A POPULATION LABORATORY FOR STUDYING DISEASE PROCESSES AND MORTALITY

The Demographic Surveillance System, Matlab, Comilla, Bangladesh

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June 1981

Special Publication No. 13

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PREFACE

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) is an autonomous, international, philanthropic and non-profit centre for research, education and training as well as clinical service. The Centre is derived from the Cholera Research Laboratory (CRL). The activities of the institution are to undertake and promote study, research and dissemination of knowledge in diarrhoeal diseases and directly related subjects of nutrition and fertility with a view to develop improved methods of health care and for the prevention and control of diarrhoeal diseases and improvement of public health programmes with special relevance to developing countries. ICDDR,B issues two types of papers: scientific reports and working papers which demonstrate the type of research activity currently in progress at ICDDR,B. The views expressed in these papers are those of authors and do not necessarily represent views of International Centre for Diarrhoeal Disease Research, Bangladesh. They should not be quoted without the permission of the authors.

ABSTRACT

The paper briefly discusses the Demographic Surveillance System (DSS) in Matlab as an invaluable tool for the study of disease processes and mortality. It focuses less on working details of the DSS than on its capacity to serve as a data base for indepth studies in the health area. Demographers, while fully conversant with problems in their own field-related to data collection, quality control etc.--tend to be less aware that a good population data base is indispensable for the study of health problems. Examples of applied research are provided which show how the Matlab DSS has made possible some important research findings in the understanding of diarrhoeal diseases as well as mortality and morbidity processes. The paper is not intended to be a historical covering of the DSS, and consequently the documentation indicated in the paper remains limited to areas directly illustrative of the utility of the DSS.

Although the inverse correlation between the socio-economic status and mortality has been well documented, the process by which higher mortality rates occur in the lower socio-economic groups is not well understood. One "path" of understanding would be to consider the sequence of elements: low economic status ---→ malnutrition ---→ "disease-prone" ---→ mortality. Studies in this "path" have indicated that lowering of infant mortality rates is not necessarily connected with increasing nutritional standards. More efficacious may be inputs of public health preventive measures.

At the ICDDR,B studies are being undertaken to investigate both "paths" referred to earlier. The DSS has utilised as an overall vital registration system for the study area in Matlab. Intervention and "control" areas have been set up without close study of individual village characteristics. With the arrival of the computer, it is now possible to investigate in detail the "structure" of the various elements forming the study population. Data can be tabulated by village, baris and families. Health monitoring at the village level through FVWs will be more effective when sufficient account is taken of other factors such as community organisation, participation of the community in the health field, type of health services provided, water supply.

BACKGROUND

Beginning in 1963 the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B*) has initiated a Demographic Surveillance System (DSS) in selected villages within and adjacent to Matlab Thana, Comilla district, Bangladesh. The system consists of periodic censuses of the study population with intervening registration of vital events: births, deaths, and migrations. In 1966, a census was conducted in the Matlab Demographic Surveillance Area (DSA**) covering a population of 110,000 residing in 132 villages (OTA**). The DSA was doubled in 1968 with the addition of another 101 adjacent villages (NTA). At the last census (1974), the population of the total DSA was 264,000 residing in 233 villages. In October 1978, the study area was reduced to 159 villages containing an estimated 1974 population 160,000. All of these retained villages are within Matlab Thana.

The population of the study area is 88 percent Muslim and 12 percent Hindu. The average household consists of six persons. Households of patrilineally related families are grouped in clusters called baris, having a common courtyard. Landholding is skewed, with 18 percent of the households owning 47 percent of the land. About 40 percent of the males and 16 percent of the females over age 15 have completed four years of schooling. About 70 percent of the males and 6 percent of the females are classified as "economically active". Over the past decade, the Matlab Demographic Surveillance System (DSS) has generated an enormous volume of unusually reliable data. Censuses of the population are available in 1966 (OTA), 1968 (NTA), 1970 (OTA), and 1974 (DSA). Vital events have been registered since 1966 in the OTA and since 1968 in the NTA. Beginning in January 1975, the continuous registration of marital unions and dissolutions was introduced. Depending upon the census, selected socioeconomic information are available on all households. An update of registered events was undertaken in 1978, aiming for an estimate of the 1 January, 1979 population. Field checking of this updated census is underway in 1980. Also in progress at this time is the checking, and editing of all registered events in the DSA for computer linkage to the census records. A copy of the field forms used in the DSA is attached in Appendix 1.

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* Formerly known as Cholera Research Laboratory.

** It is recommended that DSA be used in the future to describe the Matlab field study area. Former terms, such as the vaccine trial area (VTA), old or new trial area (O/NTA), and contraceptive distribution project area (CDP) imply an unnecessarily restricted operation of the DSA.

The long range goal of the Matlab Demographic Surveillance System is to obtain reliable information on demographic and selected other characteristics of the Matlab study population and to monitor changes of these characteristics over time. Research products include, among others, studies on: cholera and other infectious diseases, epidemiology; vaccine efficacy; effectiveness and development; beliefs in food/feeding/health; social relationships and community structure; biosocial determinants and correlates of fertility, mortality, migration and marriage. These studies are made possible due to the data base.

SPECIFIC AIMS

The immediate objectives of the Matlab project are:

1. To provide a "small area" vital registration system and to apply the demographic programme toward the assessment of the effectiveness, safety and acceptability of MCH-FP technologies (contraception, oral therapy, nutrition and immunization) to be used within the context of national programmes in the region and developing countries.

2. To undertake research related to diarrhoeal diseases and on the measurement and determinants of fertility and mortality within one specific field site of the region. This research should help facilitate the formulation of more effective programme strategies and policy planning both in Bangladesh and beyond.

3. To develop a demographic field site which can be used for training of programme planners, researchers and implementors of national programmes.

METHODS AND PROCEDURES

Section I: Data Collection and Processing

The scientific "support" work of the ICDDR,B is undertaken in "branches". Each branch has a specific technical role. The DSS involves three branches--the Field Station at Matlab, the Data Management Branch and the Computer Information Services Branch at Dacca.

The Demographic Surveillance Programme of the Matlab Field Station headed by a Field Research Officer (Grade I), is responsible for the field operation and collection of the surveillance data. The Dacca Data

Management Branch is responsible for editing, processing, and initial tabulations of the demographic field data. The newly created Computer Branch will be responsible for the computerization of data on the IBM System 34 of the ICDDR,B. Progressive transfer of data from other computers is being undertaken.

An operational diagram of the DSS activities is presented below:

FIELD STATION MATLAB	DATA MANAGEMENT BRANCH, DACCA	COMPUTER BRANCH DACCA
Field operations and data collection	Editing, verification coding	Preliminary tabulations
	Preparation of annual reports	Final tabulations

In Progress: Full computerization of the data processing system and creation of a computerized population register.

The current data collection system under the Demographic Surveillance Programme of the Matlab Field Station is a three-tier system. Detection of vital events is primarily the responsibility of 110 female village workers (FVW). 80 FVWs undertake the primary detection of the vital events in half of the surveillance area as part of their work in providing village based MCH-FP services. Each of the FVWs covers approximately 300 households and visits each family fortnightly. In the remaining half of the Matlab study area, 30 FVWs covering approximately 500 households each undertake only demographic surveillance work. These workers visit each household weekly. All FVWs have at least a seventh grade education. They inquire about births, deaths, migrations, marriages and marriage dissolutions (divorces) and record these events in register books. The work of FVWs is checked by 12 to 16 male field assistants (FA's) who, accompanied by the FVWs, visit each household monthly* to review the completeness of the registration and to record the vital events on standard registration forms. The area covered by a FA is called a field unit and contains about 16,000 people (2,800 households). The work of FA's is again checked by 3 or 4 senior field assistants (SFA's) who visit each household at least three times annually. All of these workers are supervised by the Demographic Surveillance Field Research Officer (Grade I), who along with 2 Assistant Supervisors randomly check on the quality and completeness of the field work.

* The monthly schedule of FA's may be abridged or lengthened depending upon scientific cost, and logistical factors, but every effort would be made to maintain quality.

The completed registration forms are checked in Matlab and the events are recorded in the Matlab copy of the census volume. The recorded forms are then transferred to the Data Management Branch in Dacca for coding and data processing. Although there have been lapses recently, vital event cards were sorted and preliminary demographic information were usually reported annually. At present, field data is being transferred directly onto the computer and linked with family and individual records.

Section 2: Proposed Modifications

Census Update: In 1978 an effort was made to update the surveillance population to January 1, 1979 by using the 1974 census and the intervening vital events. The computer work has been completed, and in 1980 field checking was undertaken to obtain the best possible estimate of the January 1, 1979 population. Further, as in previous censuses, socio-economic information will be collected in 1981 and this will result in a 1981 update as a byproduct. A pilot study on five villages has been undertaken to select appropriate variables.

Annual Reporting: A system of regular annual reporting of the Matlab demographic system has been developed by the Data Management Branch. Appendix 2 contains a listing of such reports. Future annual demographic reports will be facilitated by the introduction of a fully computerized population register on an IBM System 34 that has recently been installed.

Streamlining of Registration Forms: To ensure the continuing usefulness of the data collected on the DSS registration forms a continuing process of review of current information obtained as well as of the proposed future information to be obtained in the registration forms is undertaken. Since the demographic data serve multiple functions, the redesign of registration forms has to be undertaken in consultation with scientists of the Centre.

Confidentiality: A system to safeguard the confidentiality of the information obtained from the study population has been operating and will be continued.

SOME RESULTS

In this section some results are presented that have been obtained on the basis of the Demographic Surveillance System in Matlab. While this surveillance is directed primarily at vital registration, since a population base is available, one is able to super-impose on it studies in which particular aspects of mortality or morbidity are focused. In-depth

epidemiological studies related to diarrhoea and nutrition have also been developed in the Matlab setting.

Some of the results of these studies or from ongoing surveillance systems have been selected to illustrate the possibilities of a population laboratory within the context of mortality and morbidity.

The information presented at first are concerned with mortality data. These are related to infant and child mortality as well as the main causes of death that occur in the Matlab area for these age groups. The question of sex biases, in mortality rates, is then raised as well as results from a food distribution study showing that this bias may be due to differential intake of calories and proteins.

Mortality rates are inversely correlated with socio-economic status. This important policy finding is documented in the Matlab area. The "education of head of household" is an important variable which has a depressing effect on mortality irrespective of whether the family is poor or comparatively rich. With regard to morbidity studies, data from an Oral Therapy field trial conducted in the Matlab area over a period of two years--January 1979 to December 1980--are presented, as well as surveillance of measles cases occurring over the period--November 1979 to October 1980. More detailed studies have been done in the Matlab area related specifically to diarrhoeal diseases control. The illustrations given above do not go into this detail, but sufficient evidence is provided to show the powerful possibilities of a good operational registration system.

The Matlab vital registration data show that little improvement in the mortality rate has taken place over the past decade. In fact there are some suggestions that the levels have risen in the early 1970s. (see Figure 1, Chen 1980).

Table I shows that the largest contribution to the present overall mortality is from diarrhoeal diseases, accounting for as much as a third of all deaths and 45 percent of deaths among children 1-4 years. Another fourth of all deaths resulted from other infectious diseases for which medical science has a decisive prevention. A heavy burden of these diseases and death falls on children. About 30 percent of all deaths occur during infancy between ages 0-11 months, and another 25 percent during early childhood between ages 1-4 years (Ruzicka 1978).

Matlab data provide conclusive documentation on higher female than male mortality shortly after birth and thereafter through childhood and childbearing ages. Most available data from various countries suggests that higher male mortality risks in the neonatal period continue through childhood and adolescence. In the case of the Matlab data, mortality differentials are reversed during the post-neonatal period with female mortality exceeding that of male by as much as 50 percent (D'Souza and Chen, 1980).

FIG.1: INFANT (Neonatal and Postneonatal) MORTALITY RATE, CHILD 1-4 YEAR DEATH RATE, & CRUDE DEATH RATE IN MATLAB, BANGLADESH(1966 – 1977)

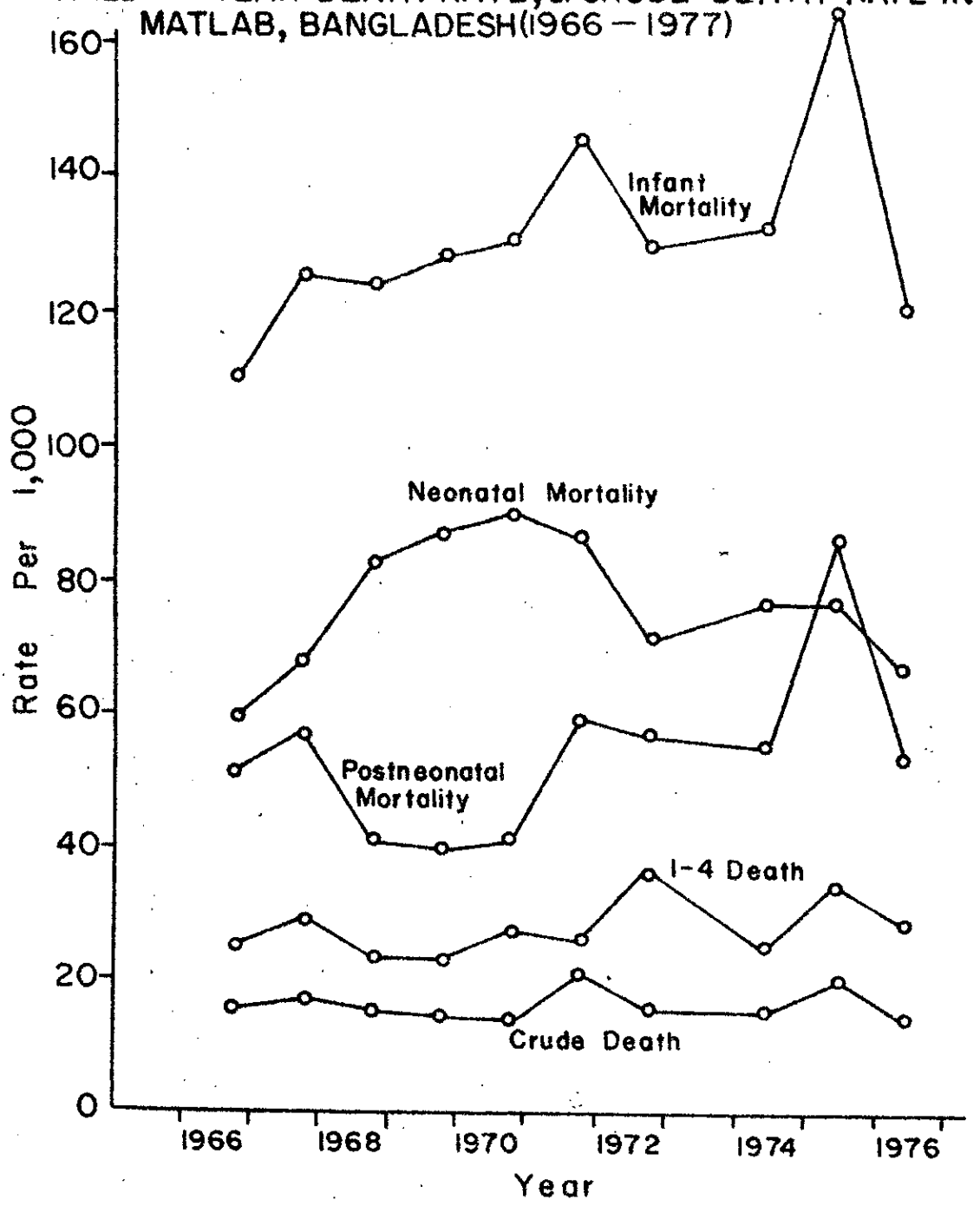

TABLE I-ADJUSTED PERCENTAGE DISTRIBUTION OF CAUSES OF DEATH, MATLAB, BANGLADESH (1975-77)

Cause of death	Infant (0-11 months)	Children (1-4 years)	All Ages
Diarrhoea	16.0	45.0	33.7
Tetanus	25.5	1.4	8.1
Respiratory	7.0	5.0	6.6
Fever	5.0	8.4	7.6
Measles	2.0	12.7	3.8
Others	44.5	27.5	40.2
All causes	100.0	100.0	100.0

A study on food distribution within the family has shown that a sex bias exists with regard to the intake of calories and proteins. Table II shows that at all age groups males have a higher intake of both calories and proteins. This feeding pattern would, for instance, explain the higher mortality rates among female children (Chen, Huq, and D'Souza, 1981)*.

TABLE II-INTAKE OF CALORIES (NO.) AND PROTEIN (GMS.) BY AGE AND SEX IN MATLAB, BANGLADESH (JUNE-AUGUST 1978)

	Calories (No.)			Protein (Gms.)		
Age	Male	Female	Ratio M/F	Male	Female	Ratio M/F
0-4	809	694	1.16	23.0	20.2	1.14
5-14	1,590	1,430	1.11	50.9	41.6	1.22
14-44	2,700	2,099	1.29	73.6	58.8	1.25
45+	2,630	1,634	1.61	71.8	46.9	1.53

A socio-economic census was taken in Matlab area in 1974. Mortality rates for children in the years 1974 through 1977 are tabulated by education of household head in table III against occupation, area of dwelling, number of cows owned, and use of fixed latrine (D'Souza *et al.*, 1980). Controlling

* The problem in comparing intake with requirements by age and sex is the uncertainty of requirement computations. An attempt is made in the paper cited above.

Table III-

		Education of Household Head (years of schooling)	Occupation		
			Agricultural labourer	Owner worker etc.	Land Owner
	I	0 (No schooling + Maktab)	32.8	23.0	20.4
	II	1-6	26.9	18.5	8.9
	III	7+	9.5	13.5	10.4
	All		31.2	19.9	13.5
Ratio	I:III		3.5	1.7	2.0
			Area of Dwelling (in Sq.ft.)		
			169	170-242	243+
	I	0 (No schooling + Maktab)	31.4	26.7	18.3
	II	1-6	24.8	19.6	16.2
	III	7+	17.0	19.6	11.5
	All		28.9	23.5	16.2
Ratio	I:III		1.8	1.4	1.6
			Number of Cows Owned		
			0	1-2	3+
	I	0 (No schooling + Maktab)	29.0	22.6	16.9
	II	1-6	22.0	17.6	14.0
	III	7+	14.3	13.1	10.3
	All		25.3	19.6	14.8
Ratio	I:III		2.0	1.7	1.6
			Use of Fixed Latrine		
			Yes	No	
	I	0 (No schooling + Maktab)	24.3	28.7	
	II	1-6	18.7	19.6	
	III	7+	12.6	16.0	
	All		20.6	26.0	
Ratio	I:III		1.9	1.8	

for various socio-economic variables, this table allows an assessment of the impact of education (of household head) on child mortality. In a rural society that has been traditionally rather conservative, education of household head beyond primary level shows a marked effect on child mortality, irrespective of whether the family is a poor or a comparatively rich one. Better socio-economic conditions, as may be expected, have an additional favourable effect depressing child mortality further. This finding is important obviously for policy orientation.

An Oral Therapy field trial was conducted in the Matlab area from January 1979 through December 1980. Diarrhoea incidence data for the period January 1979 - August 1980 are presented in graphic form for two areas* of Matlab thana in which different oral therapy interventions were arranged (Figure 2, Zimicki *et al.*, 1981). Average incidence rates were around one episode per hundred person-weeks. Since an episode of diarrhoea is recorded as reported by individuals or local informants in the household, the results do not represent a clinical appraisal of diarrhoea rates. The reported rates are probably lower than would have been appraised under a clinical setting. However, the maintenance of a longitudinal data set provides at least a lower bound to this type of disease in a particular developing country when such data are not available in most parts of the developing world.

Figure 3 represents the number of cases of measles occurring per month in the Matlab area over the period November 1979 to October 1980. From a fairly low 200 cases per month in November the outbreak of measles gradually peaked till over 1500 cases reported in March. There was a rapid fall over the next two months but an interesting feature is the presence if cases of measles in every month of the year (D'Souza *et al.*, 1981). Measles is an important cause of death in a developing country and programmes of maternal and child health tend to include a measles vaccine where feasible. An inhibiting factor is that an expensive "cold chain" to maintain measles vaccine is necessary.

Figure 4 represents general fertility rates from two areas--comparison and treatment--in Matlab thana. Simple contraceptive distribution programmes which started in 1974 were modified to include a full range of family planning services with some MCH elements in 1978. One notices that the difference between comparison and treatment area is small prior to the second quarter of 1978 and grows wider in the last quarter of 1978 and 1979 (Phillips *et al.*, 1981). The Matlab DSS has made possible an accurate longitudinal recording to the impact of an integrated health service programme.

Figure 5 represents results from a tetanus immunization intervention in the Matlab area. Neonatal death rates between September 1978 and December 1979 were significantly lower for infants born to mothers who had been immunized (Makhlisur Rahman *et al.*, 1980).

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* Approximate population in each area: 40,000.

Fig. 2

DIARRHEA INCIDENCE RATES FOR ALL AGES BY TWO MONTH PERIOD MATLAB

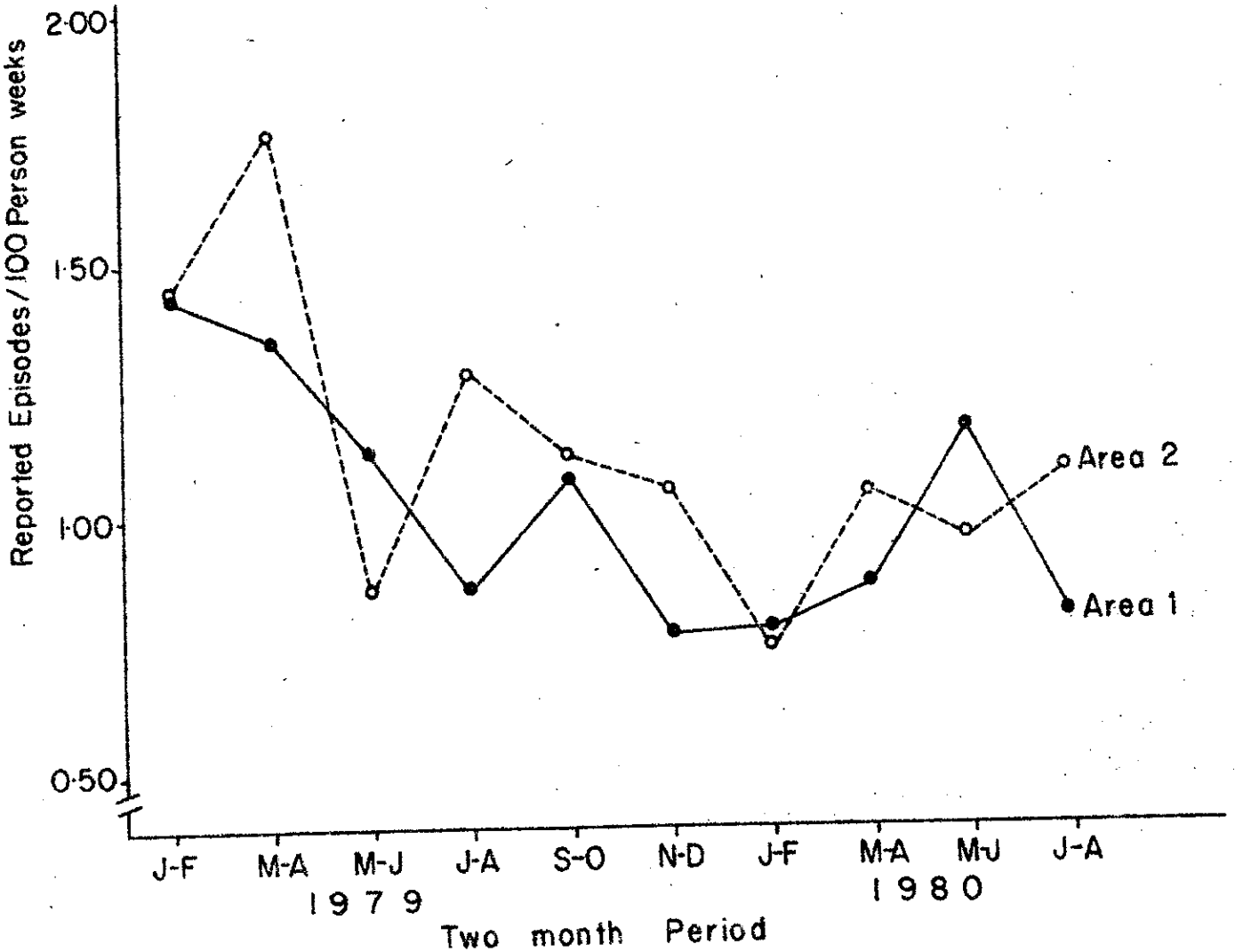


Fig. 3

NO. OF MEASLES CASES BY MONTH (NOV.'79-OCT.'80)

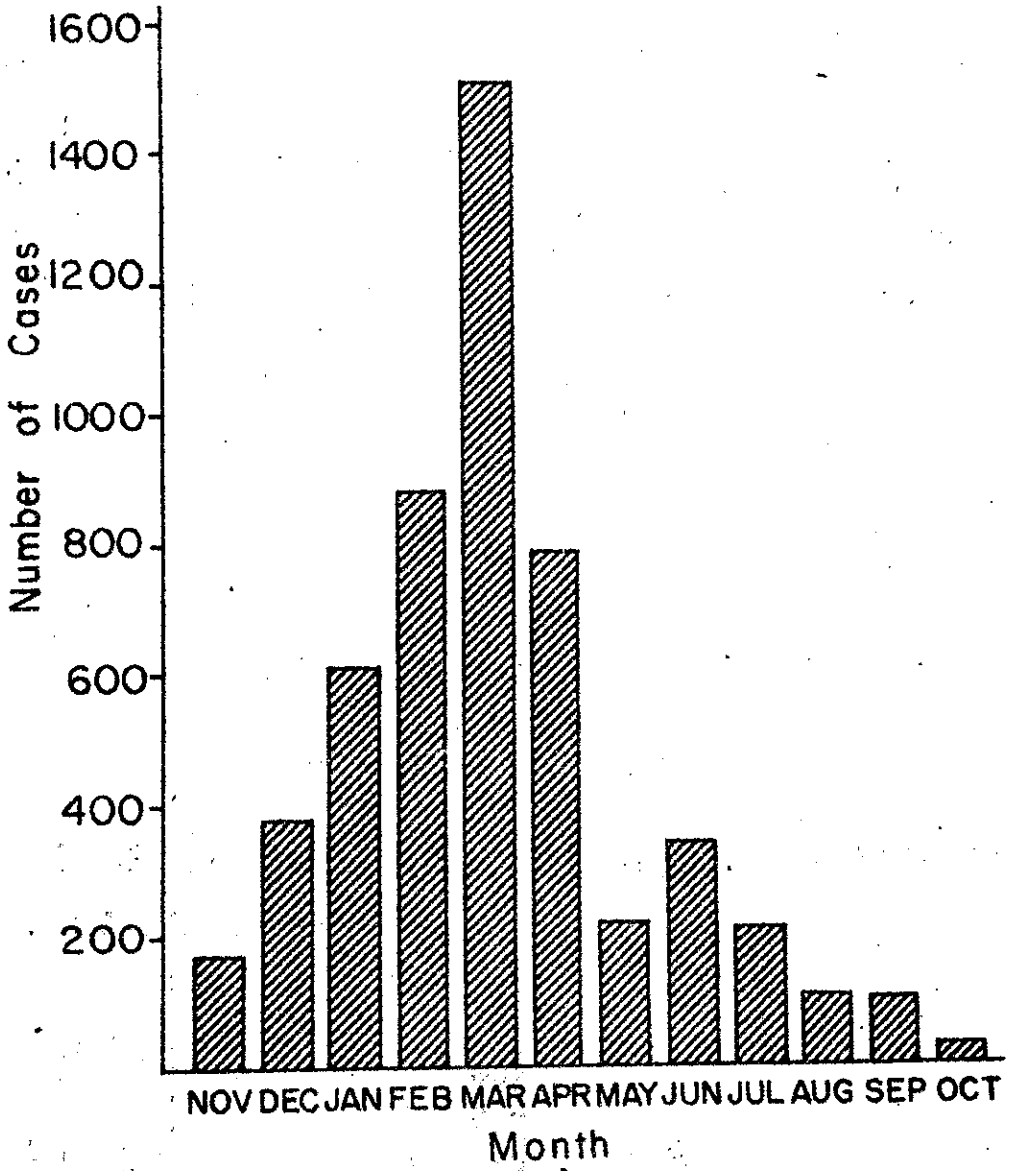


Fig. 4

QUARTERLY GENERAL FERTILITY RATES IN FP/HSP TREATMENT AND COMPARISON AREAS, 1974-1980, MATLAB

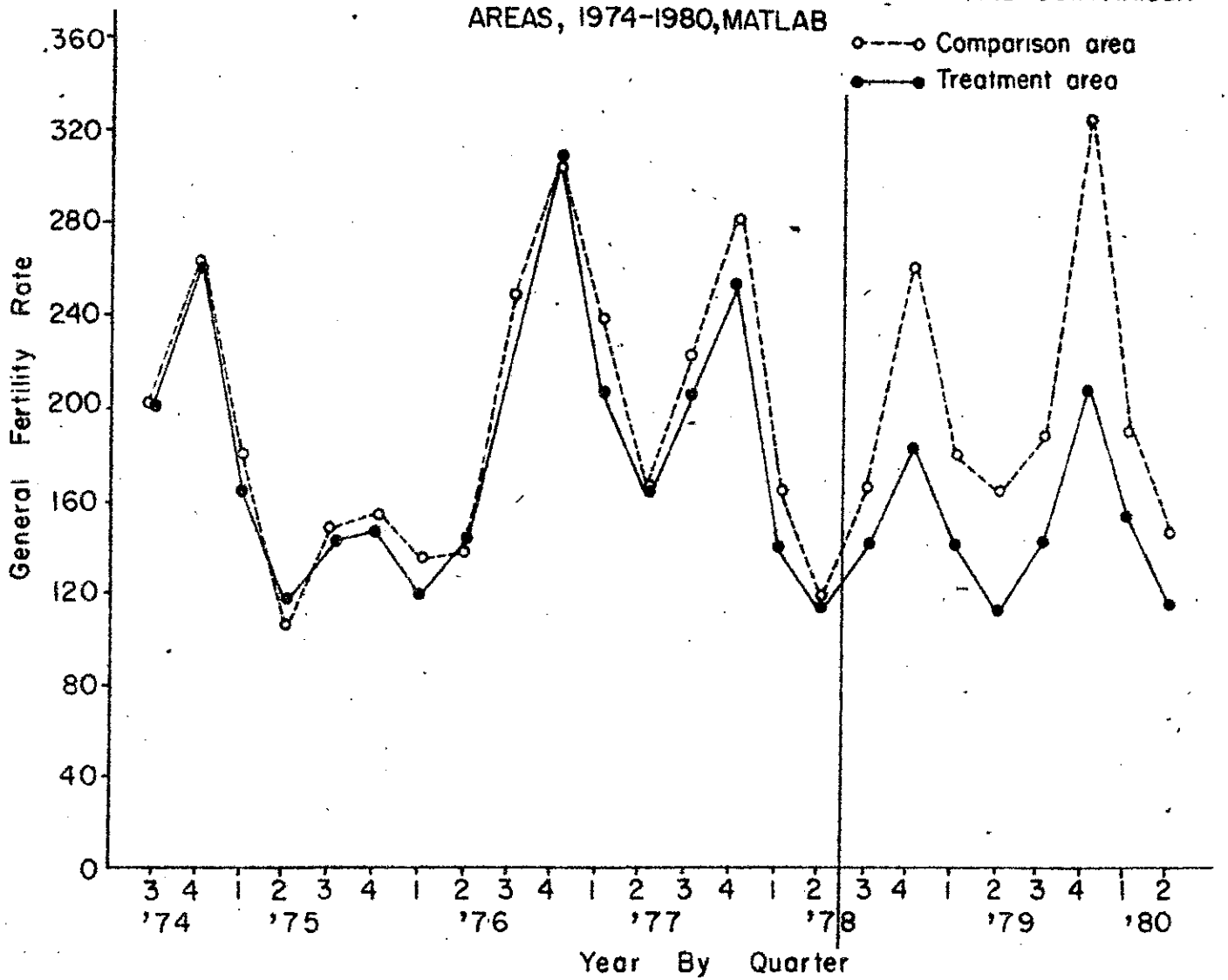
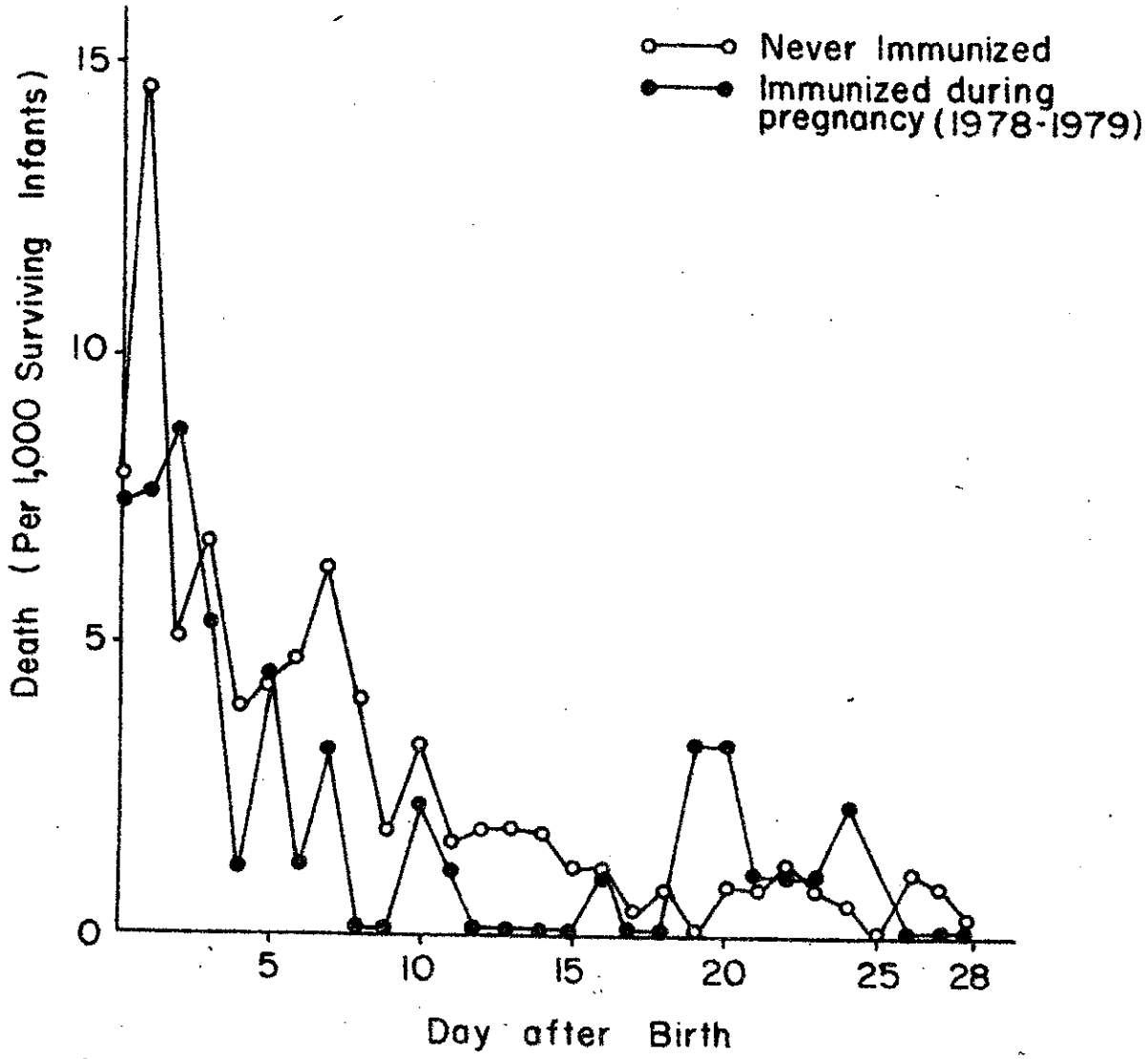


Fig. 5

NEONATAL DEATH RATES BY AGE OF DEATH FOR INFANTS BORN BETWEEN SEPT. 1, 1978 & DEC. 31, 1979 ACCORDING TO MATERNAL TETANUS IMMUNIZATION STATUS MATLAB.



The data base provided by the DSS has been shown to be indispensable in terms of evaluation of health intervention programmes. An extremely important component of the DSS system consists of accurate information on the whereabouts of particular individuals within a rural setting. This element makes it possible to set up studies where "follow-up" methods are part of the investigation. In the case of the cholera vaccine trial conducted in 1974 a serological survey was conducted among volunteers of every thirty-third family which had participated in the field trial. The total number of volunteers were 92,838. The selected families were visited immediately prior to the first injection and six weeks after the first and second injections. In this way levels of vibriocidal titer could be detected and compared with cholera cases that occurred and were seen in the hospital situation at the Matlab treatment centre (Curlin *et al.*, 1978). The "follow-up" approach was also used in a survey of sterilisation acceptors in the Matlab area. A two part questionnaire was used for information in the survey. The first part of the questionnaire was completed at an interview conducted at the clinic prior to sterilisation and the second part was completed in the clients home one month after sterilisation. In this way information was obtained regarding motives for the choice of the particular contraceptive method used as well as an understanding of the side-effects and attitudes of the client and her relatives could be assessed after the operation (Bhatia *et al.*, 1979).

DISCUSSION

The results presented show some of the potential of the Demographic Surveillance System in the Matlab area.

The DSS constitute one of the most valuable institutional resources of the ICDDR,B, vital for the conduct of certain types of field research in diarrhoeal diseases, nutrition, population and health care.

Seven broad areas, in which the system possesses distinct comparative advantages, have been identified. These are:

1. The Matlab Surveillance System is necessary for health, nutrition and demographic research which requires an accurate count of the population. Such demographic information is essential for computation of rates. Vital and other rates are essential for field research particularly for the assessment of the impact of various programmatic or technologic interventions (e.g. vaccine, oral therapy, contraceptives).
2. The Matlab Surveillance System provides accurate sampling frames for sample surveys or indepth studies.

3. Because the DSS has been operational since 1966, the precise age of most children under 14 is known with accuracy in most of the DSA. Precise age data strengthen selected research in nutrition, population and infectious diseases.

4. Because of the continuous relationship of the ICDDR,B with the Matlab population, including the provision of health and diarrhoeal diseases service, some studies requiring client cooperation may be more easily conducted in this, as compared to other areas.

5. The longitudinal nature of the surveillance system facilitates prospective research designs, including the documentation of time trends.

6. The demographic data may reflect (not necessarily represent) national statistics and thus may be useful for national planning purposes.

7. The DSA may be employed as a field training area in epidemiological, population, nutrition and health care research.

Five limitations of the system are:

1. This demographic surveillance system of the ICDDR,B is an expensive research instrument operated by an institution which enjoys a high level of autonomy. It does not necessarily represent a replicable model for others who may require surveillance systems for other purposes.

2. The DSS provides reliable measurements of outcome variables (such as births and deaths) but contains little information on antecedent biosocial causes or processes responsible for the observed outcomes. Except where study designs take this into account, only inferences may be made about the determinants of the observed outcomes.

3. The data collection of the surveillance systems is hierarchial and depends upon close supervision. There is insufficient community participation in the data collection or in the use of the information generated.

4. Past intervention research, current health services, and multiple, concurrent research designs are only several of the factors that may "contaminate" the study design of any individual study in the DSA, sometimes affecting the research policy of an unquantifiable bias.

5. Detection and correction of errors is slow and annual reports are delayed. The latest report is for 1978. Formal quality control systems external to the DSS system have yet to be established.

The advent of the computer should make possible the transformation of the DSS to a population registration system. Plans are now underway at the ICDDR,B to effect this change. So far the DSS is being conducted in two independent operations--the registration of births, deaths, migration, marriages and divorces and occasional censuses, (1968, 1970, 1974). This system can be transformed into a full scale register with population count outputs and vital registration returns as a by-product of the system. There are important implications of this change in terms of the operation and management of the system. The register could also make use of the possibility of automatic checks, and quality control so that some of the present defects in detecting errors and corrections would be alleviated. Also completeness of records could be checked systematically. At present the use of the DSS is not efficient enough due to the fact that important data files are not easily accessible for the study on morbidity and epidemiological studies because they are not linked with the DSS. The population register would allow for timely annual reports to be prepared.

There are other population laboratories in various parts of the world with slightly different focus than the International Centre for Diarrhoeal Disease Research, Bangladesh.

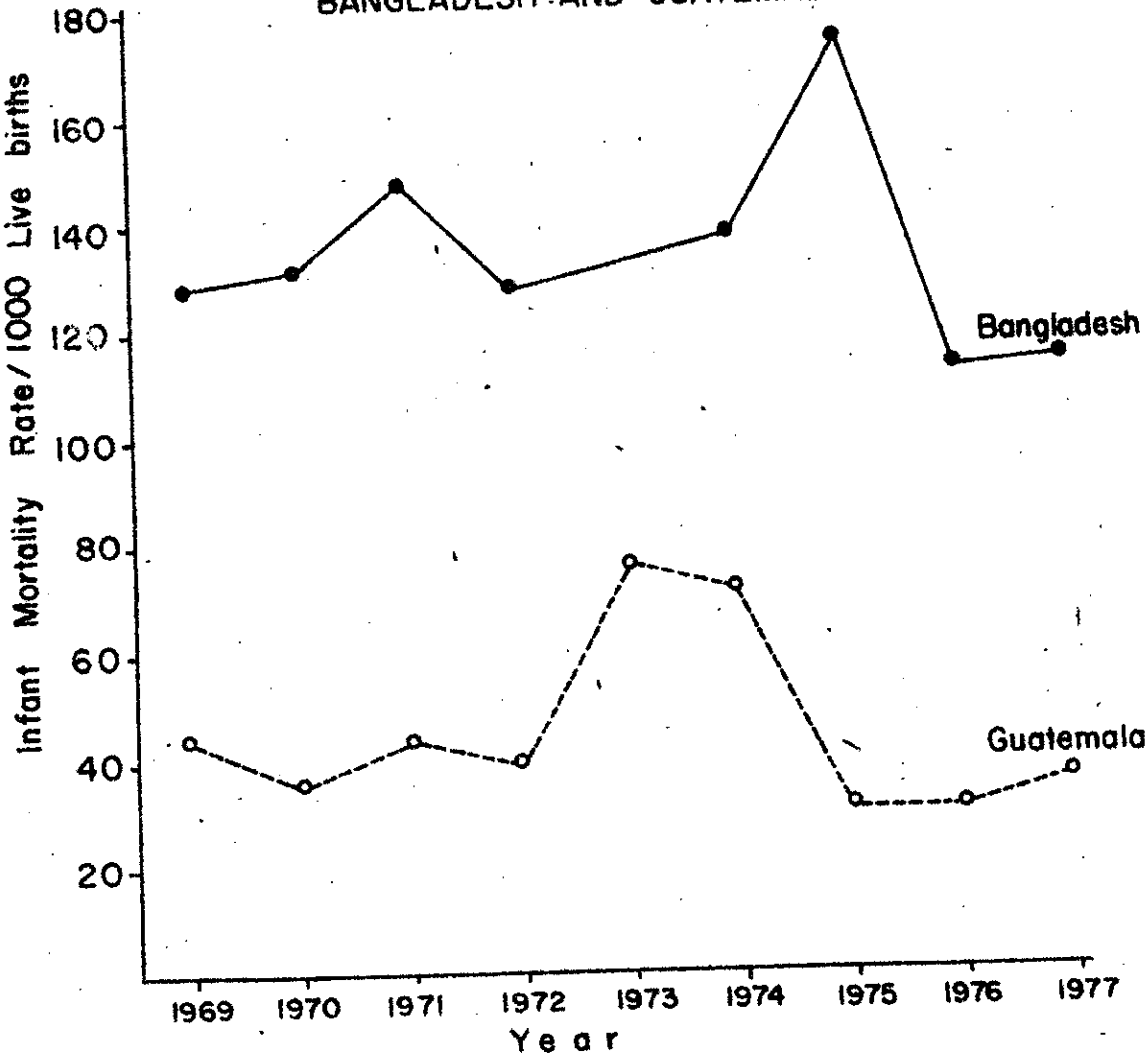
The Institute of Nutrition Central America and Panama (INCAP) is a scientific institution affiliated to the Pan American Health Organization (PAHO) situated in Guatemala.

The Member countries of INCAP are Costa-Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. It serves as a specialised centre for the study of the nutritional problems of the area, seeking solutions to these problems and collaborating, through technical cooperation, with the member governments to make effective the measures recommended for this purpose. It also contributes to the training of professional and technical personnel in the field of nutrition and food sciences. A longitudinal study conducted under the auspices of INCAP has provided data on infant mortality for several years. Some of these data have been collected in 4 rural communities in Eastern Guatemala.

Data from 1969 till 1977 are presented in Figure 6. It is clear from the data that though infant mortality rates are much lower than in the Matlab area there has been no decline in these rates during the nine years shown. The results from Matlab and INCAP though not directly comparable--different methodologies of data collection and cultures exist--do have policy implications for third world countries. In two different parts of the developing world no important impacts have been made on infant mortality rates over a long period. Within the context of the INCAP framework several nutrition studies have been conducted. A recently proposed study possesses as major hypothesis "that integrated health, nutrition and family planning services which include active and informed community participation, will

Fig. 6

INFANT MORTALITY RATES FOR 1969-1977 IN TWO RURAL AREAS BANGLADESH AND GUATEMALA



reduce overall levels of child morbidity, infant mortality and severe malnutrition and improve contraceptive utilization rates when compared with the system currently used by the Ministry of Health". (INCAP, 1978).

Another longitudinal epidemiological study area has been established in the North West part of the Machakos district of Kenya, involving approximately 4000 households--24,000 rural people--in an area of 87 square kilometers. The various objectives of this "Joint Project Machakos" were based on the collection of comprehensive field data intended to assist in the formulation of policy to improve the health of mothers and children in the rural areas (Muller A.S. *et al.*, 1977). Specific objectives for the longitudinal population based project can be summarized as follows:

1. To obtain accurate data on morbidity and mortality from a number of acute infectious diseases and on the outcome of pregnancy and to investigate nutritional factors and factors of the social, biological and physical environment which may have a bearing on the observed disease pattern.

2. To develop a system of registration of births, deaths and morbidity which is suitable for use in a district in Kenya having limited resources.

The study was intensively carried out till 1977 and a phasing down of the project is now in process. Initially under the scientific supervision of scientists from the Netherlands the programme is now being transformed into a collaborative relationship with the Government of Nairobi.

Data processing has constituted a major bottleneck in the Machakos experience. Such a problem has also been found in other longitudinal studies (Behar *et al.*, 1968; Neumann *et al.*, 1973). In the case of Matlab most of the data processing in the early stages at the Centre were done in the U.S.A. at the Johns Hopkins University, Baltimore. One of the major goals of a recently drawn up agreement between Johns Hopkins University and the ICDDR,B has been to transfer back the data files to Dacca.

As in the case of the ICDDR,B the Machakos study area was set up under the auspices of expatriate scientists mainly from a single country. In view of the changing availability of funds, the increasing national aspirations and awareness of the importance of the data resource there has been a transformation of both projects. In the case of Matlab in the former Cholera Research Laboratory set up largely by the U.S. scientific initiative has been developed into an International Centre whereas in the Machakos area the programme is being conducted by the Government of Kenya.

This paper has not presented details regarding basic demographic studies that have been developed within the context of the Demographic Surveillance System. Tabulations regarding the vital events and migration are discussed

in detail in the reports listed in Appendix 2. It is important to mention one type of study that has been undertaken within the Matlab context. This study deals with the validation of "indirect estimation techniques". Mortality estimates are often obtained by the use of the Brass method in areas where there are incomplete vital registration data. The Matlab DSS provides a unique opportunity in which estimates obtained by retrospective methods can be compared with longitudinal-registration of vital events in a rural developing country setting. Clearly, of course, some "contamination" effect would exist, due to the fact, that persons questioned in Matlab could have a more accurate knowledge of their age, than as usual in a similar rural setting in Bangladesh.

The paper, too, has not concentrated on aspects of costs. The DSS protocol has been budgeted to cost around $ 300,000 per year. Efforts are being made to reduce the costs of the DSS system. An integral part at the moment is supervision of staff which is effected by speedboats. The rising costs of gasoline make intense supervision a costly affair. Twenty percent of the budget has been allocated to transport costs. Personnel costs too are high accounting for nearly half of the overall budget. Cheaper surveillance systems are clearly necessary. The question remains whether the type of intensive field check-ups both in the terms of vital registration and of indepth studies, that can be done in Matlab are feasible under cheaper surveillance systems.

At the inception of the ICDDR,B, health care was primarily set within a vaccine trial framework for research purposes; now the present limited health interventions in Maternal and Child Health--Family Planning area constitute a serious attempt to combine service and research goals. Nutrition studies have been made but major nutritional interventions, apart from education, have not been carried out. As mentioned earlier, a recent study has documented an inverse relationship between mortality and socio-economic status (D'Souza, 1980). Education, especially of the mother, is an important indicator of mortality differentials. During the difficult years of 1974-77, children under three years of age of mothers with no education were liable to mortality rates five times higher than children of mothers with seven years or more of education. Health care delivery systems have to take into account the social stratification of the community. The national health policy will have to focus on selected health care items that reach the economically lower segments of the population which have the highest mortality rates.

The ICDDR,B is studying the possibility of setting up surveillance systems that are based on repeated cross-sectional surveys. Studies of this kind have been undertaken in various countries. Elements of the Matlab health intervention programmes that can be replicated within a frame-work of normal government inputs and evaluated through a low-cost mechanism are being investigated.

Although the inverse correlation between the socio-economic status and mortality has been well documented, the process by which higher mortality rates occur in the lower socio-economic groups is not well understood. One "path" of understanding would be to consider the sequence of elements: low economic status ⟶ malnutrition ⟶ "disease-prone" ⟶ mortality. Studies in this "path" have indicated that lowering of infant mortality rates is not necessarily connected with increasing nutritional standards. More efficacious may be inputs of public health preventive measures (Solimano and Vine, 1980).

At the ICDDR,B studies are being undertaken to investigate both "paths" referred to earlier. The fall in neonatal mortality rates due to tetanus immunization of pregnant mothers would indicate that particular preventive measures are in fact more efficacious, in the short term, in lowering infant mortality rates. The relationship between nutrition, morbidity and mortality is now under study. Those morbidity indicators, which would enable health planners to determine particular sectors of the population at high risk of mortality may be isolated. Intervention programmes would thus be better focused if a set of simple input points could be identified.

A review of Table I shows that over 40 percent of the "causes of death for all ages are classified under "others". The system reporting the "causes of death" is dependent on reporting by field workers, who do not have formal medical training and hence not qualified to provide precise diagnosis as to the "cause of death". Plans are being set up at the ICDDR,B to train workers to identify with greater precision "causes of death". "Lay Reporting is now considered an extremely important part of the statistical information system for health care in developing countries (WHO 1978). This information is both useful for alerting the emergence of future health problems--epidemic levels--and for planning and evaluation of health care delivery in rural areas especially. Minimal mortality and morbidity lists suggested in the WHO document will be tested in the Matlab situation.

The DSS has been utilised as an overall vital registration system for the study area in Matlab. Intervention and "control" areas have been set up without close study of individual village characteristics. With the arrival of the computer, it is now possible to investigate in detail the "structure" of the various elements forming the study population. Data can be tabulated by villages, baris and families. Health monitoring at the village level through FVWs will be more effective when sufficient account is taken of other factors such as community organisation, participation of the community in the health field, type of health services provided, water supply (WHO 1981). "Structural variables" will be included in a SES census to be undertaken in 1981. Family formation studies in five villages are underway. It is believed that the combined effect of efficient data processing and such studies will improve the overall capacity of the DSS to provide the data base necessary for understanding of the processes of mortality and morbidity.

APPENDIX 1

APPENDIX 1

BIRTH REPORT

ICDDR,B/MATLAB

Village ☐ Code ☐ Study No. ☐

Sl. No. ☐ Name of New Boro _____

Date : Day ☐ Month ☐ Year ☐

1 Single birth | 2 Twin birth | 3 Triplet birth

Result		Sex	Result		Sex
1	Miscarriage induced (< 7 m)	M	1	Miscarriage induced (< 7 m)	M
2	Miscarriage-spontaneous (< 7 m)		2	Miscarriage-spontaneous (< 7 m)	
3	Still birth	F	3	Still birth	F
4	Live birth	Unk	4	Live birth	Unk

Census No. '74/79 Census No. '74/79

Information on Mother :

Name _____ Age ☐ Type of age Census | Birth | M-In Date M-In ☐

VTS No. '68/70/74 _____ Census No. '74,79 _____

Information on Father :

Name _____ Age ☐ Type of age Census | Birth | M-In Date M-In ☐

VTS No. '68/70/74 _____ Census No. '74,79 _____

No. of previous pregnancy to mother ☐ (Exclude this birth)

No. of living children Total ☐ Sons ☐

No. of children born alive now dead Total ☐ Sons ☐

No. of chidren born dead Total ☐

Place of birth _____ Village _____ P. O. _____ Thana _____ Code ☐

Usual Residence of Mother :

Village _____ P. O. _____ Thana _____ Code ☐

Remarks : _____

Reported by : _____ Date _____

Date entered : Field ☐ Matlab ☐

APPENDIX 1 (Contd.)

DEATH REPORT

ICDDR,B/MATLAB

Sl. No. [ ] Village [ ] Code [ ] Study No. [ ]

Name of deceased : _____

Date of death : Day [ ] Month [ ] Year [ ]

Age : Years [ ] Months [ ] Days [ ] Sex [M] [F]

Type of age [Census] [M.In] Date of M.In _____ Date of Birth _____

VTS No : '68/'70 _____ Census No. '74/ _____

Mother's VTS No. 68/'70 _____ Census No. 74/ _____ (if any)

Marital Status at the time of death

Never Married [1] Married [2] Widowed [3] Separated [4] Divorced [5]

Education at death [ ] Occupation at death [ ]

Events and symptoms leading up to death :

Measles	02	Diarrhea : Acute	07	Chronic	08
Tetanus	03	Dysentery : Acute	09	Chronic	10
Drowning	04	Childbirth	11		
Murder	05	Jaundice	12		
Suicide	06	Other not covered above	13		

Symptoms Leading up to death _____

Usual Residence, _____ Code [ ]
Village P. O. Thana

Place of death. _____ Code [ ]
Village P. O. Thana

Type of Doctor Consulted :
Licenced Allopath [1] Allopath quack [2] Homeopath [3] Kabiraj [4] Others [5] Doctor not Consulted [6]

Remarks _____

Reported by _____ Date _____

Date entered _____

Field Vol. [ ] Matlab Vol. [ ]

APPENDIX 1 (Contd.)

MIGRATION IN REPORT
ICDDR,B/MATLAB

Sl. No. ☐ Village ☐ Card ☐ Study No. ☐ Identification ☐

Date of movement : Day ☐ Month ☐ Year ☐ Event : Moved In ☐

Whole family ☐ Partial family ☐

Total No.	VTS No. 1968/1970	Census No. 1974 or after	Name	Age	Sex	Remarks (Type of age)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Reason for movement : _____

Where From : _____ Vill/Thana HQ/Sub-Divn/Dt. Town/City _____ P.O. _____ Thana _____ District

Remarks : _____

Reported by _____ Date _____

Date entered : Field ☐ Matlab ☐

APPENDIX 1 (Contd.)

MIGRATION OUT REPORT

ICDDR,B/Matlab

Sl No. [ ] Village [ ] Code [ ] Study No. [ ]

Date of movement : Day [ ] Month [ ] Year [ ] Event : Moved out [ ]

Whole family [ ] Partial family [ ]

Total No.	VTS No. 1968/1970/74	Census No. 1974/79	Name	Age	Sex	Type of Age	Reason for Movement
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Where To : _____ (Vill/Thana HQ/Sub-Divn/Dt. Town/City) _____ (P.O.) _____ (Thana) _____ (District)

Remarks : _____

Reported by : _____ Date _____

Date entered in Field Vol. [ ] Matlab [ ]

APPENDIX 1 (cont

Marital Status Registration Form
ICDDR,B/MATLAB

Sl. No. | Village | Event | Study No.

Date of event : Day | Month | Year | Code

Information (Male Partner)

Name _____ V. T. S. No. '68/70/74 _____ Census No. '74/79 _____

Age | Type of age : Census | M-In | Date M-In

Marital status prior to this event :

Never married 1 | Married 2 | Widowed 3 | Divorced 4

If the prior status was married, widowed or divorced,

then specify the duration of that status in months

Education | Occupation

Usual Residence (Male Partner) :

Village : _____ P. O. _____ Dist. _____ Code | H. F. No. of Current Residence

Information (Female Partner) :

Name _____ V. T. S.No. '68/70/74 _____ Census No. '74/79 _____

Age | Type of age : Census | M-In | Date M-In

Marital status prior to this event :

Never married 1 | Married 2 | Widowed 3 | Divorced 4

If the prior status was married, widowed or divorced,

then specify the duration of that status in months | Education

H/F. No. of current residence

Residence of female partner prior to this event

Village _____ P. O. _____ Dist. _____ Code _____

Residence status Both within V. T. S. | Only female partner within V. T. S.

Remarks : _____

Reported by _____ Date _____ Only male partner within V. T. S.

APPENDIX 2

Reports of DSS Activities

1. Demographic Surveillance System - Matlab. Volume One. Methods and Procedures. March 1978. 28 p. ICDDR,B Scientific Report No. 9.

2. Demographic Surveillance System - Matlab. Volume Two. Census 1974 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. March 1978. 48 p. ICDDR,B Scientific Report No. 10.

3. Demographic Surveillance System - Matlab. Volume Three. Vital Events and Migration, 1975 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. March 1978. 45 p. ICDDR,B Scientific Report No. 11.

4. Demographic Surveillance System - Matlab. Volume Four. Vital Events and Migration, 1975 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. March 1978. 48 p. ICDDR,B Scientific Report No. 12.

5. Demographic Surveillance System - Matlab. Volume Five. Vital Events and Migration and Marriages-1976 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. March 1978. 55 p. ICDDR,B Scientific Report No. 13.

6. Demographic Surveillance System - Matlab. Volume Six. Vital Events and Migration 1977 by Aporn Samad, Kashem Sheikh, A.M. Sardar, Stanley Becker and Lincoln C. Chen. February 1979. 65 p. ICDDR,B Scientific Report No. 18.

7. Demographic Surveillance System - Matlab. Volume Seven. Vital Events and Migration, 1978 by Mridul K. Chowdhury, Stan Becker, Abdur Razzak, A.M. Sardar, Kashem Shaikh and Lincoln C. Chen. May 1981. 80 p. ICDDR,B Scientific Report No. 47.

8. Demographic Studies in Rural Bangladesh: May 1969-April 1970 by A.I. Chowdhury, K.M.A. Aziz and Kashem Shaikh. April 1981. 28 p. ICDDR,B Working Paper No. 16.

9. Demographic Studies in Rural Bangladesh: May 1970-April 1971 by A.I. Chowdhury, K.M.A. Aziz and Kashem Shaikh. April 1981. 31 p. ICDDR,B Working Paper No. 17.

REFERENCES

1. Behar M, Scrimshaw NS, Guzman MA, *et al.* Nutrition and infection field study in Guatemalan villages, 1959-1964. 8. An epidemiological appraisal of its wisdom and errors. Arch Environ Health (Chicago) 1968; 17:814-827.

2. Bhatia S, Osteria T, Chakraborty J, Faruque ASG. A survey of sterilization acceptors in a family planning program in rural Bangladesh. Intl J Gynaecol Obstet 1979; 17(3):268-273.

3. Chen LC, Huq E, D'Souza S. Sex-bias in the family allocation of food and health care in rural Bangladesh. Pop Dev Rev 1981; 7(1):55-70.

4. Chen LC, Rahman M, Sarder AM. Epidemiology and causes of death among children in a rural area of Bangladesh. Intl J Epidemiol 1980; 9(1):25-33.

5. Curlin GT, Levine RJ, Ahmed A, Aziz KMA, Rahman ASMM, Verwey WF. Immunological aspects of a cholera toxoid field trial in Bangladesh. Dacca, Cholera Research Laboratory 1978; Scientific report no. 8.

6. D'Souza S, Bhuiya A, Rahman M. Socio-economic differentials in mortality in a rural area of Bangladesh. Dacca, International Centre for Diarrhoeal Disease Research, Bangladesh 1980; Scientific report no. 40.

7. D'Souza S, Chen LC. Sex differentials in mortality in rural Bangladesh. Pop Dev Rev 1980; 6(2):257-270.

8. INCAP. The Guatemalan family health project: an integrated health, nutrition and family planning program. Guatemala, 1978.

9. Muller AS, Ouma JH, Mburu FM, Blok PG, Kleevens JWL. Machakos Project Studies: Agents affecting health of mother and child in a rural area of Kenya. Trop Geog Med 1977; 29(3):291-302.

10. Neuman AK, Sai FT, *et al.* Focus: Tech Coop 1973; 2(11).

11. Rahman M, D'Souza S. A review of findings on the impact of health intervention programmes in two rural areas of Bangladesh. Paper presented at WHO/ESCAP meeting in Manila, December 1-5, 1980.

12. Rahman M, Chen LC, Chakraborty J, *et al.* Reduction of neonatal mortality by immunization of non-pregnant women and women during pregnancy with alluminum-adsorbed tetanus toxoid. Dacca, International Centre for Diarrhoeal Disease Research, Bangladesh 1981; Scientific report no. 41.

13. Ruzicka LT, Chowdhury AKMA. Demographic surveillance systems - Matlab. Volume 5. Vital events, migration, and marriages--1976. Dacca, Cholera Research Laboratory 1978; Scientific report no. 13.

14. Solimano RG, Vine M. Undernutrition, infection and infant mortality. Paper presented at IUSSP Seminar on Biological and Social Aspects of Mortality and the Length of Life, Italy, May 13-16, 1980.

15. World Health Organization. Lay reporting of health information. Geneva, 1978.

16. World Health Organization. Lay reporting of health information for primary health care; report of a meeting (SEARO), October 27-31, 1980. New Delhi, 1980.

17. Zimicki S, Yunus M, Chakraborty J. Diarrhoea incidence and case hospitalization rates in Matlab, Bangladesh. Paper presented at the Regional Conference for Diarrhoeal Diseases, February 16-20, 1981, Dacca.

IN PREPARATION

D'Souza S, Bhuiya A, Chen LC. Measles surveillance in a rural area of Bangladesh. Dacca, International Centre for Diarrhoeal Disease Research, Bangladesh, 1981.

Phillips JF, Stinson W, *et al.* The demographic impact of two contraceptive service projects in Matlab Thana of Bangladesh. Dacca, International Centre for Diarrhoeal Disease Research, Bangladesh, 1981.

ICDDR,B publications can be obtained from Head, Library and Publication Branch, International Centre for Diarrhoeal Disease Research, Bangladesh, G.P.O. Box 128, Dacca 2, Bangladesh.

A. CRL Annual Report 1976.

CRL Annual Report 1977.

CRL Annual Report 1978.

ICDDR,B Annual Report 1979.

ICDDR,B Annual Report 1980.

B. Working Paper:

No. 1. The influence of drinking tubewell water on diarrhoea rates in Matlab Thana, Bangladesh by George T. Curlin, K.M.A. Aziz, M.R. Khan. June 1977 (2nd Rep. Sept 1980). 21 p.

No. 2. Water and the transmission of El Tor cholera in rural Bangladesh by James M. Hughes, John M. Boyce, Richard J. Levine, Moslemuddin Khan, George T. Curlin. Dec 1977 (Rep. Mar 1980). 27 p.

No. 3. Recent trends in fertility and mortality in rural Bangladesh 1966-1975 by A.K.M. Alauddin Chowdhury, George T. Curlin. Jan 1978 (Rep. Oct 1979). 14 p.

No. 4. Assessment of the Matlab contraceptive distribution project - implications for program strategy by T. Osteria, Makhlisur Rahman, R. Langsten, Atiqur R. Khan, Douglas H. Huber, W. Henry Mosley. Apr 1978 (Rep. Feb 1981). 25 p.

No. 5. A study of the field worker performance in the Matlab contraceptive distribution project by Makhlisur Rahman, T. Osteria, J. Chakraborty, Douglas H. Huber, W. Henry Mosley. Jul 1978 (Rep. Feb 1981). 17 p.

No. 6. Constraints on use and impact of contraceptives in rural Bangladesh: Some preliminary speculations by R. Langsten, J. Chakraborty. Aug 1978 (Rep. Feb 1981). 23 p.

No. 7. The demographic impact of the contraceptive distribution project by T. Osteria, W.H. Mosley, A.I. Chowdhury. Sept 1978. 17 p.

No. 8. Development of milk teeth in rural Meheran children of Bangladesh by Moslemuddin Khan, George T. Curlin. Sept 1978. 23 p.

No. 9. A follow-up survey of sterilization acceptors in Matlab, Bangladesh by Makhlisur Rahman, Douglas Huber, J. Chakraborty. Oct 1978 (Rep. Jul 1980). 31 p.

No. 10. The demographic impact of sterilization in the Matlab village - based MCH-FP program by T. Osteria, S. Bhatia, J. Chakraborty, A.I. Chowdhury. Nov 1978 (Rep. June 1980). 23 p.

No. 11. Parental dependency on children in Matlab, Bangladesh by Makhlisur Rahman. Dec 1978. 28 p.

No. 12. An areal analysis of family planning program performance in rural Bangladesh by T. Osteria, S. Bhatia, A.S.G. Faruque, J. Chakraborty. May 1979. 19 p.

No. 13. The people of Teknaf: births, deaths and migrations (1976-1977) by Mizanur Rahman, M. Mujibur Rahaman, K.M.S. Aziz, Yakub Patwari, M.H. Munshi, M. Shafiqul Islam. May 1979. 46 p.

No. 14. Pilot study of the calendar rhythm method in the Matlab area of Bangladesh by Stan Becker, Rasheda Akhter. Nov 1980. 23 p.

No. 15. Comparison of measures of childbearing: patterns by age and parity in Matlab, Bangladesh by Stan Becker, Helen Hiltabidle. Mar 1981. 29 p.

No. 16. Demographic studies in rural Bangladesh - May 1969-April 1970 by A.I. Chowdhury, K.M.A. Aziz, Kashem Shaikh. April 1981. 28 p.

No. 17. Demographic studies in rural Bangladesh - May 1970 - April 1971 by A.I. Chowdhury, K.M.A. Aziz, Kashem Shaikh. April 1981. 31 p.

No. 18. Interrelationships among certain socioeconomic variables in a rural population of Bangladesh by M. Shafiqul Islam, Stan Becker. May 1981. 24 p.

No. 19. Effects of diarrhoea on absorption of macronutrients during acute stage and after recovery by Ayesha Molla, Abdul Majid Molla, Shafiqul Alam Sarker, Makhduma Khatoon, M. Mujibur Rahaman. June 1981. 25 p.

No. 20. Intake of nutrient during and after recovery from diarrhoea in children by A.M. Molla, Ayesha Molla, S.A. Sarker, M.M. Rahaman. June 1981. 31 p.

No. 21. Epidemiologic pattern of diarrhoea caused by non-agglutinating vibrio (NAG) and EF-6 organisms in Dacca by Moslemuddin Khan, M. Shahidullah. June 1981. 29 p.

C. Scientific Report:

No. 1. Double round survey on pregnancy and estimate of traditional fertility rates by A.K.M. Alauddin Chowdhury. Jul 1977 (Rep. May 1978). 28 p.

No. 2. Pattern of medical care for diarrheal patients in Dacca urban area by Moslemuddin Khan, George T. Curlin, Md. Shahidullah. Aug 1977 (Rep. June 1978). 20 p.

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No. 5. Household distribution of contraceptives in Bangladesh - the rural experience by Atiqur R. Khan, Douglas H. Huber, Makhlisur Rahman. Sept 1977 (Rep. Dec 1979). 19 p.

No. 6. The role of water supply in improving health in poor countries (with special reference to Bangladesh) by John Briscoe. Sept 1977 (Rep. Feb 1979). 37 p.

No. 7. Urban cholera study, 1974 and 1975, Dacca by Moslemuddin Khan, George T. Curlin. Dec 1977 (Rep. May 1980). 24 p.

No. 8. Immunological aspects of a cholera toxoid field trial in Bangladesh by George T. Curlin, Richard J. Levine, Ansaruddin Ahmed, K.M.A. Aziz, A.S.M. Mizanur Rahman, Willard F. Verwey. Mar 1978. 16 p.

No. 9. Demographic Surveillance System - Matlab. Volume One. Methods and procedures. Mar 1976. 28 p.

No. 10. Demographic Surveillance System - Matlab. Volume Two. Census 1974 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. Mar 1978. 48 p.

No. 11. Demographic Surveillance System - Matlab. Volume Three. Vital events and migration, 1975 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. Mar 1978. 45 p.

No. 12. Demographic Surveillance System - Matlab. Volume Four. Vital events and migration, 1975 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. Mar 1978. 48 p.

No. 13. Demographic Surveillance System - Matlab. Volume Five. Vital events, migration and marriages - 1976 by Lado T. Ruzicka, A.K.M. Alauddin Chowdhury. Mar 1978. 55 p.

No. 14. Ten years review of the age and sex of cholera patients by Moslemuddin Khan, A.K.M. Jamiul Alam, A.S.M. Mizanur Rahman. May 1978. 18 p.

No. 15. A study of selected intestinal bacteria from adult pilgrims by M.I. Huq, G. Kibriya. Aug 1978 (Rep. Feb 1980). 15 p.

No. 16. Water sources and the incidence of cholera in rural Bangladesh by Moslemuddin Khan, W. Henry Mosley, J. Chakraborty, A. Majid Sarder, M.R. Khan. Dec 1978. 19 p.

No. 17. Principles and prospects in the treatment of cholera and related dehydrating diarrheas by William B. Greenough, III. Jan 1979. 20 p.

No. 18. Demographic Surveillance System - Matlab. Volume Six. Vital events and migration 1977 by Aporn Samad, Kashem Sheikh, A.M. Sarder, Stanley Becker and Lincoln C. Chen. Feb 1979. 65 p.

No. 19. A follow-up survey of sterilization acceptors in the modified contraceptive distribution projects by Shushum Bhatia, Trinidad Osteria, J. Chakraborty, and A.S.G. Faruque. Feb 1979. 25 p.

No. 20. Cholera due to the El Tor biotype equals the classical biotype in severity and attack rates by Moslemuddin Khan and Md. Shahidullah. Mar 1979. 20 p.

No. 21. An estimation of response bias of literacy in a census of rural Bangladesh by M. Shafiqul Islam, George T. Curlin and K.M.A. Aziz. Mar 1979. 26 p.

No. 22. *Vibrio cholerae* by William B. Greenough, III. Apr 1979. 43 p.

No. 23. M.R. Clients in a village based family planning programme by Shushum Bhatia and Lado T. Ruzicka. Apr 1979. 26 p.

No. 24. Passive hemagglutination assays for quantitation of cholera antitoxin: gluteraldehyde and chromium chloride used as coupling reagents to sensitize human erythrocytes with purified choleragen by Ansaruddin Ahmed, Kh. Abdullah Al Mahmud, George T. Curlin. June 1979. 25 p.

No. 25. Investigation of outbreak of dysentery due to *Shigella sonnei* in a small community in Dacca by M.I. Huq. June 1979. 21 p.

No. 26. Indigenous birth practices in rural Bangladesh and their implications for a maternal and child health programme by Shushum Bhatia, J. Chakraborty, A.S.G. Faruque. July 1979. 24 p.

No. 27. Isolation, purification and characterization of a Shigella phage by M.I. Huq, M.A. Salek. July 1979 18 p.

No. 28. Growth and development studies: Meheran by Moslemuddin Khan, George T. Curlin, J. Chakraborty. July 1979. 33 p.

No. 29. Report on reactigenicity and immunogenicity of Wellcome Cholera Toxoids in Bangladeshi volunteers by Robert E. Black, Md. Yunus, Abu Eusof, Ansaruddin Ahmed, M.R. Khan, David A. Sack. July 1979. 55 p.

No. 30. Strongyloides Stercoralis Larvae recovered from patients with diarrhoea and dysentery by G.H. Rabbani, Robert H. Gillman, Asma Islam. July 1979. 18 p.

No. 31. The condom in rural Bangladesh - A special effort is needed by Douglas Huber, Makhlisur Rahman, J. Chakraborty. Aug 1979. 14 p.

No. 32. The Matlab contraceptive distribution project by Makhlisur Rahman, W.H. Mosley, Atiqur Rahman Khan, A.I. Chowdhury, J. Chakraborty. Dec 1979. 119 p.

No. 33. Epidemiologic study of dysentery cases of Dacca Urban Area by Moslemuddin Khan, Md. Shahidullah. Jan 1980. 30 p.

No. 34. The gut as an immune organ by A.M. Molla. Feb 1980. 51 p.

No. 35. Microbiological surveillance of intra-neighbourhood El Tor cholera transmission in rural Bangladesh by W.M. Spira, Y.A. Saeed, M.U. Khan, M.A. Sattar. Mar 1980. 39 p.

No. 36. Lobon-gur (common salt and brown sugar) oral rehydration solution in the diarrhoea of adults by M.R. Islam, W.B. Greenough III, M.M. Rahaman, A.K. Azad Chowdhury, D.A. Sack. Apr 1980. 19 p.

No. 37. Utilisation of a diarrhoea clinic in rural Bangladesh: Influence of distance, age and sex on attendance and diarrhoeal mortality by M. Mujibur Rahaman, K.M.S. Aziz, M.H. Munshi, Yakub Patwari, Mizanur Rahman. June 1980. 22 p.

No. 38. Birth care practice and neonatal tetanus in a rural area of Bangladesh by M. Shafiqul Islam, M. Mujibur Rahaman, K.M.S. Aziz, M.H. Munshi, Mizanur Rahman, Yakub Patwari. Jul 1980. 19 p.

No. 39. Hours of onset of cholera classical and El Tor and diarrhoea by Moslemuddin Khan. Aug 1980. 18 p.

No. 40. Socio-economic differentials in mortality in a rural area of Bangladesh by Stan D'Souza, Abbas Bhuiya, Mizanur Rahman. Nov 1980. 31 p.

No. 41. Reduction of neonatal mortality by immunization of non-pregnant women and women during pregnancy with aluminum adsorbed tetanus toxoid by Makhlisur Rahman, Lincoln C. Chen, J. Chakraborty, Md. Yunus, A.I. Chowdhury, A.M. Sarder, Shushum Bhatia, George T. Curlin. Jan 1981. 25 p.

No. 42. Are there barefoot doctors in Bangladesh: A study of non-government rural health practitioners by A.M. Sarder, Lincoln C. Chen. Jan 1981. 28 p.

No. 43. Factors related to acceptance of tetanus toxoid immunization among pregnant women in a maternal-child health programme in rural Bangladesh by Makhlisur Rahman, Lincoln C. Chen, J. Chakraborty, Md. Yunus, A.S.G. Faruque, A.I. Chowdhury. Jan 1981. 33 p.

No. 44. Infant mortality in rural Bangladesh: an analysis of causes during neonatal and postneonatal period by M. Shafiqul Islam, M. Mujibur Rahaman, K.M.S. Aziz, Mizanur Rahman, M.H. Munshi, Yakub Patwari. April 1981. 21 p.

No. 45. Role of water supply and sanitation in the incidence of cholera in refugee camps by Moslemuddin Khan. May 1981. 21 p.

No. 46. Infant deaths, determinants and dilemmas (A cohort analysis for rural Bangladesh) by A.K.M. Alauddin Chowdhury. May 1981. 30 p.

No. 47. Demographic surveillance system - Matlab. Volume Seven. Vital events and migration - 1978 by Mridul K. Chowdhury, Stan Becker, Abdur Razzaque, A.M. Sarder, Kashem Shaikh, Lincoln C. Chen. May 1981. 80 p.

No. 48. Determinants of natural fertility study. Volume One. Methods and descriptive tables for the prospective study 1975-1978 by A.K.M. Alauddin Chowdhury, Stan Becker. May 1981. 55 p.