MICROCOMPUTERS, USAID PROPOSES A NINE-MONTH PREPROJECT ACTIVITY TO USE THE TECHNICAL AND MICROCOMPUTER HARDWARE/SOFTWARE SERVICES OF A LOCAL FIRM TO ESTABLISH THE FIRST PHASE OF THE MIS FOR MALARIA CONTROL BY CREATING A DATABASE AT NMEP FROM AVAILABLE HISTORICAL MALARIA SURVEILLANCE DATA. USAID WOULD APPRECIATE M/SER/IRM SUGGESTIONS/CONCURRENCE TO USE PD&S FUNDS TO PROCURE TECHNICAL SUPPORT AND MICROCOMPUTER USAGE FOR THE PROPOSED ACTIVITY. THE ESTIMATED COST FOR THE PREPROJECT ACTIVITY IS DOLS 35,100 INCLUDING NINE PERSON-MONTHS SENIOR-LEVEL TA, EIGHTEEN PERSON MONTHS MIDDLE-LEVEL TA, THE USE OF TWO 16-BIT, MS-DOS MICROCOMPUTER SYSTEMS (WITH HARDWARE AND SOFTWARE AS SPECIFIED ABOVE) DEDICATED EXCLUSIVELY TO THE PREPROJECT ACTIVITY, AND ALL TRAINING MATERIALS INCLUDING A 10-MIN TRAINING DOCUMENTARY VIDEOTAPE, OVERHEAD PROJECTION TRANSPARENCIES, TECHNICAL DOCUMENTATION, AND USER'S MANUALS. THE MICROCOMPUTER USAGE COMPONENT OF THE COST IS ESTIMATED TO BE DOLS 400 PER MONTH PER COMPLETE SYSTEM.

ANNEX A: COST ESTIMATE WORKSHEET

Nonrecurrent Costs		Unit Cost	Total
Physical System			
NMEP Central Office			
2	16-bit microcomputer systems with MS-DOS operating system, 512k random access memory, keyboard, monochrome monitor, 10 MB hard disk drive, one floppy disk drive (DS/DD)	8,000	16,000
2	dot-matrix printers (132-ch)	650	1,300
2	pen plotters (four-pen)	1,300	2,600
1	letter-quality printer	1,700	1,700
2	A/C voltage stabilizers	80	160
100	floppy diskettes, DS/DD	3	300
50,000	sheets fan-folded stationery	0.02	1,000
20	dot-matrix printer ribbons	10	200
20	letter-quality printer ribbons	10	200
4	pen plotter replacement kits	40	160
1	air conditioner, 1.5 ton	1,200	1,200
2	microcomputer desks	150	300
2	computer desk chairs	30	60
1	disk storage cabinet	150	150
1	dust-proof flooring	500	500
2	Freight	400	800
Pilot Test State			
31	8-bit microcomputer systems with CP/M operating system, 64k random access memory, keyboard, monochrome monitor, two floppy disk drives (DS/DD)	1,200	37,200
31	dot-matrix printers (132-ch)	650	20,150
31	A/C voltage stabilizers	80	2,480
620	floppy diskettes, DS/DD	3	1,860
100,000	sheets fan-folded stationery	0.01	1,000
93	dot-matrix printer ribbons	10	930
31	Freight	300	9,300
Subtotal of Physical Resources			99,550
Logical System			
NMEP Central Office			
2	MS-DOS Operating System	Incl	0
2	dBASE III	500	1,000
1	Wordstar 2000	450	450
1	Lotus 1-2-3	350	350
1	SPSS/PC	800	800
1	CP/M to MS-DOS Utility	250	250
Pilot Test State			
31	CP/M Operating System	Incl	0
31	dBASE II	350	10,850
31	Wordstar (or similar)	Incl	0
31	Supercalc 2 (or similar)	Incl	0
31	Plotrax/transplot (or similar)	170	5,270
31	Microstat (or similar)	300	9,300
Subtotal of Logical Resources			28,270

System Implementation			
36	pm of computer specialist	800	28,800
72	pm of computer training splst	500	36,000
1	training materials	2,500	2,500
1	system documentation, publ	2,500	2,500
Subtotal of System Implementation Resources			69,800
Subtotal of Nonrecurrent Costs			197,620
Annual recurrent costs (4 yr provided by project component)			
NMEP Central Office			
2	computer maintenance fee	100	200
20	floppy diskettes, DS/DD	3	60
50,000	sheets fan-folded stationery	0.01	500
20	dot-matrix printer ribbons	10	200
20	letter-quality printer ribbons	10	200
4	pen plotter replacement kits	40	160
Pilot Test State			
31	computer maintenance fee	100	3,100
310	floppy diskettes, DS/DD	3	930
100,000	sheets fan-folded stationery	0.01	1,000
93	dot-matrix printer ribbons	10	930
Subtotal of annual recurrent costs			7,280
Subtotal of four years' recurrent costs			29,120
Subtotal of all project component costs			226,740
Contigency			3,260
GRAND TOTAL OF PROJECT COMPONENT			230,000