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9. ABSTRACT
A PROJECT: To provide policy makers with an analytical framework that will facilitate the efficient allocation of resources to programs intended to reduce the rate of infant mortality.

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DEVELOPMENTS: Direct assessments are provided of health interventions designed to raise the probability of child survival in a specific locality. The techniques developed are intended to have general application to an analysis of the cost effectiveness of alternative health programs. Although the infant mortality problem involves a nonlinear optimization problem, the approach used to obtain an optimum solution parallels that used in a linear optimization program. The optimization problem thus results in four distinct phases of the project; the development of the model of the process by which infants and toddlers are exposed to mortality risks and strategies to alter the process; specification of the parameters of the model either through direct estimation or as the result of a survey of medical and public health professionals regarding the impact of alternative health interventions on infant mortality; estimation of the cost of alternative health interventions, an assessment of available resources, and the specification of baseline epidemiological and demographic data; and the choice of a simulation or non-linear optimization procedure to determine the set of interventions which are most cost effective in raising the probability of child survival given the design of the model and the estimated effectiveness of interventions. At present the optimization procedure is functioning effectively with a segment of the model and a subset of the interventions. It is anticipated that the optimization procedure will be ready

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AN ANALYSIS OF THE EFFICIENCY OF HEALTH MEASURES TO RAISE THE PROBABILITY OF INFANT AND TODDLER SURVIVAL IN DEVELOPING COUNTRIES

FIRST INTERIM PROGRESS REPORT

January, 1978

This project is being undertaken by:
CENTER FOR RESEARCH ON ECONOMIC DEVELOPMENT
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PROJECT STAFF

The infant survival project is being carried out under a proposal written by Peter Heller. The project director is Howard Barnum. Robin Barlow has collaborated in the design of the general morbidity-mortality model. Luis Fajardo and Alberto Pradilla have collaborated in the selection of interventions for analysis and the initial identification of significant interdisease relationships. Richard Parsons has translated the algebraic simulation model into a computer program and is adapting a nonlinear optimization program for the needs of the infant mortality project. Chris Augustyniak has assembled the Bibliography and is responsible for the annotation presented in the appendix. Rand Baldwin and Donna Alexander have provided additional bibliographical and data assistance.

Administrative and accounting assistance has been provided by Sherry Cogswell and Jane McCormick. Secretarial assistance has been provided by Linda Burnett, Magda Hernandez, Marie Klatt, Jayne Owen and Donna Specwock.

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I. INTRODUCTION

High rates of infant and toddler mortality are one of the heavier burdens borne by the populations of the less developed world. The factors underlying the low probability of child survival are complexly interwoven and are not amenable to piecemeal curative or preventive medical or health policies. Yet throughout the less developed world, efforts at raising the probability of child survival are fragmented across different operating agencies. Rarely are the minimal resources devoted to primary health care carefully marshalled to efficiently deal with the most pressing health and medical problems of the population. One partial explanation for the inadequacy of current efforts has been the failure of policy analysts to determine an integrated and cost-effective approach to the alleviation of those community health problems which underlie high infant mortality rates.

The objective of the project reported on here is to provide policy makers with an analytical framework that will facilitate the efficient allocation of resources to programs intended to reduce the rate of infant mortality. The project will be used to provide direct assessment of health interventions designed to raise the probability of child survival in a specific locality, but the techniques developed are intended to have general application to an analysis of the cost effectiveness of alternative health programs.

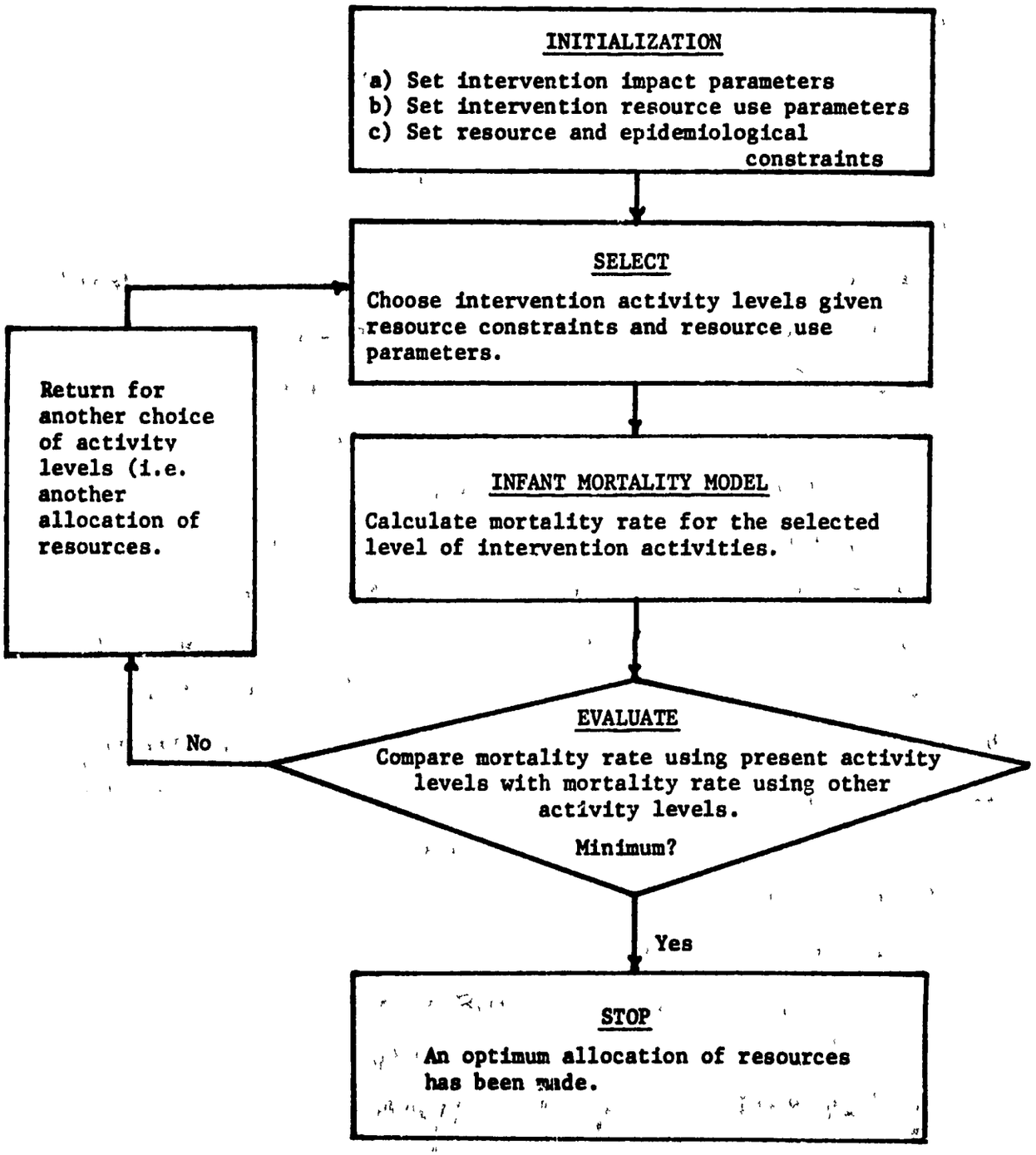
Organization of Research

A schematic presentation of the general optimization problem can be used to explain the natural order and partitioning of the research tasks involved in the infant mortality project. Diagram #1 presents a schema for the organization of an optimization program designed to allocate given

Diagram #1

OPTIMIZATION PROGRAM FOR THE
INFANT MORTALITY MODEL

The objective is to achieve the lowest possible level of infant mortality given the available resources and possible health activities.



resources among competing health interventions to achieve the lowest possible level of infant mortality. Although the infant mortality problem involves a nonlinear optimization problem, the approach used to obtain an optimum solution parallels that used in a linear optimization program. First, the epidemiological characteristics of the population, the availability of resources, and the effectiveness of various health interventions are set. Second, a choice of intervention activity levels lying within the resource constraints for the locality under analysis is made. Third, the level of the objective, the rate of infant mortality, is calculated given the choice of intervention activities. Finally, the first three steps are repeated and an optimization algorithm is used to determine whether a minimum mortality rate has been reached or whether a further selection of activity levels should be made.

The optimization problem thus results in the following four distinct phases of the project.

1. The development of a model of the process by which infants and toddlers are exposed to mortality risks and of the way in which alternative strategies may alter the process.

2. Specification of the parameters of the model either through direct estimation or as the result of a survey of medical and public health professionals regarding the impact of alternative health interventions on infant mortality.

3. Estimation of the cost of alternative health interventions, an assessment of available resources, and the specification of baseline epidemiological and demographic data.

4. The choice of a simulation or nonlinear optimization procedure

to determine the set of interventions which are most cost effective in raising the probability of child survival given the design of the model and the estimated effectiveness of interventions.

Progress to Date

1. Bibliographical Search

An important preliminary activity contributing to the design of the model, has been the assembly of a collection of books, journal articles and institutional documents related to the quantitative dimensions of the infant mortality problem and research on the disease processes underlying infant and child mortality. The survey was commenced in September 1976, and continues as an ongoing part of the project. While the volume of potential bibliographical materials and the scale of the professional fields covered precludes an exhaustive and definitive study suitable for independent publication, the bibliographical research has been an invaluable aid in the determination of disease categories, the designation of potentially important interdisease relationships and the choice of interventions for analysis. The appendix presents a summary of the results of the bibliographical search and a partial listing of the items.

2. The Infant Mortality Model

The first phase of the project, the design of a model of the infant mortality process has been completed. Development proceded in two stages. During June through August, 1977, the algebraic and logical relationships for a general model of two diseases were developed. The model was then extended to cover an indefinite number of morbidity categories. The goal at this stage was to derive an algebraically logical and appropriate model which is sufficiently simple to be amenable

to the repeated calculation of a solution needed in the optimization program yet sufficiently complete to include essential medical relationships. Chapter Two presents a summary of the basic mortality model.

From July through October work proceeded on the specification of the general model to conform to the relationships between diseases and interventions relevant to infant mortality. The major consideration of this part of the research was to insure the medical accuracy of the model's relationships and to choose practical health interventions which might actually be considered by a rapidly developing country with high levels of infant mortality. Chapter Three presents a summary of the specific infant mortality model, including interventions and disease categories, which will form the basis of the optimization program used in the project.

3. Specification of Impact Parameters

The calculation of the morbidity and fatality rates from the effective levels of intervention activities and the socioeconomic characteristics of the population requires an estimate of the impact of these variables. Several problems arise in the specification of the quantitative relationships between the various policy interventions and the probability of contracting and surviving different disease problems. Perhaps the most accurate specification would involve the statistical analysis of morbidity and fatality data under various intervention conditions. But for many of the interventions and disease categories, the technological and physiological relationships are not fully understood, and even where the theoretical relationships are explicit no suitable body of data exists which would allow their empirical specification. It is clear that providing the full set of techno-

logical parameters through the normal process of medical research might delay any comprehensive analysis of alternative policy interventions until the distant future.

We have chosen a survey of health practitioners as an alternative, practicable means of specifying the intervention effects. In spite of the dearth of explicit theoretical information, a sufficient wealth of practical experience and knowledge exists to allow the use of "Bayesian" or "Delphi" techniques to estimate the needed quantitative relationships at a level of accuracy adequate for policy analysis. It is obvious that policy choices are often made using government policy makers' own subjective evaluations of the impact of health policies. The use of a subjective survey to specify the parameters of a model such as the present one allows the subjective evaluations of health planners to be combined with information about costs to facilitate the choice of the most cost effective policies.

During October and November, 1977, a tentative survey procedure and a set of survey questions, sufficient for the specification of the model, were developed. Several preliminary interviews were held and based on the experience gained a final survey procedure and set of questions has been adopted. Contacts with potential participants have been made and interviews are taking place from December, 1977, through February of 1978. Chapter Four presents the protocol which is being followed in the survey of health practitioners.

4. Costs and Baseline Data

The need for cost information and baseline data requires the selection of a community for analysis. After a consideration of

several sites, it was decided to locate the analysis in Cali, Colombia, in the area of the PRIMOPS project which is currently being carried out by the Universidad del Valle and Tulane University under a contract by AID. An important advantage of this site is that a preliminary morbidity and demographic survey, which can provide baseline data, was carried out at the inception of the PRIMOPS project. A second advantage is that an objective of the PRIMOPS project is to obtain information about the cost of interventions similar to those interventions being considered for the present project. The use of PRIMOPS cost data will provide a considerable savings in time and effort. A final advantage is that data is being gathered which will allow the statistical estimation of intervention impacts. Although this information will not be available until about two years from the present, the prospect of such information holds out the possibility of a corroboration or rejection of the subjective specification procedure to be tested in the infant mortality project.

Approval for the conduct of the infant mortality project in Colombia has been given by the Colombian Ministry of Health. PRIMOPS personnel in Colombia have agreed to provide the needed baseline data and cooperate in the costing of the interventions. The baseline morbidity and epidemiological data has been partially assembled; it is anticipated that the remaining baseline data will be available by February, 1978. The cost information will be obtained in Colombia in March and April of 1978.

5. The Optimization Technique

A preliminary simulation program which will provide the objective for a nonlinear optimization technique has been completed. The final simulation program awaits the results of the survey of health practitioners and the acquisition of the baseline data. The optimization method

will probably be EXPLORE, a program widely available and which uses a constrained gradient search procedure to set activity levels. The program is being modified with the addition of a grid search and by expanding its dimensions for use with the mortality model. At the present time, the optimization procedure is functioning effectively with a segment (one age group) of the model and a subset (twenty-five) of the interventions. It is anticipated that the optimization procedure will be ready for application by the summer of 1978.

Summary

1. The model has been completed.

2. The survey protocol is complete and several interviews have been carried out. The remaining interviews will take place in January and February of 1978.

3. Arrangements have been made to obtain baseline data and intervention cost information in a cooperative effort with PRIMOPS personnel in Cali, Colombia. This work will take place in March and April of 1978.

4. Work on the optimization procedure is underway and is expected to be complete by the summer of 1978.

5. Application, simulation and refinement of the model will take place from September of 1978 through June of 1979.

II. THE BASIC MORTALITY MODEL

The core of the optimization program is the infant mortality model used to calculate the infant mortality rate which results from the epidemiological characteristics of the population and the choice of intervention activities. The model derives an ostensive complexity and nonlinearity from the intrinsic characteristics of the morbidity process. However, in spite of the apparent complexity a closer inspection of the model will reveal that the logical, if not the algebraic, relationships are forthright and intuitively clear. It can be argued that for a practical application the size of the model should be increased; the degree of aggregation of the disease categories and the broad definitions used for the intervention tasks are both aspects which might allow a fruitful expansion of the model with sufficient time and funds. But given the lack of a precedent for a model such as this - previous optimization models have either dealt with only one disease[1] or with an even greater level of aggregation[2] - the project's overriding objective, which is to develop a framework or technique for policy analysis, is best served by the level of aggregation used here. The model is large enough to contain many of the essential characteristics to be met with in modelling multiple disease processes, but small enough to be tractable.

Salient features of the model include the use of interactive

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[1] See, Martin Feldstein, M.A. Piot and T.N. Sundaresan, Resource Allocation Model for Public Health Planning: A Case Study of Tuberculosis Control, WHO, Geneva, 1973.

[2] For instance see, Hector Correa, Population, Health, Nutrition and Development, D.C. Heath, Lexington, 1975, Chapter Five.

simultaneous equations to model the multiple disease causes of death, the clear distinction between preventative activities affecting morbidity and curative activities affecting case fatality rates, the separation of the early childhood period into age sub-groups with distinct morbidity characteristics, and the use of equation forms which represent, as appropriate, increasing, constant and decreasing returns to additional health services. Further, the optimization program distinguishes between program usage (which an economist might view as the demand side of the market for health services) and program availability (which can be viewed as supply), and operates in such a manner as to set intervention levels which will equilibrate usage and availability.

Synopsis of the Model

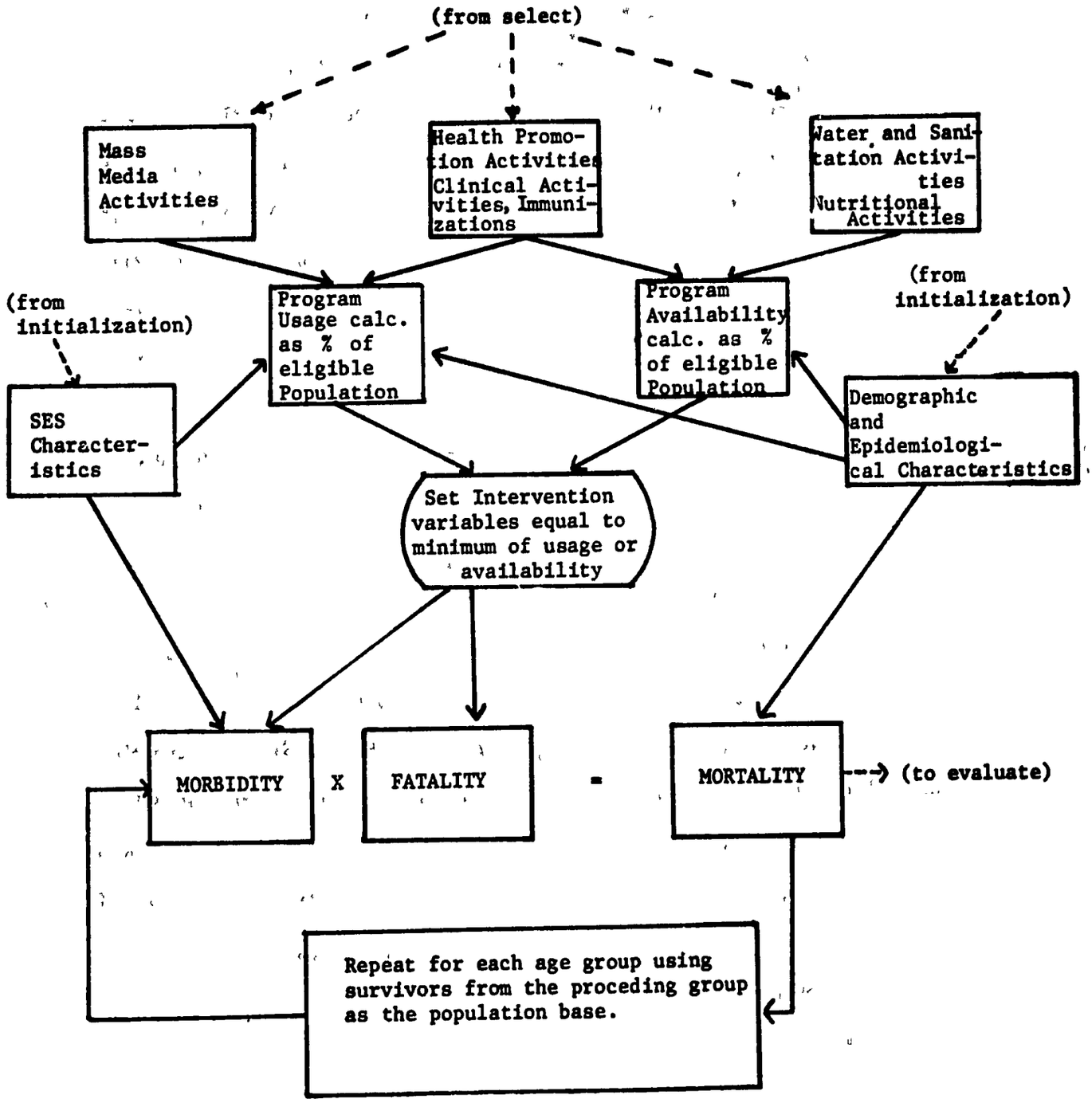
The details are elaborated below but diagram #2 is sufficient to gain an overview of the model and illustrate some of these features. The basic relationship, shown towards the bottom of the diagram, is the calculation of mortality rates as the product of morbidity (the morbidity rate measures the prevalence of disease in the reference population) and case fatality (the fatality rates measure the incidence of death in the diseased population). Although not shown in the diagram, separate morbidity and case fatality rates are derived for each age group and an overall mortality rate is then obtained by an appropriate summation over all disease categories.

1. Usage Versus Availability

The boxes at the top of the diagram represent the choice of intervention activities flowing from the selection part of the optimization program. These are conveniently partitioned into mass media and other health promotional activities, clinical activities, immunizations, water and sanitation and

Diagram #2

THE INFANT MORTALITY MODEL*



*This diagram provides an exploded view of the third box down in the optimization flow diagram (diagram # 1).

nutritional activities. The level of the activities, originally measured in the resource allocation part of the optimization program in terms of an absolute number of visits or other appropriate units, is recalculated as a percent of the eligible population given the demographic and epidemiological charcteristics of the population as represented in the box on the right-hand side of the diagram. For some of the interventions, such as water and sanitation, this yields program availability directly. Other interventions, such as mass media, act together with socioeconomic characteristics to determine the level of program usage. Still other interventions, such as health promoters who visit the household, both provide services and encourage program use.

Since, in order to be effective, a program must not only be available, but also used; the model selects the minimum of usage or availability, expressed as a percent of the eligible population, to be used as the <u>effective</u> level of intervention activities in the determination of morbidity and case fatality rates.[1] Thus, for instance, if clinic capacity is 70%, but it is calculated that only 60% of the eligible population uses the clinics, the morbidity and fatality rates would be calculated using the 60% as the effective level of the clinical interventions. On the other hand, if program usage would be 100%, but the available capacity is only 70%, the calculation of morbidity and fatality rates is based on the 70% figure.

2. Age Groups

Given the effective level of intervention activities, and the socio-

---

[1] Water and sanitation usage enters the model somewhat differently. For these interventions, the usage segment of the model determines the <u>efficacy</u>, rather than the level, of intervention use.

economic characteristics of the population, and estimates of the impact of these variables on morbidity and fatality rates, a mortality rate is calculated for each age group. Since the survivors from each age group become the population base for the next older age group, the age specific mortality rates for younger ages affect the flow of population into the box labeled "demographic characteristics" for older age groups. Repeating the process outlined in diagram #2 over all age groups considered in the model allows the derivation of an overall mortality rate for a baseline number of births over the first 60 months of life and for a given selection of intervention levels.

3. An Example of the Allocational Trade-off between Interventions Effecting Usage and Availability

The mortality rate thus calculated becomes one reference point (used in the diamond labeled "evaluate" in diagram #1) allowing the generation of an optimum resource allocation. For example, consider the equilibration of usage and availability, if an initial allocation of resources to health promotional activities leads to a low participation rate and slack capacity in intervention activities such as clinical services this would be discovered in subsequent runs through the optimization program. It would be discovered in the evaluation segment of the program, through algorithms dictating the procedure for experimenting with intervention choices, that when resources were taken from usage promoting activities and given to clinic activities, mortality would increase (because of decreased use of clinic services when needed), but that when resources were taken from clinical activities and used for health promotion, mortality would decrease (because of an increased use of clinic services and a reduction of slack capacity).

Similar examples can be constructed to illustrate other trade-offs of interest, such as the trade-off between inpatient care, which effects case fatality rates, and interventions such as water and sanitation primarily affecting morbidity rates. In actuality, the program treats all of these problems jointly and considers the simultaneous trade-off of all interventions viewed as choice variables, although the design of the program permits some interventions to be preset at given levels and allows a restricted search over a subset of interventions of interest for particular problems.

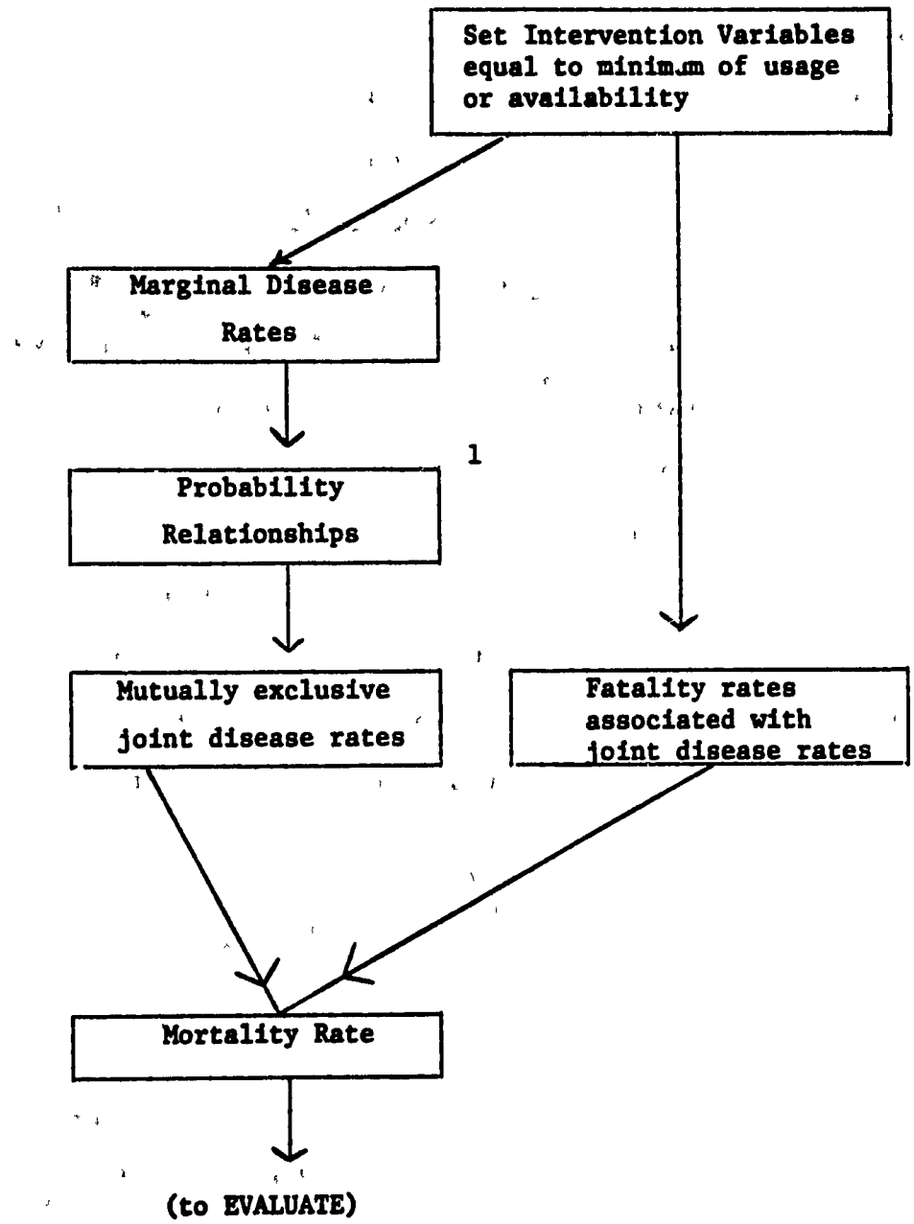
4. Marginal versus joint morbidity rates

Diagram #3 presents a detail of the calculation of the mortality rates. The diagram is intended to emphasize that the morbidity rates, i.e., the marginal disease rates, are derived from functions analagous to marginal probability functions. These functions do not necessarily generate mutually exclusive rates, but instead generate the incidence of given diseases including cases where other diseases are present as well as less complicated disease states. Using these functions and a set of assumptions regarding the degree of independence between diseases, together with a set of probability relationships, mutually exclusive joint disease rates are generated. These rates can be used to calculate the distribution of the population among the disease states representing the various possible combinations of the individual diseases considered. Fatality rates for each of the mutually exclusive joint disease states are then used to calculate the state-specific mortality rate. The overall mortality rate is obtained by summing over all disease states.

By generating the morbidity structure of the model from marginal disease functions rather than directly through the use of separate functions for each of the mutually exclusive disease states, the number

Diagram #3

THE INFANT MORTALITY MODEL
Detail Showing Calculation of Mortality Rates



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[1] In general it is not possible to go from a marginal distribution to a joint distribution without knowledge of the kind and degree of ralationships among variables. Here we assume all diseases are independent except where an interaction is noted by the connecting arrows in Diagram 4.

of parameters needed to specify the model is substantially reduced. Whereas n structural equations[1] are needed for a model of n diseases if the model is specified using marginal morbidity rates, 2^n-1 equations would be needed to specify the model directly at the level of the mutually exclusive disease states. In addition, the specification of the model at the level of the marginal disease rates has several other advantages which are brought out in the discussion below.

Reducing Mortality When Diseases are Interdependent

Comparatively little work has been done on the modeling of interdependent diseases. A recent study by Correa is typical. In developing a series of models for use in health planning, he explicitly assumes that no interdependence exists, on the grounds that "fortunately, when the plan refers to short time periods, this interdependence is not likely to be important".[2] But it would not be difficult to argue that interdependence might well be quite important, even in the short run. A few examples of the phenomenon can be given from the area of childhood diseases:

- gastro-enteritis leads to malnutrition, and vice versa, both conditions being major causes of child mortality in low-income countries.[3]
- measles often causes respiratory problems.[4]

---

[1]The structural equations give an algebraic formulation of the model in terms of relationships which have a direct interpretation. The information contained in the equations describe the relationships between diseases and the impact of interventions and socioeconomic variables on disease incidence.

[2]Correa, p. 134.

[3]Heller, P. S. and Drake, W. D. Malnutrition, child morbidity, and the family decision process, (1976). Center for Research on Economic Development, University of Michigan, Discussion Paper No. 58.

[4]Rashmi, A., Guha, D. K. and Khanduja, P. C. Postmeasles pulmonary complications in children, (1971). Indian Pediatrics 8, 834-38.

malnutrition produces a general debilitation, and increases the death rate from a variety of respiratory and digestive diseases.[1]

The purpose of this section is to describe a simple model which allows for this kind of interdependence. First, some features of existing mortality risk models (which don't allow for interdependence) are reviewed. Next, a general approach to incorporating interdependence is outlined. A specific model based on two interdependent diseases is then developed, with some numerical illustrations.

1. Existing models of competing risks

Suppose that in a population of a given age the general death rate (from all causes) is 20 percent. The death rate from a certain specific disease is 5 percent. That disease is then eliminated. What happens to the general death rate? This question is of obvious interest for our study.

One approach to this question says that the answer will definitely exceed 15 percent. This is the theory of competing risks which points out that some of the 5 percent who would have died from the eliminated disease will now die from some other cause (during the period in question). Several models of competing risks have been developed, all of them based on mutually exclusive combination disease states, for example refer to the models of Chiang[2] and Kimball.[3]

---

[1] Newman, P. Malaria Eradication and Population Growth, (1965). Bureau of Public Health Economics, Ann Arbor, Michigan.

[2] Chiang, C. L. "On the probability of death from specific causes in the presence of competing risks," (1966). Fourth Berkely Symp. IV, 162-80, and "Competing risks and conditional probabilities," (1970). Biometrics 26, 767-76.

[3] Kimball, A. W. "Models for the estimation of competing risks from grouped data," (1969). Biometrics 25, 329-37.

Interdependence has not typically been allowed for in models of competing risks. When one disease is eliminated, it is essentially assumed that the probability of catching any other disease is unaffected. With this assumption Chiang (1961) derives the following formulation for answering our opening question about death rates:

$$p_2' = 1 - (1 - p_1 - p_2)^{p_2/(p_1 + p_2)}$$

where p_1 = probability of death from Disease 1 (later eliminated)

p_2 = probability of death from all other causes, before elimination of Disease 1.

p_2' = probability of death from all other causes, after elimination of Disease 1.

(The notation follows that used in the version of Chiang's model presented by Kimball, 1969). Using our numbers, $p_1 = 0.05$ and $p_2 = 0.15$. Chiang's model therefore predicts that the general death rate after the elimination of Disease 1 (i.e., p_2' will be 0.154).

Kimball offers a contrasting model, based on what he terms a "multinomial approach". Still assuming independence of risks, he derives the following formulation for the general death rate after the elimination of Disease 1:

$$p_2' = p_2 (1 - p_1')$$

With our numbers for p_1 and p_2', p_2 equals 0.158, slightly different from Chiang's prediction.

In a comment on Kimball's contribution, Chiang (1970) recognizes the importance of interdependence between causes of death, and suggests that a proper method of allowing for interdependence is to specify probabilities of morbidity as well as of mortality. Models of competing

risks have been deficient in not specifying morbidity rates:

> "We must recognize the fact that the death of an individual is usually preceded by an illness (condition, disorder). It is not realistic to speak of a person's chance of dying from tuberculosis when he is not even affected with the disease. Also competition of risks of death depends on the health condition of an individual: a person affected with a disease (say, cardiovascular-renal (CVR) diseases) probably has a probability of dying of a second disease different from a person who is not affected with CVR. Therefore, a mortality study is incomplete unless illness is taken into consideration".

Following Chiang's suggestion, we develop in the next section an alternative approach to an analysis of mortality which explicitly incorporates morbidity. This second approach, which is based on the notion that many diseases are interdependent raises the possibility that the answer to the question posed at the beginning of this section might well be less than 15 percent. Because of interdependence there may be a tendency for the death rate from the other diseases to decline, and this tendency may offset the opposite effect of competing risks on that death rate.

2. A General Approach to the Modelling of Mortality Risks with Disease Interdependence.

In this section we give a more formal description of the approach set forth in the discussion associated with diagram 3. The objective is to derive a procedure for the specification of a model which will predict the mortality effects of specific health improvements while allowing for interdependence between diseases. This can be done in four logical stages as follows:

a) Specify a morbidity function for each disease (or group of diseases), showing for the population in

question the determinants of the morbidity rate:

$$p_i = p_i\ (A_i,\ p_j) \qquad i,j = 1,2,\ldots,\ n; \quad i \neq j \quad (1)$$

where $\underline{p_i}$ is the fraction of the population (defined by age, sex or other characteristics) who have disease $\underline{i}$ at some time during a defined time interval. There are $\underline{n}$ diseases. Each morbidity rate $\underline{p_i}$ is determined by a set of socioeconomic, environmental, and policy variables represented by the vector $\underline{A_i}$ and also by the prevalence of each other disease $\underline{p_j}$. Degrees of interdependence are measured by the partial derivatives $\partial p_i/\partial p_j$. The impact of policy variables is measured by the partial derivatives $\partial p_i/\partial A_i$.

b) Define all possible combinations of diseases, and derive from the morbidity functions the fraction of the population having each combination:

$$c_k = c_k\ (p_i) \qquad k = \overline{1}23\ldots n,\ 1\overline{2}3\ldots n,\ 12\overline{3}\ldots n,$$

for a total of $(2^n - 1)$ such terms; $(\overline{1}23\ldots n)$ is read as "having all diseases except Disease 1" (2)

where $\underline{c_k}$ is the fraction with disease-combination $\underline{k}$. If there are $\underline{n}$ diseases, there will be $(2^n - 1)$ disease-combinations. For example, in a two-disease system a person may have Disease 1 but not Disease 2, may have Disease 2 but not Disease 1, or may have

both diseases, for a total of three possible disease combinations. Clearly the c_k are mutually exclusive (unlike the p_i), and the following relationship also holds true:

$$\sum_k c_k + c_w = 1 \qquad (3)$$

where c_w is the fraction of the population who remain well (or have diseases excluded from the analysis) throughout the entire interval. In addition the generated rates must be consistent with the elementary postulates of probability theory.[1]

c) For each disease-combination, specify a fatality function, showing what determines the fatality rate among those with a given disease-combination:

$$f_k = f_k\ (B_k) \qquad (4)$$

where f_k is the fraction of those with disease-combination k who die during the specified time interval, and B_k is a vector of socioeconomic, environmental, and policy variables. Specifying fatality functions in this way allows for the sort of phenomenon noted by Chiang in the quotation cited above: that a person who has cardiovascular-renal disease in combination with some other disease

[1] See Norman C. Dalkey, "An Elementary Cross Impact Model", Technological Forecasting and Social Change, 3 (1972), American Elsevier.

may have a probability of dying different from that of a person who has only that other disease.

d) Multiplying a fatality rate ($\underline{f}_k$) by the corresponding disease-combination rate ($\underline{c}_k$) then gives the fraction of the entire population who die from that particular disease-combination during the interval in question (d_k):

$$d_k = f_k \cdot c_k \tag{5}$$

And because the $\underline{c}_k$'s are mutually exclusive, the sum of the d_k's equals the general death rate D:

$$D = \sum_k d_k \tag{6}$$ [1]

The programming application of a model derived using this approach is consistent with the schema introduced in diagrams one through three above. An intervention designed to reduce mortality, like mass vaccination against measles, will cause changes in the vectors $\underline{A}_i$ or $\underline{B}_i$. A simulation exercise with the model will therefore show the effects of the intervention on the general death rate D, with full allowance being made for both interdependence and competing risks. A heuristic advantage of the approach, it might be noted, is that public health interventions involving "prevention" affect $\underline{A}_i$, while those involving "treatment" affect $\underline{B}_i$.

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[1] This derivation of D can be compared with that appearing in a series of health planning models developed by Correa [1975, pp. 117-69], whose expression for D, using our notation, is as follows:

$$D = \sum_{i=1}^{n} (f_i \cdot p_i)$$

But since the morbidity rates $\underline{p}_i$ are not mutually exclusive, this formulation obviously overstates $\underline{D}$.

3. Specification of a Morbidity-Mortality Model

Several steps must be taken in order to use the approach outlined above for the specification of a morbidity-mortality model in a given application. First, a form must be chosen for the functions generating the marginal morbidity rates (equations 1). Second, assumptions must be made and a procedure developed which will allow the transition between the marginal disease rates to the mutually exclusive joint disease rates (equations 2). Third, a form must be chosen for the fatality rate functions (equations 4).

The manner in which these steps are taken is arbitrary and will vary with the particular situation to be modelled. The steps outlined below form the basis for the initial computer simulation model we have developed for the infant mortality project. The procedure to be used for the specification of the coefficients (see chapter IV) is intended to be flexible enough to allow experiments with other equation forms. The optimization technique we are developing is likewise intended to be sufficiently flexible to allow the use of alternative treatments of the probability constraints needed for the probability transition relationships. In the final year of the project we expect to try other equation forms (such as the exponential or linear probability functions) and alternative assumptions and procedures for deriving the transition relationships between the marginal and joint disease rates.

a. Marginal Morbidity Rates

To derive a functional form for the marginal morbidity rates we commence with the general form (equation 1) which we assume to be continuous and differentiable and note that

changes in the rate of disease i are related to changes in other disease rates and to changes in policy variables by the differential equation:

$$dp_i = \sum_{j \neq i} \frac{\partial p_i}{\partial p_j} dp_j + \frac{\partial p_i}{\partial A_i} dA_i \qquad (7)$$

Since the morbidity rates, p_i, are interpreted as probabilities equations (1) and (7) must satisfy the following boundary conditions: if $p_i = 1$ or 0 then dp_i must equal zero for changes in p_j and A_i. It can be demonstrated[1] that the algebraicly simplest specification which can satisfy these conditions is the logit,

$$p_i = \frac{1}{1 + \exp(-\gamma_i - \alpha_i A_i - \sum_{j \neq i} \beta_{ij} p_j)} \qquad (8)$$

where $\beta_{ij} = \frac{\partial p_i}{\partial p_j}$ and α_i is a vector with the policy impact derivitives, $\frac{\partial p_i}{\partial A_j}$ as elements. γ_i is a constant which is chosen after values for α_i, β_i and A_i and initial values for p_i and p_j are given.

b. The transition from marginal to joint disease rates

i) Consistency

In general it is not possible to go from a marginal distribution to a joint distribution without assumptions regarding

[1] See Murray Turoff, "An Alternative to Cross Impact Analysis", Technological Forecasting and Social Change, No. 3, American Elsevier for a demonstration and the development of a cross impact analysis based on a logit specification of behavioral probability functions.

the kind and degree of relationships among the events whose distributions are being considered. For example, the simplest assumption one might make is that the events are independent; it then follows that the joint rates can simply be obtained as the product of the marginal rates. However, if there are interdependencies among events, as there are with the disease events we are considering, the generation of joint relationships quickly becomes more complicated. One of the problems is that the probabilities generated must be consistent with the elementary postulates of the calculus of probability.[1] Given a particular choice of functional form, the consistency requirement imposes relationships on the parameters of the probability functions. Consistency can be achieved either by solving analytically for the required relationships between parameters or by specifying consistent functional forms or by repeated testing of values generated by the model and the rejection of inconsistent solutions. When the model has more than two or three diseases, the analytical solution for consistent parameters or the derivation of consistent functional forms becomes intractable. For our initial simulation model, we have decided to use the second alternative, that is, to impose constraints (boundary) values), on the probabilities generated, which will force the

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[1]The problem is analogous to one which occurs in the estimation of demand systems in economics. There the estimated system should be consistent with the elementary theorems of utility theory. In practice one of two procedures can be used, either 1) a system of equations yielding consistent solutions is used for estimation or 2) a less restrictive system of equations is used and the estimated parameters are tested for consistency.

solutions produced in the optimization program to be consistent with the postulates of probability theory. Thus, resource allocation choices which produce probabilities outside the boundaries will be found to produce sub-optimum solutions and successive allocations will be made until the generated probabilities are consistent with the probability constraints.

ii) Calculation of joint disease rates

The generation of the joint disease rates is accomplished through their decomposition into components distinguished by the presence or lack of a causal influence between diseases. The problem has been simplified by assuming that there is no mutual causation, i.e., the probability that i leads to j and j to i in a given individual over a given time period is zero. It is also assumed that joint causation is negligible, i.e., the probability that i and j together cause k is zero. Finally the probability of more than three diseases is set to zero under the assumption that the loss in accuracy is negligible. An exposition of the derivation of the joint disease rates for a four disease model is given in the appendix to this chapter. The derivation for a two disease model is given in the next section.

4. An Example - A Two-Disease Model of Interdependence

We now specify an interdependence model with a view to providing a numerical illustration, choosing the simple case of only two diseases or disease-groups. The numbering of the equations in this specific model follows that used in the general model above. It will be

noted that the most complex part of the specific model lies in the derivation of the disease-combination rates $\underline{c}_k$.

The morbidity rate for Disease 1 ($\underline{p}_1$) is determined by the rate for Disease 2 ($\underline{p}_2$) and by an index of other factors ($\underline{a}_{10}$):

$$p_1 = \frac{1}{1 + e^{-(a_{10} + a_{12}\, p_2)}} \qquad (1a)$$

And similarly for Disease 2:

$$p_2 = \frac{1}{1 + e^{-(a_{20} + a_{21}\, p_1)}} \qquad (1b)$$

$\underline{a}_{12}$ and $\underline{a}_{21}$ being indexes of interdependence. As we noted above, the particular functional form chosen for these equations (the logit form) has the property of containing the morbidity rates to lie between zero and one.

The disease-combination rates $\underline{c}_{\bar{1}2}$ and $\underline{c}_{1\bar{2}}$ are readily derived as follows:

$$c_{\bar{1}2} = p_2 - c_{12} \qquad (2a)$$

$$c_{1\bar{2}} = p_1 - c_{12} \qquad (2b)$$

where c_{12} is the fraction of the population having both diseases. If the two diseases were independent, it would be reasonable to assume that this fraction was equal to the product of the two

morbidity rates:

$$c_{12} = p_1 \cdot p_2 \qquad (2c)$$

But with interdependence, equation (2c) is not valid. With interdependence, $\underline{c}_{12}$ must be measured by adding together (i) cases where Disease 1 causes Disease 2 ($\underline{c}_{1 \to 2}$), (ii) cases where Disease 2 causes Disease 1 ($\underline{c}_{2 \to 1}$), and (iii) cases where both diseases occur but without any causal link between them ($\underline{c}_{(12)}$). The point is clarified in Table 2-1. Each disease may be caused by the other, not be caused by the other, or not be present at all. Considering both diseases, there are then nine categories for the population to fall into. Three of these are eliminated on logical grounds.[2] The remaining six are mutually exclusive.

By examination of Table 1 we therefore conclude that:

$$c_{12} = c_{1 \to 2} + c_{2 \to 1} + c_{(12)} \qquad (2d)$$

Separate expressions must now be obtained for the three components of $\underline{c}_{12}$. The fraction of the population where Disease 1 causes Disease 2 can be measured as the <u>difference</u> between (i) the fraction actually having Disease 2 ($\underline{p}_2$) and (ii) the fraction who would

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2. First, a person who "does not have Disease 1" cannot have during the same time interval "Disease 2 caused by Disease 1." (Lagged effects, as when Disease 1 occurring in one period causes Disease 2 to occur in the next, can be readily incorporated into a dynamic version of the model.) Second, a person who "does not have Disease 2" cannot have "Disease 1 caused by Disease 2." Third, cases of mutual causation are ruled out, where a person has "Disease 1 caused by Disease 2" as well as "Disease 2 caused by Disease 1." It is assumed that within the given time interval, one of the diseases will occur first, and cannot therefore be caused by the other.

Table 2-1

DISEASE - COMBINATIONS WITH TWO INTERDEPENDENT DISEASES

Entries in the matrix represent the fraction of a population with the characteristics indicated

	Has Disease 1 caused by Disease 2	Has Disease 1 not caused by Disease 2	Does not have Disease 1	Row Sum
Has Disease 2 caused by Disease 1	0	$c_{1 \to 2}$	0	$c_{1 \to 2}$
Has Disease 2 not caused by Disease 1	$c_{2 \to 1}$	$c_{(12)}$	$c_{2\bar{1}}$	$p_2 - c_{1 \to 2}$
Does not have Disease 2	0	$c_{1\bar{2}}$	c_w	$1 - p_2$
Column Sum	$c_{2 \to 1}$	$p_1 - c_{2 \to 1}$	$1 - p_1$	1

have Disease 2 if Disease 1 did not exist (i.e. if $\underline{p}_1 = 0$). Symbolically:

$$c_{1 \to 2} = p_2 - \frac{1}{1 + e^{-a_{20}}} \qquad (2e)$$

Similarly:

$$c_{2 \to 1} = p_1 - \frac{1}{1 + e^{-a_{10}}} \qquad (2f)$$

The fraction of the population where both diseases exist without causal connection ($\underline{c}_{(12)}$) can be reasonably estimated as the product of two independent frequencies: (i) the frequency of having Disease 1 not caused by Disease 2, and (ii) the frequency of having Disease 2 not caused by Disease 1. That is:

$$c_{(12)} = (p_1 - c_{2 \to 1}) \cdot (p_2 - c_{1 \to 2}) \qquad (2g)$$

The three disease-combination rates $\underline{c}_{\bar{1}2}$, $\underline{c}_{1\bar{2}}$, and $\underline{c}_{12}$, having been determined, the next step is to specify the corresponding fatality rates $\underline{f}_{\bar{1}2}$, $\underline{f}_{1\bar{2}}$, and $\underline{f}_{12}$. To simplify this version of the interdependence model, the fatality rates are assumed to be fixed.[1] We then have equations for the disease-combination - specific death rates $\underline{d}_{\bar{1}\bar{2}}$, $\underline{d}_{1\bar{2}}$, and $\underline{d}_{12}$:

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[1] In the infant mortality model presented in the next chapter, the fatality rates are generated by a logit function.

$$d_{\overline{1}2} = f_{\overline{1}2} \cdot c_{\overline{1}2} \tag{5a}$$

$$d_{1\overline{2}} = f_{1\overline{2}} \cdot c_{1\overline{2}} \tag{5b}$$

$$d_{12} = f_{12} \cdot c_{12} \tag{5c}$$

and for the general death rate D:

$$D = d_{\overline{1}2} + d_{1\overline{2}} + d_{12} \tag{6a}$$

The operation of the model is illustrated with a numerical example in Table 2. It is imagined in Column (B) that information is available on the morbidity rates $\underline{p}_1$ and $\underline{p}_2$, for example from a morbidity survey of households. Information also exists on the partial derivatives $\partial \underline{p}_1/\partial \underline{p}_2$ and $\partial \underline{p}_2/\partial \underline{p}_1$, which can be interpreted as the likelihood that one disease will lead to the other (within the given time interval). This information may be obtainable from analysis of individual medical histories. Given $\underline{p}_1$, $\underline{p}_2$, and the two derivatives, the $\underline{a}$ terms in the morbidity functions can be derived, as well as the disease-combination rates ($\underline{c}_k$).[3] With fatality rates ($\underline{f}_k$) also supplied, the general death rate D can then be calculated.

In Column (c), the effects of eliminating Disease 1 are shown. To eliminate the disease, the value of $\underline{a}_{10}$ is changed to $-\infty$. The other

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3. The calculation of the $\underline{a}$ terms involves using the following for the two derivatives:

$$\partial p_1/\partial p_2 = a_{12} e^{-(a_{10} + a_{12} p_2)} [1 + e^{-(a_{10} + a_{12} p_2)}]^{-2} \tag{7a}$$

$$\partial p_2/\partial p_1 = a_{21} e^{-(a_{20} + a_{21} p_1)} [1 + e^{-(a_{20} + a_{21} p_1)}]^{-2} \tag{7b}$$

Table 2-2

HYPOTHETICAL EFFECTS OF DISEASE ELIMINATION ON MORTALITY IN A TWO-DISEASE SYSTEM WITH AND WITHOUT INTERDEPENDENCE

Values marked (*) are assumed; remaining values are derived from the equations(s) indicated

	Equation(s) from which derived	With Interdependence		Without Interdependence	
		Both diseases present	Disease 1 eliminated	Both diseases present	Disease 1 eliminated
	(A)	(B)	(C)	(D)	(E)
1. p_1	1a	.1500*	0	.1500*	0
2. p_2	1b	.4000*	.3488	.4000*	.4000
3. $\partial p_1/\partial p_2$	7a	.1000*	0	0	0
4. $\partial p_2/\partial p_1$	7b	.3500*	-	0	0
5. a_{10}	1a, 7a	-2.0483	$-\infty$*	-1.7346	$-\infty$*
6. a_{12}	1a, 7a	.7843	.7843*	0*	0*
7. a_{20}	1b, 7b	-.6242	-.6242*	-.4055	-.4055*
8. a_{21}	1b, 7b	1.4583	1.4583*	0*	0*
9. $c_{1 \to 2}$	2e	.0512	0	0	0
10. $c_{2 \to 1}$	2f	.0358	0	0	0
11. $c_{(12)}$	2g	.0398	0	.0600	0
12. $c_{\bar{1}2}$	2a	.2667	.3488	.3400	.4000
13. $c_{1\bar{2}}$	2b	.0167	0	.0900	0
14. c_{12}	2d	.1333	0	.0600	0
15. $f_{\bar{1}2}$		.2500*	.2500*	.2500*	.2500*
16. $f_{1\bar{2}}$		.3000*	.3000*	.3000*	.3000*
17. f_{12}		.4000*	.4000*	.4000*	.4000*
18. $d_{\bar{1}2}$	5a	.0667	.0872	.0850	.1000
19. $d_{1\bar{2}}$	5b	.0050	0	.0270	0
20. d_{12}	5c	.0533	0	.0240	0
21. D	6a	.1250	.0872	.1360	.1000

$\underline{a}$ terms remain the same as in Column (B), and the morbidity rate for the remaining disease is recalculated. The disease-combination rates are also affected, and the general death rate falls by 30 percent.

Columns (D) and (E) show what happens if the two diseases are independent. The same model is used (except that zero values are assumed for the interdependence terms $\underline{a}_{12}$ and $\underline{a}_{21}$), and the same initial values are assumed for the morbidity and fatality rates. The elimination of Disease 1 reduces the general death rate by 26 percent. As would be expected, this reduction is smaller than the result in an interdependent system.

Table 2 also suggests how to answer the question about death rates which was posed at the beginning of this chapter. It is evident that the answer depends on how cases with both diseases are handled in the statistics on causes of death. If deaths of persons with both Disease 1 and Disease 2 are officially attributed to Disease 1, then the elimination of Disease 1 will cause the general death rate to fall by an amount <u>less than</u> the official death rate for Disease 1, regardless of any interdependence. With this kind of record-keeping, the death rate from Disease 1 is $(\underline{d}_{\bar{1}2} + \underline{d}_{12})$. The general death rate is always $(\underline{d}_{\bar{1}2} + \underline{d}_{1\bar{2}} + \underline{d}_{12})$. Eliminating Disease 1 reduces $d_{1\bar{2}}$ and d_{12} to zero but necessarily raises $\underline{d}_{\bar{1}2}$ (because of competing risks). Hence the fall in the general death rate will be less than $(\underline{d}_{\bar{1}2} + \underline{d}_{12})$, or the official death rate from Disease 1.

If, however, deaths of persons with both diseases are officially attributed to Disease 2, the elimination of Disease 1 could lower the general death rate by <u>more</u> than the official death rate for Disease 1. Table 2 shows this happening both with and without interdependence.

When the death rate for Disease 1 is defined as $\underline{d}_{1\bar{2}}$, the elimination of that disease will lower the general death rate ($\underline{d}_{\bar{1}2} + \underline{d}_{1\bar{2}} + \underline{d}_{12}$) by more than the death rate for Disease 1 if the rise in $\underline{d}_{\bar{1}2}$ (due to competing risks) is less than $\underline{d}_{12}$.

Summary

An approach to modelling the mortality process has been developed. By separating mortality into morbidity and fatality components the approach provides for a distinction between preventative and curative interventions. Using a two disease example the approach was contrasted with the theory of competing risks. It was found that, unlike the existing theory of competing risks, the procedure devised here allows for disease interdependence in the calculation of an estimate of the mortality effects of disease elimination (or reduction). By specifying the structure of the model in terms of marginal disease rates, rather than mutually exclusive joint disease rates, the number of parameters needed for specification of a given model is significantly reduced.

The approach devised here is sufficiently general to be applied in a variety of contexts. In the next chapter the approach is used to specify a model of child mortality covering the first sixty months of life.

APPENDIX TO CHAPTER TWO

Algebraic Summary of The Morbidity - Mortality Model

This appendix presents a summary of the general morbidity-mortality model described heuristically in the text. The objective in the design of the model is to allow the calculation of a set of mortality rates for mutually exclusive morbidity categories which include all possible combinations of diseases. There are four distinct segments to the system. The first involves the specification of a set of marginal probabilities as functions of interventions as well as other variables. This segment can be referred to as that of the structural (or causal) morbidity equations. The second segment is a set of algebraic relationships that allows the calculation of the probabilities of being in the mutually exclusive joint disease states. The third segment involves the specification of fatality probabilities for each of the mutually exclusive categories. This segment can be called the structural fatality equations. Finally, the fourth segment uses the fatality rates and joint morbidity rates to calculate the mortality rate.

I. Structural Morbidity Equations

The model is developed for four diseases. The extention to n diseases is straightforward although tedius. We specify the following marginal morbidity functions for diseases 1, 2, 3 and 4.

$$p_1 = p_1 (A_1, p_2, p_3, p_4) \qquad (1a)$$

$$\vdots$$

$$p_4 = p_4 (A_4, p_1, p_2, p_3) \qquad (1d)$$

II. Calculation of Mutually Exclusive Joint Disease Rates

a) Preliminary definitions:

i. P_{ij} is the probability of having i and j jointly.

ii. P_{ijk} is the probability of having i, j and k jointly.

iii. $\tilde{P}_{ij}$ is the probability that i occurs caused by j, that is,

$$\tilde{P}_{ij} = P_i\,(A_i, P_j \cdot \cdot \cdot P_\ell) - P_i(A_i, P_k \cdot \cdot \cdot P_\ell)\Big|_{P_j = 0}$$

iv. Similarly

$$\tilde{P}_{ijk} = P_i\,(A_i, P_j \cdots P_\ell) - P_i(A_i, P_\ell)\Big|_{P_j,\, P_k = 0}$$

v. P^*_{ij} is the probability that i occurs and is not caused by j. that is,

$$P^*_{ij} = P_i - \tilde{P}_{ij}$$

vi. Similarly

$$P^*_{ijk} = P_i - \tilde{P}_{ijk}$$

b) Preliminary assumption:

It is assumed that intersection probabilities of order higher than three are zero, i.e. $P_{1234} = 0$

c) Preliminary calculation - two disease intersections:

There are two kinds of cases where two diseases can occur simultaneously:

i) no causal links between diseases

ii. the two diseases are linked causally (either i causes j, or j causes i, or both. Thus the two disease intersection for i and j can be written using the notation introduced above as

$$p_{ij} = \tilde{p}_{ij} + \tilde{p}_{ji} - \tilde{p}_{ij} \cdot \tilde{p}_{ji} + p_i^* \, p_j^*$$

d) Preliminary calculation - three disease intersections. There are eight kinds of cases where the three diseases can occur simultaneously:

		Diagrammetically
i.	no causal links between the 3 diseases	i j k
ii.	i and j are causally linked (either i causes j, or j causes i, or both), but k is not causally linked with either i or j	i—j k
iii.	i and k linked, j independent	i j | k
iv.	j and k linked, i independent	i j k
v.	i and j linked, also i and k, but not j and k	i—j | k
vi.	i and j linked, also j and k, but not i and k	i—j k

vii. i and k linked, also i and k, but not i and j

viii. i and j linked, also i and k, also j and k

The eight groups being mutually exclusive, p_{123} is the sum of all eight. Keeping the eight groups in order, and defining

$$x_{ij} = \left[\tilde{p}_{ij} + \tilde{p}_{ji} - \tilde{p}_{ij} \cdot \tilde{p}_{ji}\right]$$

the three disease intersection can be written as the sum of eight terms.

$$\begin{aligned} p_{ijk} = {} & p^*_{ijk} \cdot p^*_{jik} \cdot p^*_{kij} \\ & + x_{ij}\, p^*_{kij} \\ & + x_{ik}\, p^*_{jik} \\ & + x_{jk}\, p^*_{ijk} \\ & + x_{ik}\, x_{jk}\, (1 - x_{ij}) \\ & + x_{ij}\, x_{jk}\, (1 - x_{ik}) \\ & + x_{ij}\, x_{ik}\, (1 - x_{jk}) \\ & + x_{ij}\, x_{ik}\, x_{jk} \end{aligned}$$

e) Given the preliminary calculations above the rates for the mutually exclusive disease states can be derived as follows:

i. $C_{1\overline{234}} = P_1 - P_{12} - P_{13} - P_{14} + P_{123} + P_{124} + P_{134} - P_{1234}$

$C_{2\overline{134}} = P_2 - P_{12} - P_{23} - P_{24} + P_{123} + P_{124} + P_{234} - P_{1234}$

.
.
.

and so on for $P_{3\overline{124}}$ and $P_{4\overline{123}}$.

ii. $C_{12\overline{34}} = P_{12} - P_{123} - P_{124} + P_{1234}$

.
.
.

and so on for $P_{13\overline{24}}$, $P_{14\overline{23}}$, $P_{23\overline{14}}$, $P_{24\overline{13}}$ and $P_{34\overline{12}}$.

iii. $C_{123\overline{4}} = P_{123} - P_{1234}$

.
.
.

and so on for $P_{124\overline{3}}$, $P_{134\overline{2}}$ and $P_{234\overline{1}}$.

iv. the states defined above + P_{1234} + P_{well} will sum to one. (We have asssumed that P_{1234} is negligible.)

III. Structural Fatality Functions

Fatality functions are specified for each of the joint disease states.

$$d_1 = d_1(B_1)$$

$$\vdots$$

$$d_K = d_{15}(B_K)$$

where K is the total number of disease states ($K = 2^n - 1 = 15$)

IV. The Mortality Rate

The mortality rate can be derived as the sum of the mortality rates for the individual joint disease states.

$$D = \sum_{k=1}^{K} d_k \, c_k$$

III. THE INFANT MORTALITY MODEL

Introduction

This chapter describes the full infant mortality model which will be used in the optimization program. Diseases, disease relationships and potential interventions which are appropriate in the context of given age groups for the childhood period in a peripheral urban community in a developing country are identified and then the model is specified using the general approach discussed in the preceding chapter. The model is designed to compare the effectiveness of alternative interventions in the reduction of excess infant mortality. Before commencing with a discussion of diseases and interventions we define excess mortality and discuss the breakdown of the first five years of life into appropriate age groups.

1. Obligatory versus excess mortality

In order to limit the range of the analysis to morbidity and mortality rates which are reasonable given the state of technology and physiological reality, bounds are placed on the probability functions. The effect of the bounds will be to restrict the optimization search to plausible reductions in morbidity and mortality rates given the available technology and practicable interventions in a developing country.

The whole concept of mortality under the age of five may be analysed under two main categories: a) those deaths which might be avoided by the broader application of known measures and b) those deaths which could only be prevented by the discovery and application of

new methods. For the practical purpose of the specification of the optimization model it is possible to use developed or industrialized countries' mortality rates, as "obligatory losses" or deaths that can only be prevented by the discovery and application of new medical and public health technology in developed countries. Mortality rates above this fundamental minimum could be considered "excess losses", potentially reduceble by extending services and changing the environment in developing countries.

For developed countries, childhood (1-14 years) is the more favorable period for survival over the life span. Decreases in the risk of mortality in succeeding age periods during infancy, continue beyond the first birthday. The death rates in the preschool age groups, 1-4 years, has always been a small fraction of the infant mortality rate; in recent years in the United States it has been less that 5% of the rate under one year of age. In fact, in the United States 96.4% of all deaths under the age of 5 occurred in the first year of life. Over 40% of the deaths during the first year occur in the first day, 65% in the first week and 70% in the first month. These deaths, at least from the point of view of our model, can be attributed to unavoidable physiological causes and most of the decrease in mortality rates in developed countries over the last twenty years can be accounted for by the significant changes after the first week of life. Observation of mortality rates in developed areas thus gives a kernal of unavoidable mortality which is fairly large in the first few weeks of life but quickly tapers off to very low values for the remainder of the childhood period.

If the rates and mortality structure attained at the present time by developed countries is defined as the portion of deaths that are "obligatory", anything above could be considered as preventable. A

plausible upper bound can be obtained through the use of data for a region and time where there was little or no preventative or curative activity and environmental conditions were extremely poor.[1/] The reduction in mortality below this upper bound can then be attributed to health intervention activities and changing environmental and socio-economic conditions.

In the infant mortality model, the upper and lower bounds on morbidity and fatality rates will be specified algebraicly by an appropriate choice of α_u and α_L in functions of modified logit form,

$$p = \alpha_L + \frac{\alpha_u}{1 + e^{-Z}}$$

This function is illustrated in figure one. As Z, which is a function of intervention activities and sociological variables, becomes very large and negative, p approaches the lower limit, α_L. Conversely as Z becomes very large and positive, p approaches the upper limit, $\alpha_L + \alpha_u$. With α_u and $\alpha_L + \alpha_u$ set, respectively, to values from countries with the most and least favorable conditions for infant survival, the values for the morbidity and fatality rates generated by the model can be restricted to a plausible range.

2. Choice of age groups

Because morbidity risks and responses to interventions change with the physical development of a child, we have divided the overall period under analysis, the first sixty months of life, into three

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[1] For instance, suitable baseline data may be obtained for Guatemala or Haiti during the decade 1960-70.

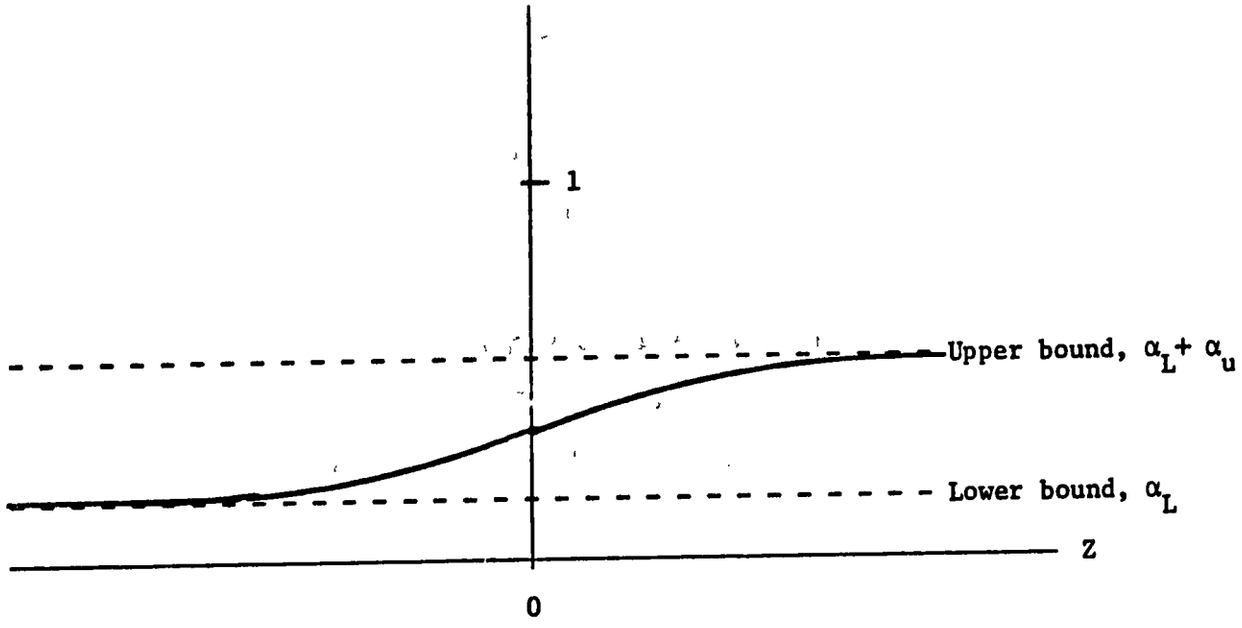

Figure One

Example of a constrained morbidity or fatality rate function (logit form)

separate age groups. The division chosen is 1) the neonatal period (the first month of life), 2) the infant period (1-12 months of life) and 3) the toddler period (12-60 months). These three periods are set apart from each other by large differences in mortality associated with distinct physiological characteristics in the development of the child. The first month of life is marked by a high risk of death from low birth weight and what we have called "obligatory causes". The period from one to twelve months is characterized by relative immobility of the child, breast feeding and transferred maternal immunity for some childhood diseases. In contrast, the period from twelve to sixty months is characterized by increased contact with the environment and susceptibility to the immunizable diseases of childhood. For the 13 countries of the PAHO mortality study the average neonatal mortality rate was 70.3 per 1,000 live born (38.8 to 123.0). For the infant period (29th day to 11 months) the rate was 39.7 of 1,000 live born. The rate for children 1 to 4 years was 6.23 (1.5 to 26.2).

The entire model therefore actually consists of three submodels covering three different age groups in the span between birth and five years of age. Individual age groups are linked in that the survivors of younger age groups become the demographic basis for intervention coverage and morbidity rates in the older age group.

Disease Categories

The selection of diseases used in the model is guided by three criteria. First, the objective of the model is to include a minimum number of morbidity states for simplicity but to account for at least 75% of childhood mortality. Second, diseases which have well known and obvious interventions which might be thought cost effective prior

to a formal analysis are included. The first two criteria might conflict, for instance tetanus and childhood inoculable diseases may account for less than 10-15% of childhood mortality in some areas. (Although in other areas, such as parts of India, their importance is indisputable.[1]) But the existence of vaccination toxins of known efficacy dictated the inclusion of these disease categories in the model.

The final criteria is a comparison of mortality rates by cause and age of death in developed and less developed regions or a comparison of mortality rates for developed countries over time to identify disease categories which show the most potential for reduction. This was the basis for the monumental study by Puffer and Serrano and is perhaps the most important criteria since it identifies a very few diseases with a great potential for improvement. The age-specific rates of death in developing countries grossly follow the same pattern as those in developed countries with a high proportion of deaths occurring at very early stages of life. The magnitude, however, is different. Very small differences are found in the rates for the first day of life (maximum two fold). The difference increases steadily however to rates 10-15 times higher at ages 2 to 4 years (See Figure Two).

A comparison of mortality rates for Cali, Colombia and California indicates that, for the neonatal group, there are marked differences in the rate of low birth weight deliveries and in the mortality rates for categories where low birth weight is either a contributing or underlying cause. This apparent interactive relationship is especially important with respect to neonatal infection. Together these two categories

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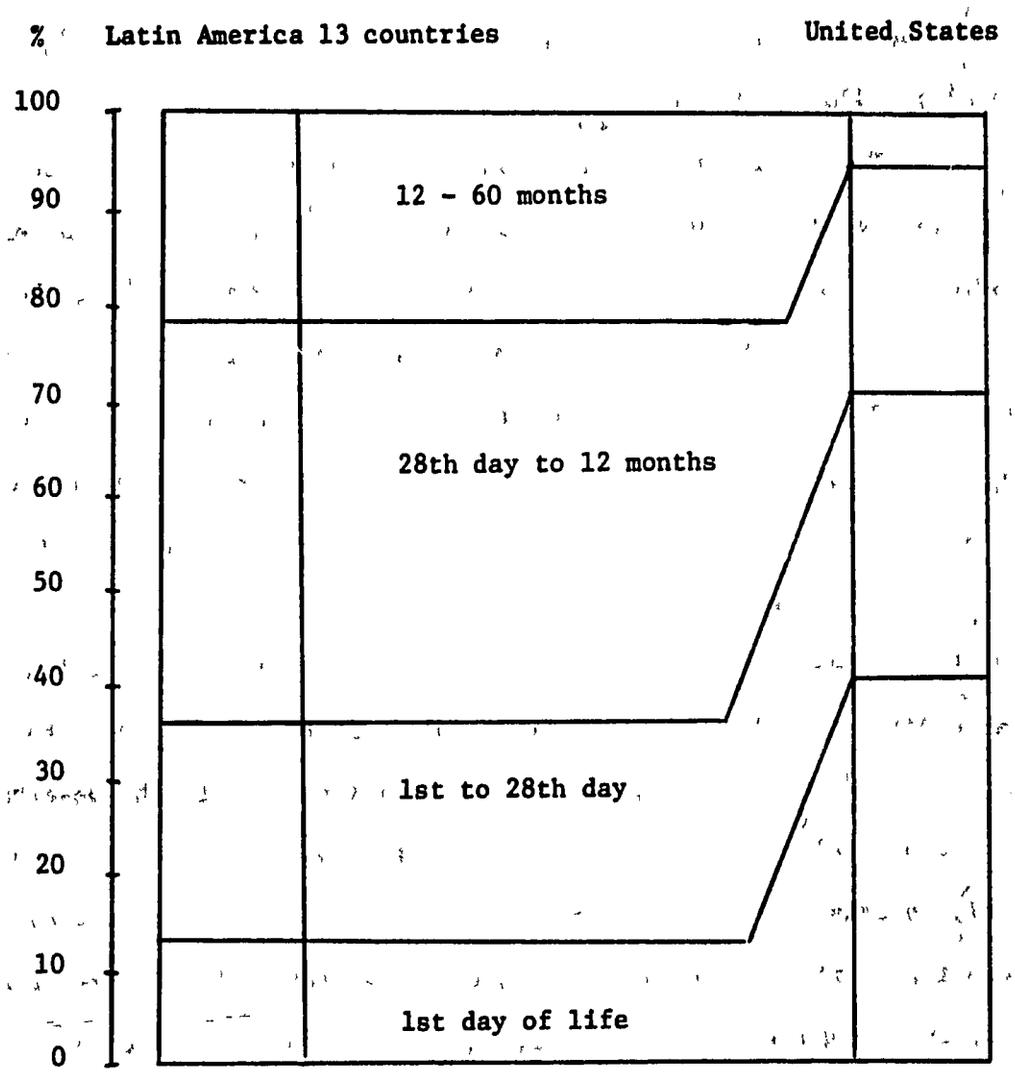
[1] See, for instance, G. S. Simmons, C. Smucker, B. D. Misra, P. Majumdar "Patterns and Causes of Infant Mortality in Rural Uttar Pradesh", forthcoming, Journal of Tropical Pediatrics and Child Health.

FIGURE TWO

Distribution as percent of deaths by age groups in Latin America and United States.



Source: Puffer and Serrano

explain a substantial proportion of neonatal deaths. To these two categories is added neonatal tetanus which has obvious associated interventions and which is almost nonexistent in the United States but is a significant cause of mortality among newborn children in developing areas. Finally, because there are major differences in the way the delivery is handled in developed and developing countries, birth trauma is added as a fourth category.

The major cause of mortality among infants in the 1-12 month group in developing countries is gastrointestinal infection. An examination of changes in childhood mortality rates in Europe and the United States shows that the primary reason for the great reduction in rates over the last 30-50 years has been the near elimination of diarrhea as a cause of infant death. A second reason for the dramatic reduction in mortality rates is the decrease in the rate of childhood mortality from respiratory infections. Both respiratory infections and diarrhea have potential synergistic relationships with malunutrition. In particular, the interrelationship between diarrhea and malnutrition has been the subject of extensive research. Further, evidence supports the observation that malnutrition is an important associated cause of death and significantly increases the fatality rates for other diseases when present. To these three diseases is added the category of immunizable disease for which only whooping cough is significant during the first twelve months.

The disease categories explaining the differential between developed and developing country childhood mortality rates remain essentially unchanged for the 1-4 year age group. The immunizable disease category, however, becomes more significant with measles and polio developing as potential causes of mortality as neonatal immunities

are lost and increased exposure to the environments occurs. In addition the interaction between immunizable diseases and malnutrition becomes sufficiently substantial to warrant including in the model.

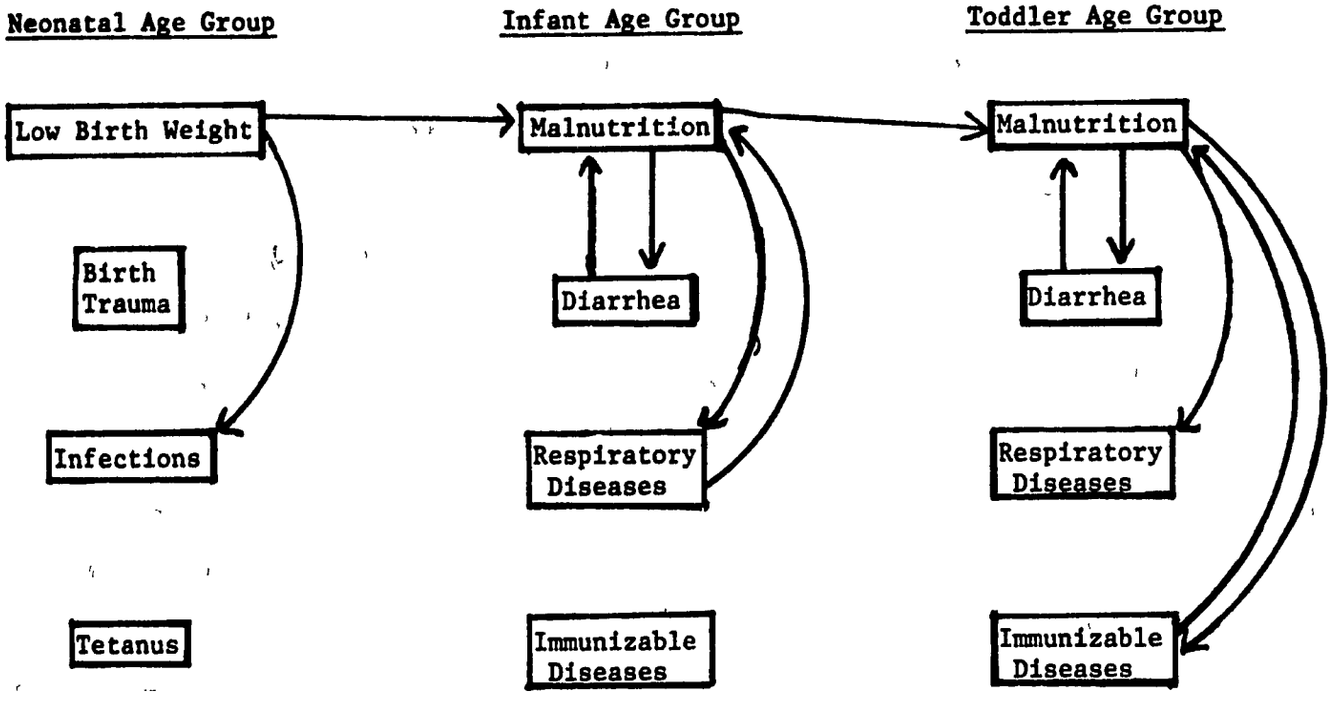
The diseases included in the analysis account for over 80 percent of childhood mortality in LDCs. The selection of diseases thus holds out the potential for a significant reduction of mortality both because the diseases account for a large part of mortality in developing areas and because known interventions have already brought about a significant decline in their incidence in developed countries.

The diseases and their interrelationships are summarized in diagram #4. The arrows connecting the diseases indicate the direction of a potential causal flow which will be included in the model in the form of a non zero interaction coefficient (for the disease identified by the arrow) in the marginal probability function (see equation (6) in chapter II). Only the most significant disease interactions are included. The importance of the disease interrelationships is that they allow for indirect effects of interventions which, if not included, might cause the effectiveness of particular interventions to be underestimated. For instance, malnutrition is not a significant direct cause of mortality; it is, however, an important contributor to higher morbidity rates for other diseases. In addition the fatality rates for respiratory and immunizable diseases are higher for malnourished children. Thus a nutritional supplement may be potentially cost effective in mortality reduction even though direct deaths through starvation or nutritional deficiencies are small in number.

The next few pages are concerned with a definition of the disease categories used in the infant mortality model, especially with

Diagram #4

THE MORBIDITY SEGMENT OF THE INFANT MORTALITY MODEL
(showing interdisease causal flows)



an explanation of the degree of aggregation used, and with an outline of the types of interventions to be considered. The interventions are described in more detail in a following section. The concern here is with a brief description of the potential mode of impact of interventions on the diseases. Since the importance of these diseases and their interrelationships is well known and previously documented[1/] the discussion is cursory.

1. Low Birth Weight

For the purposes of this study, low birth weight is defined as a weight of 2,500 grams or less immediately after delivery. This definition encompasses two sub-categories of births, each of which may arise for different reasons. The most important of these categories in developing countries and the category to which we devote most of our attention is low birth weight attributable to a deficiency in nutrients reaching the fetus. This can occur because of a malfunctioning of the placenta and/or a deficiency of nutrient intake by the mother before or during pregnancy. The second sub-category is children born prematurely who are of lower weight because of a shorter foetal development period. This group, which may be the result of non-nutritional physiological problems of either the mother or fetus, does not behave as malnourished and may be less responsive to interventions.

The interventions considered for the reduction of morbidity in the low birth weight category are aimed at increasing the quantity and quality of nutrients reaching the foetus and at decreasing the opportunity for a malfunction of the pregnancy. Generally, the interventions are aimed at 1) women not presently pregnant but capable of conception,

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[1] See the appendix.

2) pregnant women, and 3) women known to have a high risk of giving birth to a low birth weight child (because of previous birth histories or present nutritional and physiological status).

Interventions for non pregnant women within the reproductive age bracket involve health education and promotion, good health care access, and access to good nutrition. The general categories of activities which might be accomplished are: avoiding pregnancies at the extremes of the reproductive age bracket (less than eighteen or over thirty-five years of age), avoiding pregnancies within two years of a previous pregnancy, providing treatment for malnourished female adults within the reproductive age bracket, and the provision of education on hygiene and nutrition to women within the reproductive age bracket.

Interventions for pregnant women are aimed at early detection and appropriate remedial treatment of factors known to be associated with l.b.w. Thus the intervention activities include: early detection of pregnancy; early detection of anemia, urinary tract infection, venereal disease, toxemia, hypertension and diabetes; encouragement of cooperation in prenatal control, and nutritional supplements during pregnancy.

2. Birth Trauma

Birth trauma is referred to as the pathological process occurring because or as a consequence of delivery. It may be produced by misfunctioning of the birth process, misfunctioning of the birth canal, mishandling of the delivery by the mother or person attending (helping) the delivery, or malformations in the development of the fetus that produces interference with the proper transit through the birth canal. Previous to delivery, interventions to reduce birth trauma

include the early detection and treatment of diabetes, toxemia and hypertension. With early detection of pelvic malformations, birth canal obstruction or other indications of a high risk delivery, adequate facilities for instrumental or surgical delivery might be provided.

3. Neonatal Infections

Two broad categories of neonatal infection are aggregated under this heading. The first is superficial or localized infections such as pyodermitis, conjunctivitis and moniliasis. The second is systemic infections such as respiratory tract infections and sepsis. The infections can also be classified by transmission agent or source, i.e., those transmitted from the mother through the placenta to the fetus, those produced by direct contact of the child with the birth canal, and those acquired through environmental contact after birth. Generally, the interventions to reduce morbidity through infection are intended to act through a reduction of the possibility of transmission by controlling infection in the mother and by controlling the condition of the neonatal environment.

Interventions on pregnant women include detection and treatment of venereal disease, viral diseases, and infections of the birth canal, and control of the mothers environment to reduce the opportunity for maternal infection. Interventions on the child and neonatal environment include control of the delivery environment, profilaxis of the eyes and cord at birth, and appropriate care of caput or scalp hemorrhages Finally, breast feeding and counsel of the mother on breast and feeding hygiene is a potentially important activity intended to control the neonatal environment.

4. Tetanus

Tetanus neonatorium is usually produced by improper handling of the umbilical cord. The activities to reduce tetanus are immunization of the mother during pregnancy and appropriate care of the umbilical cord during and after delivery.

With regard to curative interventions, neonatal tetanus is of sufficient severity that combination disease states with tetanus are aggregated to a single mutually exclusive disease state. The assumption is that the presence of tetanus will be an overriding factor in the determination of treatment and the calculation of fatality rates for all disease states where tetanus is present. Outpatient care is assumed to have little usefulness and the only care we are considering in this study is intensive inpatient care with appropriate facilities.

5. Malnutrition

Malnutrition is a deficit of a major nutrients with respect to standard requirements that will produce retarded growth and development with respect to children of a reference population. We are using the Gomez[1/] standards as the criteria and include malnutrition of degrees I and above in this morbidity category. Malnutrition can occur by two mechanisms, with a decrease in the intake and absorption of nutrients or an increase in the requirements for nutrients or both simultaneously. Thus, a change in the volume of nutrients metabolized may not only occur as a consequence of a food deficiency, but may also occur because of metabolic changes produced by infection or the lack of absorption of the nutrients due to gastrointestinal pathology.

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[1] Gomez, C. "Malnutrition in Infancy and Childhood", Advances in Pediatrics, Vol. 7-31, 1955.

Interventions which affect the level of malnutrition directly are concerned with increasing the quality and quantity of nutrient intake. These include: nutritional education of the mother, especially concerning complementary foods, and the encouragement of breast feeding; improving lactation of the mother up to the weaning age; and supplementary weaning foods. Other interventions which affect malnutrition indirectly through a reduction in gastrointestinal infection are considered under diarrhea.

Although malnutrition is an uncommon cause of death when not associated with other diseases, it frequently severely increases the fatality rate of other morbidity conditions when it is found in association with them. The choice of curative care is dependent on the associated disease. Inpatient care of a malnourished child is considered only for grade III with rehabilitation clinics, which carefully control the environment and nutrient intake, an intervention possibility to be considered. Oupatient treatment of all grades of malnutrition consists of activities similar to those designed to reduce morbidity.

6. Diarrhea

In this study diarrhea is defined as "A disturbance of intestinal motility and absorption which once and by whatever means produced, may become self perpetuating as a disease through the production of dehydration and profound cellular disturbances, which in turn favor the continuing passage of liquid stools."[1/] Diarrhea, as defined is a symptom and can be a result of any of a great number of enteropathogen or physiological causes.

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[1] WHO 7.7 288

The morbidity interventions to be considered are primarily intended to act on the reduction of enteropathogen transmission by controlling the child's environment and reducing the opportunity for indirect fecal contact. Thus the interventions should be directed to provide potable water, a clean environment, maternal personal hygiene, a clean, bottle, and maintenance of breast feeding as long as possible.

Three processes produce death when a child has diarrhea: dehydration, dissemination of infection (sepsis) and starvation. Both inpatient and outpatient care is intended to attack the three processes by providing early and adequate replacement of fluids, adequate treatment of infections by antibiotics where necessary, and non lactose foods for early refeeding.[1/] The essential difference between outpatient and inpatient treatment is the opportunity for observation and control, and the use of rehydration facilities in the health center.

7. Respiratory Diseases

At the level of aggregation used in this study, the heading "Respiratory Diseases" refers to acute lower respiratory tract infections with the addition of acute bronchitis, pneumonia and tuberculosis. Specifically excluded are mild upper respiratory problems and immunizable respiratory diseases of childhood. The morbidity interventions are intended to reduce transmission through maternal education and the control of the environment. Maternal education and participation in a well baby clinic may also reduce the incidence in this category by providing adequate treatment for upper respiratory infections.

8. Immunizable Diseases

This category includes whooping cough and measles (11th and 12th

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[1/] The important effect of treatment for diarrhea may not be so much on fatality from diarrhea as upon the diarrhea-malnutrition link.

month only) in the infant age groups and diphtheria, whooping cough, tetanus, measles and polio in the toddler age group. Morbidity Interventions include inoculations and environmental control.

Interventions for the Reduction of Infant Mortality

The interventions to be considered in this study are defined in terms of fundamental units called "tasks." Each task consists of the execution of procedures or techniques involved in the control of various morbidity or fatality categories. The tasks are then combined, as appropriate for a particular intervention, into "activities" which are entered into the morbidity equations to allow the calculation of morbidity rates. This breakdown of intervention activities into tasks is similar to the procedure followed by Feldstein, Piot and Sundaresan in their tuberculosis control model.[1/] It diverges from their works however in its use of a higher level of aggregation in the definition of tasks. In fact many of the activities used in this study consist of single tasks. For example the provision of garbage and rubbish pick up is identified as one task. As a second example the examination of women of child-bearing age and test for various diseases is treated as a single task rather than considering each test and the examination separately. An example of an activity which consists of more than one task is an examination of potential mothers and tests for various diseases including iron deficiency and then treatment for iron deficient women. The activity thus involves two tasks (1) examination and tests and (2) treatment of iron deficiency.

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[1] Martin S. Feldstein et al, op cit.

1. A List of the Interventions and Socioeconomic Variables in the Infant Mortality Model

The table which follows (table 3-1) presents a list of the tasks, as well as the socioeconomic variables, assumed to have an impact on the morbidity, fatality and usage functions for each age group and disease included in the model. A number code used to identify the tasks is included in the left hand column. The intervention activity comprising the test and treatment of women of childbearing age for anemia thus consists of task 2 and task 5. A more detailed description of the tasks follows the table.

Table 3-1

Inventory of (1) Tasks to Reduce Infant Mortality and (2) Socioeconomic Variables Effecting Mortality

Task Code	
	A. Age 0-1
	I. Health Post-Centre
	1. Prenatal Care - pregnant women only
3	a. Examination and tests, then if needed:
7	i. Treatment of venereal disease, anemia, urinary tract infection, toxemia, hypertension and diabetes
8	ii. Nutritional supplement for l.b.w. risk mothers only
	iii. Delivery of l.b.w. risk mothers in health centre
	iv. Delivery of birth trauma risk mothers in health centre
9	b. Tetanus immunization of mothers
10	c. Hygienic education and nutritional counseling in health center
11	d. Nutritional program for all pregnant women (could be delivered without health centre-post)
	2. Health care for all women of child bearing age
2	a. Examination and tests, then if needed:
4	i. Treatment of venereal disease and urinary infections
5	ii. Treatment of anemia for iron deficient women only
6	iii. Anemia program for all women (could be delivered without health centre)

*The task code is used to identify the tasks in algebraic formulations of the model and in computer programming. The numbering corresponds to that used in the structural equation tables at the end of the chapter. Only the first occurence of the task is numbered.

Table 3-1 (continued)

Age 0-1 continued

II. Delivery

12 1. In health centre, by midwife or auxiliary nurse, doctor on call

2. In home

13 a. by midwife trained in eye and cord profilaxis

14 b. unattended, eye and cord profilaxis given later by promotora

III. Post Natal Care - (impact on both morbidity and mortality)

15 a. Outpatient examination of newborn in health centre (eye and cord profilaxis is considered under delivery). Initial counseling for mother.

16 b. Outpatient care for l.b.w. and infections

17 c. Inpatient care - specific treatments for, l.b.w., birth trauma, infections and tetanus

IV. Water

1. Adequate quantity and quality

18 a. In home

19 b. Within a short walk (100 meters)

V. Sanitation

1. Excreta disposal

20 a. In house hygienic toilet facilities connected to sewage system or septic tank

21 b. Latrines, outside, not connected to sewage system

22 2. Garbage and rubbish pick up and sanitary disposal

VI. Program Usage

1. Effect on use of prenatal care, nutrition program, postnatal care, and breast feeding of:

a. educational level of household

b. household income

23 c. mass media (specific messages)

d. promotora

Table 3-1 (continued)

2. Impact on effective use of water and sanitation of

   a. education

   b. income

   c. mass media

   d. promotora

1 VII. Promotora (two visits per year)

Services provided by promotora

1. Hygienic and nutritional education

2. Early detection of pregnancy and referral

3. Detection of infections and malnutrition of women and referral (if I.2., above, is used)

VIII. Socioeconomic Variables and Health Status

   a. income

   b. education

   c. income/family size

   d. family size

   e. sq. meters of housing/family size

   f. age of mother

   g. birth interval

B. Age 1-12

I. Promotora (three visits for 1-12 age group)

Services provided by promotora related to 1-12 age group.

1. To detect malnourished child, respiratory infections, severe diarrhea and referral

2. To encourage breast feeding (if breast feeding program is used)

Table 3-1 (continued)

3. To provide nutritional and hygienic evaluation

4. To encourage use of health centre services for check up or shots (if programs are used)

II. Health Centre - Post

24 1. DPT & Polio immunization

25 2. Measles immunization

26 3. Well baby clinic alternative #1 - routine check up (first visit to doctor, last three to auxiliary nurse) and referral at 3,4,6 and 12 months, nutritional education

27 4. Well baby clinic alternative #2 - three home visits by promotora, one health center visit

28 5. Nutritional supplement for child (could be promoted without health centre)

29 6. Nutritional supplement for breast feeding mother

30 7. Outpatient care for 1-12 age group as appropriate for diarrhea, respiratory or inoculable diseases

31 8. Inpatient care for 1-12 age group as appropriate for diarrhea, respiratory or inoculable diseases

32 9. Intensive care of malnourished child in 1-12 age group

III. Water

1. Adequate quantity and quality

a. In home

b. Within a short walk (100 meters)

IV. Sanitation

1. Excreta disposal

a. In house hygienic toilet facilities

b. Latrines

2. Garbage and rubbish pick up and sanitary disposal

Table 3-1 (continued)

V. Program Usage

1. Effect on use of postnatal preventitive care, nutrition, program, breast feeding and use of remedial care:

   a. educational level of mother

   b. household income

   c. mass media

   d. promotora

2. Impact on effective use of water and sanitation of

   a. education

   b. income

   c. mass media

   d. promotora

VIII. Socioeconomic Variables and Health Status

   a. income

   b. education

   c. income/family size

   d. family size

   e. sq. meters of housing/family size

C. Age 12-60

I. Promotora (two visits per year)

1. To detect malnourished child, respiratory infections, severe diarrhea and referral

2. To provide nutritional and hygienic evaluation

3. To encourage use of health centre services for check up or shots (if programs are used)

II. Health Centre

1. DPT & Polio

2. Measles

3. Well baby clinic - routine check up by auxiliary nurse and referral at 24, 36,48 months, nutritional education

Table 3-1 (continued)

34 4. Nutritional supplement for child

35 5. Outpatient care for 12-48 age group as appropriate for diarrhea, respiratory or inoculable diseases

36 6. Inpatient care in health centre for 12-48 age group as appropriate for diarrhea, respiratory or inoculable diseases.

III. Water

1. Adequate quantity and quality

a. In home

b. Within short walk (100 meters)

IV. Sanitation

1. Excreta disposal

a. In house hygienic toilet facilities

b. Latrines

2. Garbage and rubbish pick up and sanitary disposal

V. Program Usage

1. Effect on use of prenatal care, nutritional program and postnatal use of:

a. educational level of household

b. household income

c. mass media

d. promotora

2. Impact on effective use of water and sanitation of

a. education

b. income

c. mass media

d. promotora

Table 3-1 (continued)

VIII. Socioeconomic Variables and Health Status

a. income

b. education

c. income/family size

d. family size

e. sq. meters of housing/family size

2. Description of Intervention Tasks

Task 1. Health Promotor (Promotora)

The promotora, in the program we are considering, is a non professional health worker who is given specific messages and assigned limited services to deliver in visits to the household every four months. Promotoras are usually women between eighteen and twenty-five years old with at least seven years of primary education and receive approximately two to three months of training. They live in the areas in which they work and are generally accepted as inside members of the community. The mother is their usual contact in the household.

In infant mortality model the actions of the promotora are differentiated according to whether or not they promote the usage of health services or provide a direct service in themselves. This distinction is preserved in the survey questions regarding the impact of the promotora.

The most important functions of the promotora which have a potential direct effect on morbidity are educational. Specifically the promotora provides education about personal and child hygiene and the proper use of water and sanitary services. Nutritional advice concerning the choice and preparation of foods is also given. The promotora also teaches the mother to look for signs of morbidity and how to care for mild illness. Other, non education, service tasks are considered under appropriate intervention headings.

The primary function of the promotora is to promote the use of health services. In this function the promotora identifies, for the mother (or prospective mother), existing health services in the community and encourages the use of the services where appropriate. The promotora

also attempts to detect pregnant women, within the first trimester, for referral to a health center for a prenatal exam. The promotora may also be used as part of a program to encourage breast feeding.

Task 2. Examination and tests for women of childbearing age

This interventions task consist of an annual examination by paramedical personnel (a registered nurse or equivalent training) in a health centre with a medical doctor available for consultation. The objective is to identify fertile women with conditions which might effect the quality of a pregnancy and fetal development. Of specific concern, because related interventions are to be considered, are tests for the existence of venereal disease, other genito-urinary tract infections, and anemia.

Task 3. Examination and clinical tests for pregnant women

This intervention task consists of an examination, in a health centre or health post, of women with a suspected pregnancy. The objective of the examination is to confirm the pregnancy and screen women for medical problems which would complicate the pregnancy or detract from optimal fetal growth. Specifically the tests are concerned with venereal disease, genito-urinary tract infections, hypertension, diabetes, toxemia, anemia and malnutrition. The examination is made by a medical doctor or by a paramedic under the supervision of a doctor.

In the survey questions regarding the effectiveness of the examination and related treatment a distinction is made between an exam and treatment carried out in the first trimester of the pregnancy

(and, thus, possibly in conjuction with a program for early detection of pregnancy) and an exam and treatments carried out later in the pregnancy.

Task 4. Treatment of venereal disease and urinary tract infection

This task is the outpatient treatment, through a health center of venereal disease and urinary tract infection in fertile women of reproductive age. The treatment consist of an appropriate prescription of antibiotic drugs and the encouragement of cooperation in carrying through with the treatment and continued observation.

Task 5. Treatment of anemia for iron deficient women only

This treatment consist of the prescription of an iron supplement for anemic women and encouragement in participation in the program.

Task 6. Anemia program for all women

This intervention task consist of the fortification of food with iron in a dose sufficient to prevent anemia. The difference between task 5 and 6 is the target group. In task 6 all women, whether presently anemic or not, receive an iron supplement. The supplement and encouragement in participation can be delivered either through the health center or by a promotora. In task 5 the target group is presently anemic women. In addition to the supplement and encouragement in participation task 5 includes continued observation and measurement.

Task 7. Treatment of morbidity conditions in pregnant women

This intervention task consists of oupatient treatment of venereal disease, anemia, genito-urinary tract infection, toxemia, diabetes, hypertension and anemia. The treatments, consisting of drugs and

counsel as appropriate, are administered through a health center.

Task 8. Nutritional supplement for low birth rate weight riskmothers

This intervention task consists of the introduction of a protein-calorie and iron supplement equal to the average deficit identified in the community under analysis. The supplement is given only to households having pregnant women with a high risk of giving birth to a low birth weight infant.

Task 9. Tetanus immunization of pregnant women

The tetanus immunization is delivered by a promotora on one of her three visits per year or in the health center. The immunization is given before the eighth month of pregnancy.

Task 10. Hygienic education and nutritional counseling in a health center

In this task pregnant women are counseled by a paramedic, registered nurse or doctor on the importance of good nutrition, and hygienic habits during pregnancy. The content of the messages is standard medical practice and the counseling occurs as part of a visit to a health center for examination. Education and counsel given by the promotora is not considered as part of this intervention.

Task 11. Nutritional program of all pregnant women

In this task pregnant women are given a protein-calorie and iron supplement equal to the average deficit for women of childbearing age in the community. This intervention task differs from task 8 in that the supplement is given to all pregnant women without regard to their nutritional status.

Task 12. Delivery in a health center

Delivery is assisted in a health center by a trained midwife or registered nurse. The health center employs a medical doctor, has an ambulance and is equipped for a normal delivery. The delivery personnel are trained to recognize abnormalities in the development of the delivery that calls for referral to a regional hospital. In the optimization model and in the survey questions an intervention activity is defined which consists of an examination, screening and delivery of mothers with a high risk of low birth weight or a high risk of birth trauma in a health center. Another intervention activity consist of the delivery of average risk mothers in a health center. In each of these activities the intervention delivery task is number 12.

Task 13. Delivery at home attended by midwife

The midwife attending the home delivery in this intervention task is trained to recognize signs of an abnormal delivery for referral to a health center. The midwife is a recognized as a member of the community and has received training in treatment for asepsia and eye and cord profilaxis.

Task 14. Promotora visit after an Unattended Home Delivery

Within 48 hours of an unattended delivery a promotora is to visit the home and give eye and cord profilaxis and advice on the adequate care of the umbilical cord. The promotora also attempts to recognize neonatal problems for referral to a health center.

Task 15. Outpatient examination of newborn infants

This intervention task consists of the examination of newborn children by trained personnel in a health center within the few weeks of birth. The child is referred for treatment as appropriate and available. The mother is counseled in health and nutrition. Note that the health center delivery activity includes this task automatically.

Task 16. Outpatient neonatal care

This task consists of the current accepted treatment as needed for low birth weight and neonatal infections. The child is not hospitalized; the care is delivered through a health centre with a physician available for counsel.

Task 17. Inpatient neonatal care

This task consists of the current accepted inpatient treatment and care as needed for low birth weight, birth trauma, infection and tetanus. The care is given in a health centre with back up services available as required at a regional hospital.

Task 18. In home piped water

This intervention consists of the provision of potable water in sufficient quantity for drinking, cooking and household sanitation. The water is piped to the household and available through at least one spigot.

Task 19. Public Fountain

An adequate quality and quantity of water is avaiable at a public fountain within 100 meters of the household. Note that in both this task and task 18 the quality of the water refers to the water at

the tap and not necessarily as finally used. The quality of water usage (that is, the quality of the handling and storage of water) is considered elsewhere.

Task 20. In house toilet facilities

This intervention task consists in the provision of hygienic (flyproof) toilet facilities connected to a sewage system or septic tank.

Task 21. Out house toilet facilities

This intervention task consists in the provision of latrines, not connected to a septic tank or central sewage system, for each household. A cover for the latrine is provided, however the latrine itself is not flyproof.

Task 22. Garbage and Rubbish Pick Up

This intervention task consists of the collection (at weekly intervals) of garbage and rubbish for each household. The refuse is to be placed in one location at each household with biodegradeable matter separated and placed in a container. The refuse is disposed of in a sanitary manner.

Task 23. Mass Media

In this task specific messages are delivered through advertising on the radio, on billboards or in newspapers. The messages being considered are intended to affect the usage of health services and do not have a direct affect on morbidity.

Task 24. DPT and Polio Immunization

The sequence of shots would be delivered at appropriate intervals by either a health promotor in a home visit or at the health center

during visits to a well baby clinic. The mode of delivery is assumed to affect usage levels and not the effectiveness of the shots.

Task 25. Measles immunization

As in the preceeding intervention task the shots can be delivered by either a health promotor or at a well baby clinic. The mode of delivery is assumed to affect participation but not the effectiveness of the shots.

Task 26. Well baby clinic, infants, alternative #1.

This task is carried out in the health center and consists of a routine check up by a physician or registered nurse at three months followed by health center visits at four, six and twelve months for routine examinations by an auxiliary nurse or paramedic. Nutritional and hygienic advice is given. Mothers are encouraged to use health services and referrals are made for treatment as needed.

Task 27. Well baby clinic, infants, alternative #2.

This task is similar to task 26 except that the visit to a physician or registered nurse is followed by three home month visits (at four, six and twelve months) by a promotora. (instead of the health center visits).

Tasks 28 and 34. Nutritional Supplement for infants, Nutritional Supplement for Toddlers.

These tasks consists in the provision of a protein-calorie supplement sufficient to close the nutritional gap for the average child in the community. It is assumed that the programs are designed in such a manner that the target group actually receives the supplement.

Task 29. Nutritional Supplement for Breast Feeding Mothers

This consistsof the protein-calorie supplement needed to close the gap between the community average and the standard requirements for breast feeding women. The supplement is administered to breast feeding mothers for six months.

Task 30 and 35. Outpatient care for Infants, Toddlers

These tasks consist of the provision of appropriate outpatient care for diarrhea, respiratory diseases and inoculable diseases in the infant and toddler age groups. The care consists of an examination, tests, prescription of medicine and advice. The care is given by trained medical personnel in a health center.

Tasks 31 and 36. Inpatient care for Infants, Toddlers

These tasks consist of the provision of inpatient care for diarrhea, respiratory illness or inoculable diseases. The care is given in a health centre or regional hospital as appropriate.

Task 32. Intensive care of malnourished infants

This task consists of the institutional care and rehabilitation of malnourished infants.

Task 33. Well baby clinic, toddlers

This intervention consists of a routine check up and nutritional-counsel by an auxiliary nurse at 27, 36 and 48 months.

STRUCTURAL EQUATIONS

There are three types of structural equations in the model. The three types of equations generate the rates for 1) intervention usage, 2) marginal disease incidence and 3) fatality. By referring to Diagram #2 and recalling the associated discussion in Chapter II, the role of the three types of equations can be reviewed. As the arrows indicate, the usage rates (or alternatively participation rates), u_ℓ, are calculated as a function of socioeconomic variables and intervention activities;

$$u_\ell = u_\ell\ (C_\ell) \qquad \ell = 1 \ . \ . \ . \ L \qquad (9)$$

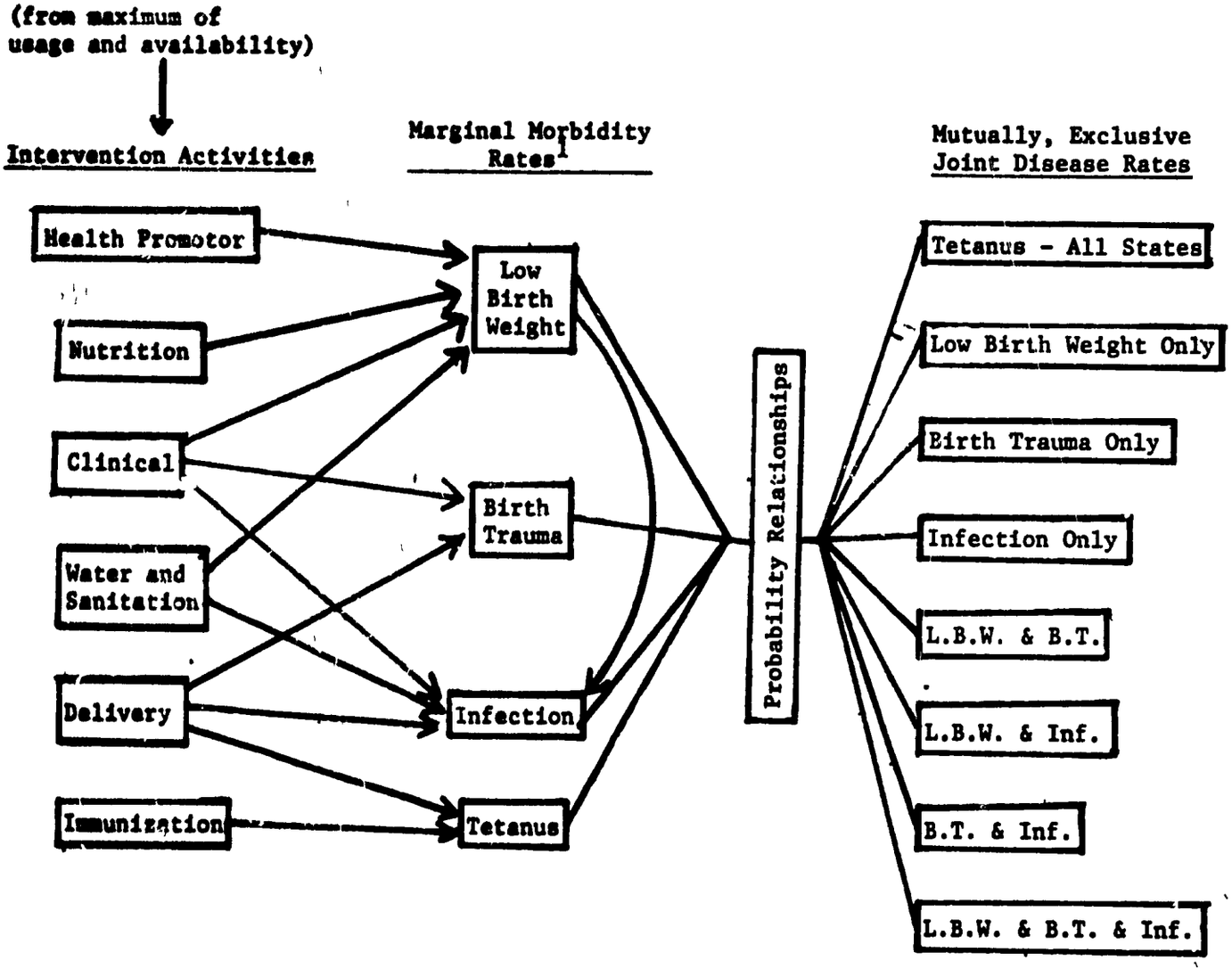
where C_ℓ is a vector of appropriate socioeconomic variables and activities made up of the tasks described on the preceding pages; L is the total numbers of usage functions calculated. The usage rates are then compared with the available level of intervention programs, x_i, and the minimum is selected to represent the level of interventions, I_i, used in the calculation of morbidity and fatality rates; that is,

$$I_i = \min \left\{ \begin{matrix} u_\ell \\ x_i \end{matrix} \right\}$$

In actuality the extent of program participation would be somewhat different for each intervention activity, since participation will vary with the perceived utility of each program as compared with the perceived costs. However, to keep the number of usage equations manageable

Diagram #5

THE MORBIDITY SEGMENT OF THE INFANT MORTALITY MODEL
NEONATAL AGE GROUP (0-1 month)



[1]The functions used to calculate the marginal disease rates are presented in more detail in tabular form in table 3-2.

Diagram #5 (Continued)

THE MORBIDITY SEGMENT OF THE INFANT MORTALITY MODEL
INFANT AGE GROUP (1-12 months)

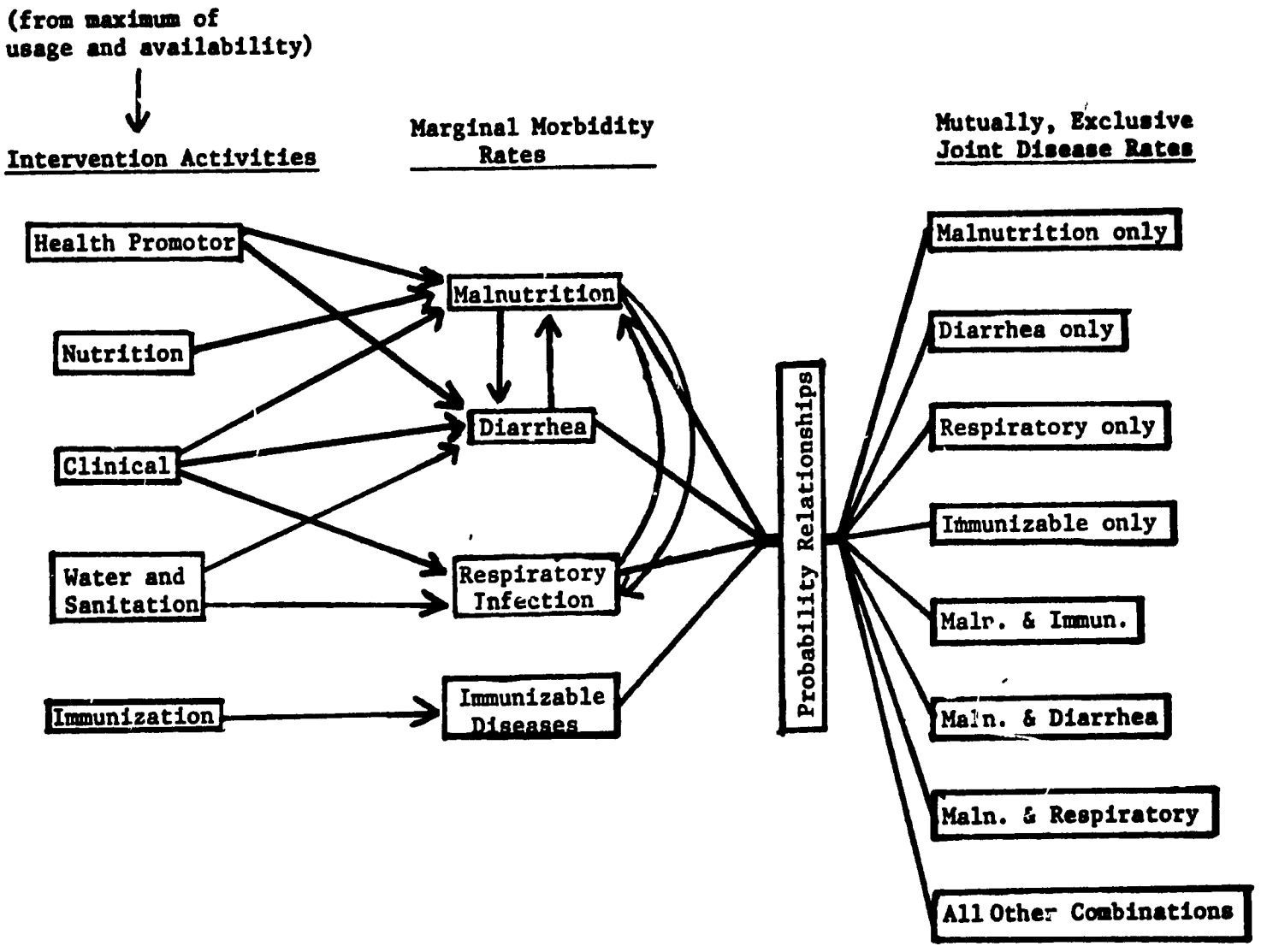
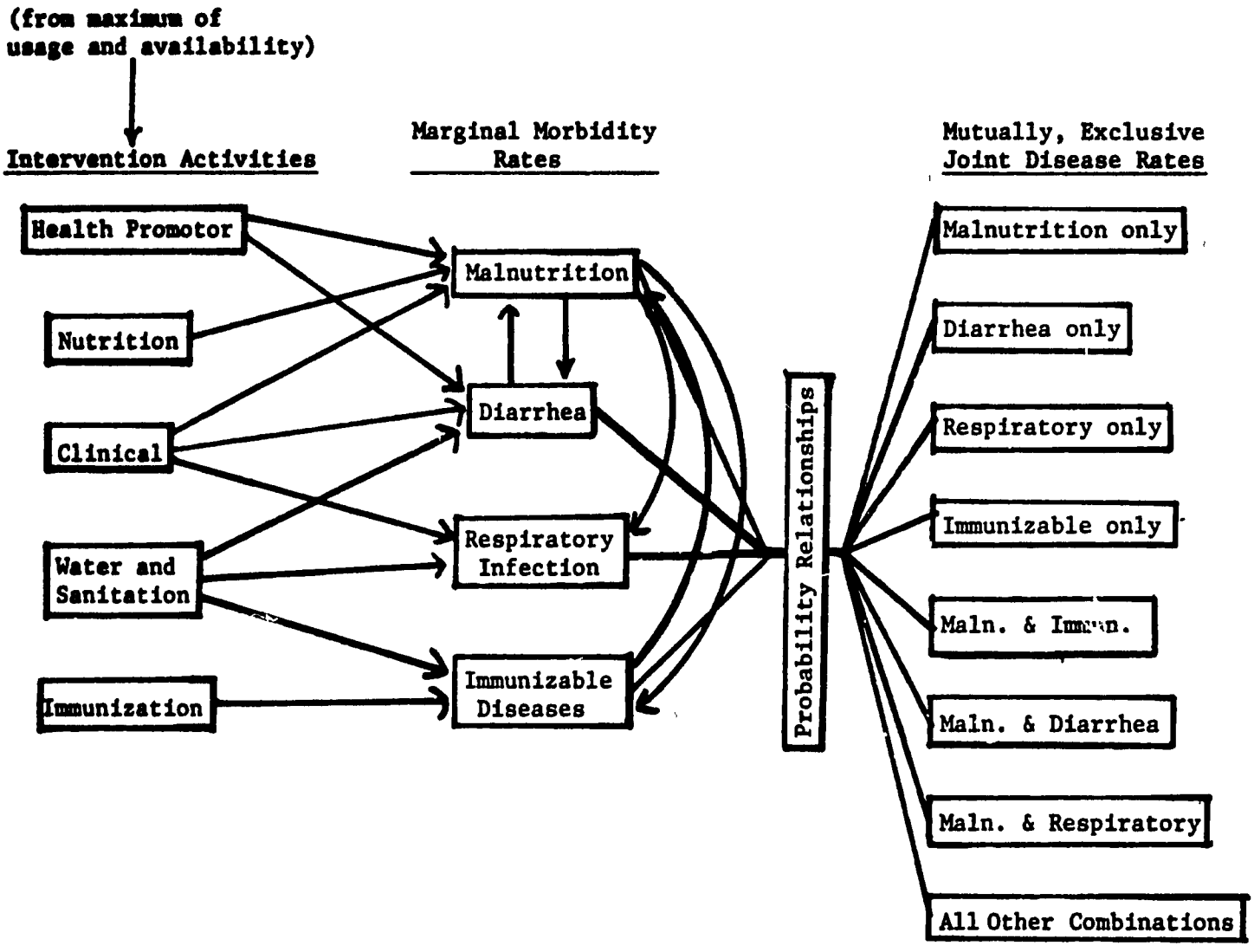


Diagram #5 (Continued)

THE MORBIDITY SEGMENT OF THE INFANT MORTALITY MODEL
TODDLER AGE GROUP (12-60)



we have collected interventions into nine groups which might reasonably be expected to have similar participation characteristics and have specified individual usage functions for each group. The nine usage equations are:

1) usage of prenatal care by all women,
2) usage of prenatal care by pregnant women,
3) usage of curative care,
4) effectiveness of water and sanitation usage,
5) usage of breast feeding,
6) usage of preventative care in the infant group,
7) usage of curative care in the infant group,
8) usage of preventative care in the toddler group, and
9) usage of curative care in the toddler group.

The availability of each intervention is compared with the applicable usage rate in deriving the minimum to be used in calculating the morbidity and fatality rates.[1] Thus, for example the available capacity for prenatal obstetric examinations, is compared with usage category number two to determine the minimum representing the effective level of the obstetric examination intervention.

Given the effective level of the interventions, the age specific morbidity rates can be calculated from the morbidity rate functions (see equation (1) chapter II),

$$p_i = p_i\ (A_i,\ p_j) \qquad i,j + 1 \ldots n \quad (1)$$
$$i \neq j$$

---

[1] With the exception of usage category four-effectiveness of water and sanitation use. This category is used multiplicatively with the water and sanitation intervention variables to derive the effective level of these

The flows involved in these calculations are illustrated in diagrams #5a through 5c. The boxes on the left represent the effective level of interventions derived from the procedure described in the foregoing paragraph. The interventions determine the marginal morbidity rates as shown by the arrows. In addition, the interactions among diseases are shown by the arrows drawn between various pairs of disease. Moving to the right the probability relationships (see equations (2) and the appendix to chapter II),

$$c_k = c_k(p_i), \qquad k = 1 \ldots k \tag{2}$$

are used to derive the mutually exclusive disease rates. Finally, if the derived rates are consistent with the constraints representing the primary postulates of probability theory (see the discussion in chapter II), the fatality rates are calculated using the fatality rate functions (see equation (4) chapter II),

$$f_k = f_k(B_k) \qquad k = 1 \ldots k \tag{4}$$

and the mortality rate is obtained,

$$D = \sum_k f_k c_k \tag{6}$$

The functional form chosen for all three types of structural equations

is the logit[1] and the structural equations can be written as:

$$u_\ell = \frac{1}{1 + e^{-U_\ell}} \qquad \ell = 1 \ldots 9$$

for the usage equations, and

$$p_{ia} = \frac{\alpha_{iU}}{1 + e^{-Z_{ia}}} + \alpha_{iL} \qquad \begin{array}{l} i = 1 \ldots 4 \text{ (diseases)} \\ a = 1 \ldots 3 \text{ (age groups)} \end{array}$$

for the marginal morbidity rates, and

$$f_{ka} = \frac{\delta_{kU}}{1 + e^{-G_{ka}}} + \delta_{kL} \qquad \begin{array}{l} k = 1 \ldots K \text{ (disease categories)} \\ a = 1 \ldots 3 \text{ (age grougs} \end{array}$$

for the fatality rates, where the U, Z and G variables are functions (at present time linear functions are being used) of the various socio-economic, intervention and simultaneous variables.

The complete set of functions is summarized in Table 3-2 below. The functions are separated by age group and within age group by usage, morbidity and fatality categories. To the right of the double line the functions are identified by dependent variable, U_1, Z_2 and so on. (The age subscripts are omitted in the Table). The first column on the left names the independent variable; the second column gives the identifying subscript

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[1]The specification of functional form is flexible and as the project progresses other forms may be tried.

for the variables, and the third column identifies tasks involved in the intervention activities.

To the right of the double line a mark in the intersection between a row and a column indicates that the activity or variable identified by the row is to be included as a variable in the equation identified by the column. There are three types of marks:

1) ✓ indicates simply that the variable is to be included.

2) U_ℓ indicates that the minimum of U_ℓ or x_i is to be used.

3) ·U, that is a U preceded by a dot, indicates that the intervention variable is to be multiplied times the indicated usage variable before inclusion in the equation indicated by the column.

As an example of the use of the Table we write the equation for the usage of prenatal care by all women. This is found in the first column to the right of the double line on the first page of the Table for the neonatal age group. Noting that there are ✓s in the rows for promotora, mass media, houehold income and education we write (omitting subscripts for the age group).

$$u_1 = \frac{1}{1 + e^{-U_1}}$$

with,

$$U_1 = \gamma_{1,0} + \gamma_{1,1}I_1 + \gamma_{1,27}I_{27} + \gamma_{1,41}S_1 + \gamma_{1,42}S_2$$

and where the $\gamma_{i,X}$ are the elements of the C vector noted previously and are constants giving the impact of the various variables on U_1. The first subscripts on the coefficients identifies the equation and the second subcript identifies the variable. The numbering of the coefficients on the socioeconomic variables is 40 plus the subscript of the variable; thus the coefficient on household income (socioeconomic variable number 1) is 41 (= 40 + 1).

As a second example consider the morbidity function for respiratory disease in the toddler age group. Following the table we write (again omitting subscripts for the age group)

$$P_3 = \frac{\alpha_{3U}}{1 + e^{-Z_3}} + \alpha_{3L}$$

with

$$Z_3 = \alpha_{3,0} + \alpha_{3,24}U_4I_{24} + \alpha_{3,25}U_4I_{25}$$
$$+ \alpha_{3,26}U_4I_{26} + \alpha_{3,37}I_{37} + \alpha_{3,44}S_4$$
$$+ \beta_{3,1}\,P_1 + \beta_{3,4}P_4$$

where I_{37} is the minimum of X_{37} or U_8. Finally, as a third example the fatality equation for the disease state "diarrhea only" in the infant age group is,

$$f_2 = \frac{\delta_{2U}}{1 + e^{-G_2}} + \delta_{2L}$$

with

$$G_2 = \delta_{2,0} + \delta_{2,34} \cdot I_{34} + \delta_{2,35}I_{35}$$

where I_{34} and I_{35} are the minimums of X_{34} and U_7, and X_{35} and U_7, respectively.

Summary

This chapter has given a description of the simulation model which will be used to calculate the value of the objective in the optimization program. The model consists of four disease categories for each of three age groups. The age specific disease rates are defined as a set of

functions of 40 health intervention activities and 6 socioeconomic variables. Diagrams 5a through 5c summarize the relationships between the interventions and disease rates. Usage rates are generated as functions of health promotion interventions and socioeconomic variables. Table 3-2 defines the usage, morbidity and fatality functions which comprise the structural equations of the model. The next chapter is concerned with the specification of the coefficients of the equations defined in Table 3-2.

Table 3-2
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

USAGE FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	Usage of Prenatal Care by All Women	Usage of Pre-natal Care by Pregnant Women	Usage of Curative Care	Effectiveness of Water and Sanitation Usage	Usage of Breast Feeding
Intervention Activities	I_i		U_1	U_2	U_3	U_4	U_5
Promotora	1	1	✓	✓	✓	✓	✓
All Women - exam and treat. for infection	2	2+4					
- exam and treat. for anemia	3	2+5					
- anemia program	4	6					
Pregnant Women - exam and treat infection, etc.	5	3+7					
- exam and treat l.b.w.-nutrition	6	3+8					
- exam and del. of l.b.w. risk	7	3+12+15			✓		
- exam and del. of b.t. risk	8	3+12+15			✓		
- tetanus immunization	9	9					
- counsel in hea'th center	10	10					
- nutritional supp. all pregnant	11	11					
Delivery - in health center	17	12+15			✓		
- in home by mid wife	18	13			✓		
- in home w/ promotora later	19	14			✓		
Outpatient examination of newborn	20	15			✓		

Table 3-2 (continued)
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

USAGE FUNCTIONS (continued)

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	Usage of Prenatal Care by All Women	Usage of Pre-natal Care by Pregnant Women	Usage of Curative Care	Effectiveness of Water and Sanitation Usage	Usage of Breast Feeding
Intervention Activities			U_1	U_2	U_3	U_4	U_5
mass media	27	23	✓	✓	✓	✓	✓
Socio Economic Variables	S_i						
Household Income	1		✓	✓	✓	✓	✓
Education	2		✓	✓	✓	✓	✓

Table 3-2 (continued)
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

MORBIDITY FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	low birth weight	birth trauma	infection	Tetanus
Intervention Activities	I_i		Z_1	Z_2	Z_3	Z_4
Promotora	1	1	✓		✓	
All Women - exam and treat infection	2	2+4	U_1		U_1	
- exam and treat anemia	3	2+5	U_1			
- anemia program	4	6	U_1			
Pregnant Women - exam and treat infection, etc.	5	3+7	U_2	U_2	U_2	
- exam and treat l.b.w. - nutrition	6	3+8	U_2			
- exam and del. of l.b.w. risk	7	3+12		U_2	U_2	U_2
- exam and del. of b.t. risk	8	3+12		U_2	U_2	U_2
- tetanus immunization	9	9				DU_2
- counsel in health center	10	10	U_2		U_2	U_2
- nutritional supplement - all preg.	11	11	U_2			

Table 3-2 (continued)
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

MORBIDITY FUNCTIONS (continued)

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	low birth weight	birth trauma	infection	Tetanus
Intervention Activities	I_1		Z_1	Z_2	Z_3	Z_4
Delivery - in health center	17	12+15		U_2	U_2	U_2
- at home by mid wife	18	13		U_2	U_2	U_2
- at home with promotora later	19	14		U_2	U_2	U_2
Outpatient examination of newborn	20	15			U_3	
breast feeding	21	U_5			✓	
Water - in home	22	18	$.U_4$		$.U_4$	
- in public fountain	23	19	$.U_4$		$.U_4$	
Sanitation - in house toilet	24	20	$.U_4$		$.U_4$	
- latrine	25	21	$.U_4$		$.U_4$	
- garbage pick up	26	22	$.U_4$		$.U_4$	

Table 3-2 (continued)
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

MORBIDITY FUNCTIONS (continued)

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	low birth weight	birth trauma	infection	Tetanus
Early Detection of Pregnancy:						
exam and treat for infection	12	1+23+3+7	U_2	U_2	U_2	
nutritional supp. for l.b.w. risks	13	1+23+3+8	U_2			
tetanus immunization	14	1+23+3+9				DU_2
counsel in health center	15	1+23+3+10	U_2		U_2	U_2
nutritional program all preg.	16	2+23+3+11	U_2			

Table 3-2 (continued)
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

MORBIDITY FUNCTIONS (continued)

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	low birth weight	birth trauma	infection	Tetanus
Socio Economic Variables	S_i		Z_1	Z_2	Z_3	Z_4
Household Income	1					
Education	2		✓		✓	
Household Income per capita	3		✓		✓	
Number of Rooms per capita	4				✓	
Age of Mother <18 years >35 years	5		✓	✓		
Birth Interval <2 years	6		✓			
Simultaneous Variables	Z_i					
l.b.w.	1				✓	

Table 3-2 (continued)
STRUCTURAL EQUATIONS - NEONATAL AGE GROUP

FATALITY FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved (See Inventory of Tasks)	Tetanus - all states	low birth weight only	birth trauma only	infection only	l.b.w. + b.t.	l.b.w. + inf.	b.t. + inf.	l.b.w. + b.t. + inf.
ntervention Activities			G_1	G_2	G_3	G_4	G_5	G_6	G_7	G_8
Outpatient Care	17	16		U_3		U_3	U_3	U_3	U_3	U_3
Inpatient Care	18	17	U_3	U_3	U_3	U_3	U_3	U_3	U_3	U_3

Table 3-2 (continued)
STRUCTURAL EQUATIONS - INFANT AGE GROUP

USAGE FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved	Usage of Preventative Care - Infant Group	Usage of Curative Care - Infant Group	Effectiveness of Water and Sanitation Usage	Usage of Breast Feeding
Intervention Activities	I_i		U_6	U_7	U_4	U_5
Promotora	1	1	✓	✓	✓	✓
Mass Media	27	23	✓	✓	✓	✓
Well baby clinic, alt. #1	29	26		U_6	U_6	U_6
Well baby clinic, alt. #2	30	27		U_6	U_6	U_6
Socio Economic Variables	S_i					
household income	1		✓	✓	✓	✓
education	2		✓	✓	✓	✓

Note: U_4 and U_5 are recomputed for the 1-12 age group.

Table 3-2 (continued)
STRUCTURAL EQUATIONS - INFANT AGE GROUP

MORBIDITY FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved	Malnutrition	Diarrhea	Respiratory	Inoculable
Intervention Variables	I_i		Z_1	Z_2	Z_3	Z_4
Promotora	1	1	✓	✓		
Water - in home	22	18		$.U_4$		
- public fountain	23	19		$.U_4$		
Sanitation - in house toilet	24	20		$.U_4$	$.U_4$	
- latrines	25	21		$.U_4$	$.U_4$	
- garbage pick up	26	22		$.U_4$	$.U_4$	
Immunization - DPT	27	24				✓
- Measles	28	25				✓
Well baby clinic, alt. #1	29	26	U_6	U_6	U_6	
Well baby clinic, alt. #2	30	27	U_6	U_6	U_6	
Nutritional supp - child	31	28	U_6			
Nutritional supp - breast feeding mother	32	29	U_5			
Breast Feeding	33	U_5	✓	✓	✓	✓

Table 3-2 (continued)
STRUCTURAL EQUATIONS - INFANT AGE GROUP

MORBIDITY FUNCTIONS (continued)

Activity or Variable	Subscript Notation	Tasks Involved	Malnutrition	Diarrhea	Respiratory	Inoculable
Socioeconomic Variables	S_i		Z_1	Z_2	Z_3	Z_4
education	2		✓	✓		
household income per capita	3		✓			
number of rooms per household member	4			✓	✓	✓
Simultaneous Variables	Z_i					
malnutrition	1			✓	✓	
diarrhea	2		✓			
respiratory	3		✓			
Lagged Variables	Z_i^{-1}					
l.b.w.	1		✓			

Table 3-2 (continued)
STRUCTURAL EQUATIONS - INFANT AGE GROUP

FATALITY FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved	Malnutrition only	Diarrhea only	Respiratory only	Inoculable only	Malnutrition + Inoculable	Malnutrition + diarrhea	Malnutrition + respiratory	Other Combinations (2+3, 2+4, 3+1, 2+3+4)
Intervention Activities	I_1		G_1	G_2	G_3	G_4	G_5	G_6	G_7	G_8
Outpatient Care	34	30		U_7	U_7	U_7	U_7	U_7	U_7	U_7
Inpatient Care	35	31		U_7	U_7	U_7	U_7	U_7	U_7	U_7
Intensive Care for malnourishment	36	32	U_7				U_7	U_7	U_7	

Table 3-2 (continued)
STRUCTURAL EQUATIONS - TODDLER AGE GROUP

USAGE FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved	Usage of Preventative Care	Usage of Curative Care	Effectiveness of Water and Sanitation Usage
Intervention Activities	I_i		U_8	U_9	U_4
Promotora	1	1	✓	✓	✓
Mass Media	27	23	✓	✓	✓
Well baby clinic	37	33		✓	✓
Socio Economic Variables	S_i				
household income	1		✓	✓	✓
education	2		✓	✓	✓

Note: U_4 is recalculated for the 12-60 age group.

Table 3-2 (continued)
STRUCTURAL EQUATIONS - TODDLER AGE GROUP

MORBIDITY FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved	Malnutrition	Diarrhea	Respiratory	Inoculable
Intervention Variables	I_i		Z_1	Z_2	Z_3	Z_4
Promotora	1	1	✓	✓		
Water - in home	22	18		$.U_4$		
- public fountain	23	19		$.U_4$		
Sanitation - in house toilet	24	20		$.U_4$	$.U_4$	$.U_4$
- latrines	25	21		$.U_4$	$.U_4$	$.U_4$
- garbage pickup	26	22		$.U_4$	$.U_4$	$.U_4$
Immunization - DPT	27	24				U_6
- Measles	28	25				U_6
Well baby clinics	37	33	U_8	U_8	U_8	
Nutritional supplement - child	38	34	U_8			

Table 3-2 (continued)
STRUCTURAL EQUATIONS - TODDLER AGE GROUP

MORBIDITY FUNCTIONS (continued)

Activity or Variable	Subscript Notation	Tasks Involved	Malnutrition	Diarrhea	Respiratory	Inoculable
Socioeconomic Variables	S_i		Z_1	Z_2	Z_3	Z_4
education	2		✓	✓		
household income per household member	3		✓			
number of rooms per household member	4			✓	✓	✓
Simultaneous Variables	Z_i					
malnutrition	1			✓	✓	✓
diarrhea	2		✓			
respiratory	3					
immunizable	4		✓		✓	
Lagged	Z_i^{-1}					
malnutrition	1		✓			

Table 3-2 (continued)

STRUCTURAL EQUATIONS - TODDLER AGE GROUP

FATALITY FUNCTIONS

Activity or Variable	Subscript Notation	Tasks Involved	Malnutrition only	Diarrhea only	Respiratory only	Inoculable only	Malnutrition + Inoculable	Malnutrition + diarrhea	Malnutrition + respiratory	Other Combinations (2+3, 2+4, 3+4, 2+3+4)
Intervention Activities	I_i		G_1	G_2	G_3	G_4	G_5	G_6	G_7	G_8
Outpatient Care	39	35		U_9	U_9	U_9	U_9	U_9	U_9	U_9
Inpatient Care	40	36		U_9	U_9	U_9	U_9	U_9	U_9	U_9

IV. A PROTOCOL FOR THE SPECIFICATION OF THE STRUCTURAL PARAMETERS OF THE INFANT MORTALITY MODEL

The model described in the preceeding chapter is intended to involve the minimum number of relationships necessary for the specification of a quantitative planning model to be used for the evaluation of policy choices affecting infant mortality. An effort was made to include only the most important disease relationships and the most feasible interventions from among the host of interrelationships and interventions that might be identified. The goal was to keep the model tractable while still being large enough to provide a practical illustration of the construction of a disease model for cost effectiveness analysis. This effort notwithstanding, there is still a total of 234 parameters (coefficients) which need to be specified before the model can be applied. Potentially the parameters could be specified statistically using data from field studies and clinical research. In fact the parameters provide a catalogue of the separate problem areas which have been the focus of medical and health research on child mortality in developing regions over the last twenty to thirty years. However, in spite of the substantial body of operational and theoretical research on the treatment and prevention of childhood disease, the extant literature does not allow the complete specification of the quantitative relationships required by even the modest dimensions of the infant mortality simulation model. The major problem with an objective specification of the model is that the results of existing studies are not always summarized in the required quantitative form and even when the research is sufficiently explicit from a quantitative

standpoint it is based upon controlled experimental conditions or is derived from disparate economic, social and physical environments which are not replicated in the area to be analysed in this study.

For this reason we have decided to specify the parameters through the use of a set of survey questions designed for that purpose. An advantage of the survey procedure is that it will allow the best available opinion, that is the opinion of medical and health practitioners with considerable experience in the problems of delivering health services in less developed countries, to be utilized in the specification of the models parameters in the context of an actual environment in a specific location. The results of the survey will be compared, where possible, with the results from existing objective research. An argument can be made, however, that given the tremendous statistical and conceptual problems which are faced in experimental research a subjective specification derived from the opinions of people who have a first hand experience is a more applicable and accurate method for the specification of a practical optimization model.

Selection of Survey Participants

It is apparent from the foregoing discussion that the quality, rather than the quantity, of survey participants is important for this study. Given budget and time restriction we have decided to limit the survey to (approximately) thirty health professionals of outstanding reputations. Of this number 18 will be chosen from Colombia, the country in which the community to be analysed is located, and 12 will be chosen internationally. Survey participants will be selected from a number of different fields - maternal and perinatal health, nutrition, environmental sanitation, pediatrics and epidemiology. The participants will

Table 4-1

Number of Parameters to be specified in the Structural Equations

Equation Type	Age Group	Number of Parameters	
Usage	Neonatal	26	
	Infant	22	
	Toddler	14	
		Sub Total	62
Morbidity	Neonatal	61	
	Infant	34	
	Toddler	31	
		Sub Total	126
Fatality	Neonatal	14	
	Infant	18	
	Toddler	14	
		Sub Total	46
		Total	234

also differ from the point of view of institutional affiliation and experience and will inlcude medical doctors, public health specialists and scientists engaged in the selection and administration of government or institutional health policies, the actual delivery of medical and health services, and research related to the estimation of health intervention effectiveness and interdisease relationships.

There are four different sets of questions covering, respectively, usage, morbidity, fatality, and disease interactions. Respondents will be asked questions appropriate to their experience and knowledge with no respondent asked the total of all four sets of questions. Table 4-2 gives the number of respondents to be included in each category.

As is apparent from the relative number of participants in each category the emphasis of the survey is on the morbidity questions. It is felt that the opinions of highly regarded health professionals with regard to the relative effectiveness of alternative health policies may be of interest as a separate study apart from the application of the results to the programming model. The disease interaction questions will be asked primarily of institutional researchers who have been involved in studying the interaction between malnutrition and infection. The questions concerning fatality rates will be asked of health professionals with clinical experience. Finally the survey questions with regard to usage will be asked only of Colombian respondents. This is because the effects of alternative policies and socioeconomic variables on participation rates are apt to be determined by institutions, traditions and customs which are particular to the study area. In contrast the other sets of questions involve relationships which have strong physiological bases that are independent of the area under

Table 4-2

Number of Survey Participants by Category of Survey Frame[1/]

	Survey Frame			
	Usage	Morbidity	Disease Interaction	Fatality
Colombian Participants	8	12	4	6
Non Colombian Participants	-	12	8	4

[1]The totals are not additive because some survey participants answer questions from more than one survey frame.

analysis.

The use of participants with a variety of professional backgrounds will provide a cross comparison of professional opinion which may, on the one hand, reveal contrasts in the current views of the efficacy of the various health interventions; or, on the other hand, may reveal a cross corroboration of the judgements of participants with different professional experiences. In either case the use of survey participants with diverse backgrounds should add balance to the choice of coefficients for the optimization program, and, in the event of contrary opinions, it is possible that separate simulations can be run in order to obtain the alternative optimal resource allocations implied by the differing participant views.

Because they are being asked to cooperate in a process with only limited precedence and unknown outcome, the health professionals involved are to be given certain assurances regarding the disposition of the survey results and the use of their names. The assurances are contained in the letter, which follows, soliciting their cooperation.

Dear Dr.

This letter has three purposes (1) to inform you of an on-going project to evaluate the cost effectiveness of alternative health activities for reducing infant mortality, (2) to solicit your possible consultation in a survey of world health experts to determine the best professional opinion regarding the impact of alternative health interventions and (3) to inquire about the possibility of meeting with you in at sometime in December or January to discuss the mortality project.

The infant mortality project is being carried out at the Center for Research on Economic Development at the University of Michigan, Ann Arbor, Michigan and at the University del Valle, Cali, Colombia. The objective of the project is to provide policy makers with an analytical framework that will facilitate the efficient allocation of resources to programs aimed at reducing the rate of infant mortality. The project will be tailored to fit a specific region, probably in Colombia, but involves the development of techniques which we hope will have general application to analysis of the cost effectiveness of medical programs.

There are four distinct phases to the project:

1. Development of a model of the process by which infants and toddlers are exposed to mortality risks and of the way in which alternative strategies may alter this process.

2. Conduct of a survey of medical and public health professionals to estimate the impact of alternative health interventions on infant mortality.

3. Estimation of the cost of alternative health interventions.

4. Application of a simulation or non linear programming procedure to determine the set of interventions which are most cost effective in raising the probability of child survival.

We have recently finished the first part of the project, the design of the simulation model. Briefly, the model involves the separation of children under the age of four into three age-groups neonatal (0 to 28 days), infant (29 days to 1 year) and toddler (1 to 4 years). Within each age group we have distinguished four-five broad categories of morbidity which together account for approximately 80% of child mortality. To allow a clear distinction between the impact of preventative activities affecting morbidity and curative activities affecting case fatality rates, the model separates mortality into morbidity and case fatality components.

Allowance has also been made for combination morbidity conditions (such as an inoculable disease complicated by the presence of malnutrition) which clearly involve different risks than less complicated morbidity states (such as malnutrition or measles alone). In addition, allowance has been made for the interaction between disease states (such as between malnutrition and diarrhea).

At the present we are commencing the second part of the project - the specification of the impacts of the alternative interventions. Perhaps the most accurate specification would involve the statistical analysis of morbidity and fatality data under various intervention conditions. This alternative is, however, not possible since no suitable body of data exists to allow the estimation of the entire model and the cost, both in time and money, of obtaining adequate data would be prohibitive. (In addition, "objective" statistical analysis is not without ambiguities and bias in interpretation).

We have chosen a survey of health practitioners as an alternative, practicable means of specifying the intervention effects. Policy choices are often made using government policy makers' own subjective evaluations of the impact of health policies. We feel that it is preferable to combine the opinions of health professionals with information about costs in a programming approach to policy choice. The advantages are several. First, programming provides a method

of ordering information about policy impacts with information about policy costs in order to choose the most cost effective policies. Second, a survey of health professionals allows the best professional opinion to be consulted in the specification of policy effectiveness. Third, the cost of a subjective specification is much less than long term statistical analysis. Should this procedure prove useful, it holds out the possibility of the analysis of the cost effectiveness of alternative policy choices in a variety of medical situations and geographical areas where statistical analysis is not possible.

"Survey" is perhaps not an accurate word since participant responses are not to be used solely in the form of group averages in a mechanical fashion, instead responses will be weighted according to respondants' areas of expertise and strength of opinion. An outline of the questions and information needed will be sent prior to the interview. However, it is important that the survey be conducted through consultation in a personal interview which will allow participants to comment on the design of the model and the selection of health interventions and to qualify their responses. A personal interview will also allow the participant to be given a thorough geographical, social and economic description of the area under analysis.

It is obvious that the quality, rather than the number of participants, is crucial to a study such as this. We have decided to limit the survey to a total of 20 - 24 health professionals of outstanding reputations. For this reason your participation is greatly desired.

A list of participants will be given with the results of the study, however, individual participants may remain anonymous if they wish. Further, the results of the study will not be used in a manner which will allow the responses of individual participants to be identified unless their permission is obtained. In publications associated with the "survey", it will be emphasized that the results do not necessarily represent the opinion of any participant individually, and that participation took place in the spirit of professional inquiry and the search for a solution to the pressing problem of infant mortality. It will also be stated that participation does not imply an endorsement of the use to which the survey results are put. Participants will be kept informed of the progress of the study over the next year, will be sent early drafts of any associated publications and will be given an opportunity to revise their responses.

The interview is expected to take approximately one day. If you are interested, please give me an indication of your consulting fee and dates when you might be available. Should you have further questions, please write. I appreciate your time in consideration of this request and I am looking forward to hearing from you.

Sincerely,

Survey Questions

1. Introduction

There are four separate survey frames designed to provide subjective estimates of 1) the impact of health interventions on morbidity, 2) the impact of interventions on fatality, 3) the impact of interventions on participation in health programs and, 4) the extent of interdisease causal relationships. In general, the questions are asked in the form of elasticities, that is, the questions are designed to give the percentage change in one variable (for instance, the rate of neonatal infections) in response to a percentage change in another (for instance, the percentage of children delivered in a health center). The primary advantage of an elasticity is that it can be estimated without knowledge of the units of measurement. A second advantage of the use of elasticities is that the estimates can be related to a variety of functional forms without requiring an additional survey. The estimated elasticities will be related by a straightforward algebraic formula to the coefficients of the relevant structural equation.

2. Confidence in answers

The degree of confidence the respondent places in his answer will be obtained for all questions. Confidence is expected to fluctuate both with variations in the fields of specialization of the participants and with variations in the extent of contemporary knowledge about particular interventions and relationships. For instance wide fluctuations in the confidence placed in the responses to a particular question might reflect a respondent panel made up of people who have extensively researched a given relationship as well as people who have little familiarity with

the relationship. In contrast, a low degree of confidence among all responding to a given question might indicate that, with the present state of knowledge, little is known about the relationships needed to answer the question. Confidence is measured on a scale of 0-5 as defined in Table 4-3 below.

TABLE 4-3

SCALE FOR CONFIDENCE IN ACCURACY OF ANSWERS

0	Can't answer this question.
1	Not highly confident, but an educated guess is possible.
2	Somewhat confident. No hard data is available but clinical or field experience allows a guess.
3	Moderately confident. Although some controversy may exist, there is tentative support based on data and/or a consensus of practitioners with clinic or field experience would support this estimate.
4	Confident. Personal knowledge through extensive research or clinical and field experience leads to this estimate; controversy is minimal.
5	Highly confident. This estimate is the accepted professional opinion and can be considered incontrovertible at the present time.

Participants will be forewarned that most of the questions require subjective estimates and in many cases the estimates may be no more than "educated" guesses. However, it will be emphasized that even though hard data is lacking and controversy may exist, a response is important if it is based, intuitively or otherwise, on clinical, field or research knowledge.

3. Note regarding assumptions underlying all questions

The questions are to be answered under the assumption that the

program or activity being considered has been operating for a long enough period to achieve a stable (or equilibrium) impact on the population in question. Also, each question assumes that all other programs and conditions are remaining unchanged except for the activity under consideration.

Survey Frame # 1

Estimates of the impact of health interventions and socio-economic conditions on child morbidity.

Table 4.5 gives the survey frame for the morbidity questions. Preliminary tests with the questionnaires have shown that there is no one method of response which is satisfactory for all survey participants or for all questions. For this reason a variety of procedures were devised, and the format of the response tables was designed accordingly, so that the question and response format with which each participant feels the most comfortable can be used. In order of desirability, from the point of view of specifying the model, the procedures are 1) a subjective point estimate, 2) an 80% confidence range, 3) a subjective response on a scale of 1 to 10, 4) a ranking of the interventions. Fortunately, the preliminary tests of the survey method have shown that most respondents feel comfortable with the first two procedures which yield answers that are more readily translated into impact coefficients than are the answers derived from the latter procedures. The columns under the heading "Estimates of Impact" provide space for the responses under each of the four procedures. Explanations of the four procedures and the use of the response tables are provided below.

1) Point Estimate

Respondents are given the present morbidity rate for the reference population identified in column five. They are then asked to give their

best subjective estimate of the percentage change in the morbidity rate among 100 new recipients of the intervention under consideration.

2) Range

Respondents are asked to give an interval for the percentage change in the morbidity rate among 100 new recipients which has, approximately, an eighty percent chance of containing the true percentage change. This procedure can be used together with the best point estimate.

3) Scale

Using the scale in Table 4-4 respondents are asked to choose the number between 1 and 10 that best conveys their opinion of the impact of the intervention on the reference population.

4) Ranking

Respondents are asked to rank the interventions in each group of interventions set apart by the double horizontal lines. For example, on the first page there are four questions concerning the effect of intervention activities related to maternal education on low birth weight. The activities are to be ranked from 1-4 in order of probable effectiveness. An effort will be made to elicit at least one response using one of the other three procedures to provide a means of relating the relative effectiveness of interventions across categories.

TABLE 4-4

Scale for the Subjective Estimation of the Effects of Health Interventions on Morbidity Risks

Scale	Verbal Description of Impact	Approximate Quantitative Interpretation: the morbidity risk will be reduced by,	
		Suggestion or	Other
0	almost no significant impact	<1%	—
1	weak	5%	—
2			
3	moderate	10%	—
4			
5	moderately strong	25%	—
6			
7	strong impact	50%	—
8			
9	extremely strong impact	75%	—
10	nearly absolute impact	>95%	—

TABLE 4- 5

1

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
0-1	L.B.W.		promotora - hygiene and nutritional ed.	presently without intervention	100 additional women						
			health center - hyg. and nut. ed. 1st trimester	presently without intervention	100 additional women						
			health center - hyg. and nut. ed. 2nd trimester	presently without intervention	100 additional women						
			educ. attainment of mother, at least 4 years.	presently without intervention	100 additional women						
			exam and tx for infection, etc. all women	presently without	100 additional women						
				not to receive intervention							

TABLE 4-5 (cont.)

2

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
0-1	L.B.W. (cont.)		prenatal exam and tx for infection, etc. in 1st trimester	presently without intervention	100 additional women						
			prenatal exam and tx for infection, etc. in 2nd trimester	presently without intervention	100 additional women						
			anemia tx for anemic women only	presently without intervention	100 additional women						
			iron fortification for all women	presently without intervention	100 additional women						
			nutritional program (prot., cal., iron) preg. women 1st trimester	presently without intervention	100 additional women						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	L.B.W. (cont.)		nutritional (prot., cal., iron), l.b.w. risk pregnancies 1st trimester	presently without intervention	100 additional women							
			nutritional program (prot., cal., iron) preg women 2nd or 3rd trimester	presently without intervention	100 additional women							
			nutritional (prot , cal., iron), l.b.w. risk pregnancies 2nd or 3rd trimester	presently without intervention	100 additional women							
			in home pipe water	without intervention	increase from 50% to 100% of HH.							
				already have intervention								
			public fountain < 100M	without intervention	increase from 50% to 100% of HH.							

TABLE 4-5 (cont.)

4

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	L.B.W. (cont.)		public fountain < 100M (cont.)	already have intervention								
			in house toilet	without intervention	increase from 50% to 100% of HH.							
				already have intervention								
			latrine	without intervention	increase from 50% to 100% of HH.							
				already have intervention								
			garbage and rubbish pick up	without intervention	increase from 50% to 100% of HH.							
				already have intervention								

TABLE 4-5 (cont.)

3

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	L.B.W. (cont.)		education of mother ≥ 4 yrs.	ed. of mother ≤ 2 yrs.	100 additional women							
			a doubling of household income per person		100 additional women							
			no mother of age < 18 or > 35 years.	mothers < 18 & > 35 years	100 additional women							
			no mother with < 2 yrs. birth internal	mother < 2 yrs. birth int.	100 additional women							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	Infection		promotora - hygienic and nutritional ed.	presently without intervention	100 additional women							
			health center - hyg. and nut. ed. 1st trimester	presently without intervention	100 additional women							
			health center - hyg. and nut. ed. 2nd trimester	presently without intervention	100 additional women							
			educ. attainment of mother, at least 4 years	presently without intervention	100 additional women							
			exam and tx for infection, etc. all women	presently without	100 additional women							

TABLE 4-5 (cont.)

7

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
0-1	Infection (cont.)		prenatal exam and tx for infection, etc. in 1st trimester	presently without intervention	100 additional women						
			prenatal exam and tx for infection, etc. in 2nd trimester	presently without intervention	100 additional women						
			breast feeding	doesn't breast feed	100 additional women						
			delivery in health center	unattended home del. no profilaxis,	100 additional women						
				no tet. imm.							
			delivery at home by midwife	unattended home del. no profilaxis,	100 additional women						
				no tet. imm.							

TABLE 4-5 (cont.)

8.

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	Infection (cont)		unattended delivery at home, eye and cord later by promotora	unattended home del. no profilaxis,	100 additional women							
				no tet imm								
			in home piped water	without intervention	increase from 50% to 100% of HH.							
				already have intervention								
			public fountain < 100M	without intervention	increase from 50% to 100% of HH.							
				already have intervention								
			in house toilet	without intervention	increase from 50% to 100% of HH.							
				already have intervention								

TABLE 4-5 (cont.)

9

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
0-1	Infection (cont.)		latrine	without intervention	increase from 50% to 100% of HH						
				already have intervention							
			garbage and rubbish pick up	without intervention	increase from 50% to 100% of HH.						
				already have intervention							
			doubling of household income per person		100 additional women						
			mothers education ≥ 4 years	ed. of mother ≤ 2 years	100 additional women						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	Infection (cont.)		≤ 2 people per room	presently > 3 people per room	100 additional women							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1 SCALE	Method #2 BEST ESTIMATE	Method #2 RANGE to		
0-1	Birth Trauma		exam and treatment for preg. women 1st trimester	presently without	100 additional women						
			delivery in health center	unattended home del. no profilaxis, no tet. imm.	100 additional women						
			delivery at home by midwife	unattended home del no profilaxis, no tet imm	100 additional women						
			unattended delivery at home, eye and cord later by promotora	unattended home del no profilaxis, no tet imm	100 additional women						
			delivery of l.b.w. and b t. risk mother in h.c.	unattended home del. no profilaxis, no tet. imm.	100 additional women						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
0-1	Birth Trauma (cont.)		no mother < 18 or > 35	mothers < 18 & > 35 years	100 additional women						
			no mother with < 2 yrs. birth internal	mother < 2 yrs birth int.	100 additional women						
			exam and treatment in 2nd or 3rd trimester	presently without	100 additional women						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	Tetanus		delivery in health center	unattended home del. no profilaxis, no tet imm.	100 additional women							
			delivery at home by midwife	unattended home del. no profilaxis, no tet imm	100 additional women							
			delivery unattended, a promotora visit later	unattended home del no profilaxis, no tet. imm	100 additional women							
			prenatal hygienic education by promotora	presently without intervention	100 additional women							
			prenatal hygienic education by health center	presently without intervention	100 additional women							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
0-1	Tetanus (cont.)		tetanus immunization of mother	not presently immunized	100 additional women							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method SCALE	Method #2 BEST ESTIMATE	Method #2 RANGE to		
1-12	Malnutrition		1, nutritional advice, promotora	presently without intervention	100 additional children						
			29, nutritional advice, well baby clinic	presently without intervention	100 additional children						
			30, nutritional supplement - all children	presently without intervention	100 additional children						
			U_5, breast feeding no supplement	presently not breast feeding	100 additional children						
			U_5, breast feeding with nutritional supplement for mother	breast feeding without supplement	100 additional children						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Rankings	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
1-12	Malnutrition (cont.)		mothers education ≥ 4 years	ed. of mother < 2 years	100 additional children						
			doubling of household income per person		100 additional children						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
1-12	Diarrhea		in home piped water	without intervention	from present 50% to 100% of pop.						
				already have intervention							
			public fountain < 100M	without intervention	from present 50% to 100% of pop.						
				already have intervention							
			in house excreta disposal	without intervention	from present 50% to 100% of pop.						
				already have intervention							
			latrine	without intervention	from present 50% to 100% of pop.						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
1-12	Diarrhea (cont.)		latrine (cont.)	already have intervention								
			rubbish pick up	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			hygienic counsel - promotora	presently without intervention	100 additional children							
			hygienic counsel - health clinic	presently without intervention	100 additional children							
			ed. ≥ 4 yrs.	ed. of mother < 2 years	100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1 SCALE	Method #2 BEST ESTIMATE	Method #2 RANGE to		
1-12	Diarrhea (cont.)		< 2 people per room	presently 3 people per room	100 additional children						
			breast feeding	doesn't breast feed	100 additional children						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
1-12	Respiratory		in house toilet	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			latrines	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			rubbish pick up	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			hygienic education health center	presently without intervention	100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
1-12	Respiratory (cont.)		breast feeding	doesn't breast feed	100 additional children							
			≤ 2 people per room	presently 3 people per room	100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
1-12	Immunizable		≤ 2 people per room	presently 3 people per room	100 additional children							
			inoculation	presently without intervention	100 additional children							
			U_5 breast feeding	presently not breast feeding	100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Rankings	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
12-60	Malnutrition		nutritional advice, promotora	presently without intervention	100 additional children							
			nutritional advice, well baby clinic	presently without intervention	100 additional children							
			nutritional supplement, all children	presently without intervention	100 additional children							
			mothers education ≥ 4 years	ed. of mother ≤ 2 years	100 additional children							
			doubling of household income		100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
12-60	Diarrhea		in home piped water	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			public fountain < 100M	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			in house excreta disposal	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			latrine	without intervention	from present 50% to 100% of pop.							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name _____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
12-60	Diarrhea (cont.)		latrine (cont.)	already have intervention								
			rubbish pick up	without intervention	from present 50% to 100% of pop.							
				already have intervention								
			hygienic counsel - promotora	presently without intervention	100 additional children							
			hygienic counsel-health center	presently without intervention	100 additional children							
			mother education ≥ 4 years	ed. of mother ≤ 2 years	100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)					CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2				
							SCALE	BEST ESTIMATE	RANGE to			
12-60	Respiratory (cont.)		~~breast feeding~~	doesn't breast feed	~~100 additional~~ children							
			≤ 2 people per room	presently 3 people per room	100 additional children							

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
12-60	Immunizable		in house toilet	without intervention	from present 50% to 100% of pop.						
				already have intervention							
			latrine	without intervention	from present 50% to 100% of pop.						
				already have intervention							
			rubbish pick up	without intervention	from present 50% to 100% of pop.						
				already have intervention							
			inoculation	presently without intervention	100 additional children						

TABLE 4-5 (cont.)

SUBJECTIVE ESTIMATES OF THE IMPACT OF HEALTH INTERVENTIONS ON CHILD MORBIDITY

Name_____

AGE GROUP	DISEASE	PRESENT MORBIDITY RATE	INTERVENTIONS	REFERENCE POPULATION	INTERVENTION COVERAGE	ESTIMATES OF IMPACT (% change in present rate)				CONFIDENCE	COMMENTS (ID NO.)
						Ranking	Method #1	Method #2			
							SCALE	BEST ESTIMATE	RANGE to		
12-60	Immunizable (cont.)		≤ 2 people per room	presently 3 people per room	100 additional children						

Survey Frame # 2

Estimates of the impact of health interventions on fatality.

Table 4-7 gives the survey frame for the fatality questions. The responses pertain to joint morbidity states as described in the row headings. The response procedures are the same four alternatives as used for the morbidity questions except that respondents are also asked to give an estimate of the rate that would be expected in the absence of any formal institutional care. The scale for the fatality questions is given in Table 4-6.

TABLE 4-6

Scale for the Subjective Estimation of the Effect of Health Interventions on Fatality Risks

Scale	Verbal Description of Impact	Approximate Quantitative Interpretation: the fatality risk will be reduced by,	
		Suggestions	or Other
0	almost no significant impact	<1%	—
1	weak impact	5%	—
2			
3	moderate impact	10%	—
4			
5	moderately strong impact	25%	—
6			
7	strong impact	50%	—
8			
9	extremely strong impact	75%	—
10	nearly absolute impact	>95%	—

Table 4-7a

Estimates of Fatality Rates for Joint Disease Categories

(out of 100 cases, for each category)

Name of Participant _____

I. 0-1 Age Group

1) Best Estimates

	Tetanus (all states)	low birth weight only	birth trauma only	infections only	l.b.w. & b.t.	l.b.w. & inf.	b.t. & inf.	l.b.w. & b.t. & inf.
no care								
outpatient								
inpatient								
present								

2) Range

no care								
outpatient								
inpatient								

3) Confidence

no care								
outpatient								
inpatient								

4) Scale

no care								
outpatient								
inpatient								

Table 4-7b

Estimates of Fatality Rates for Joint Disease Categories

(out of 100 cases, for each category)

Name of Participant _____

II. 1-12 Age Group

1) Best Estimates

	Malnutrition only	Diarrhea only	Respiratory only	Immunizable only	Maln. & immun.	Maln. & diarrhea	Maln. & respiratory	Other comb.
no care								
outpatient								
inpatient								
int. maln.								
present								

2) Range

no care								
outpatient								
inpatient								
int. maln.								

3) Confidence

no care								
outpatient								
inpatient								
int. maln.								

4) Scale

no care								
outpatient								
inpatient								
int. maln.								

Table 4-7c

Estimates of Fatality Rates for Joint Disease Categories

(out of 100 cases, for each category)

Name of Participant _____

II. 12-60 Age Group

1) Best Estimates

	Malnutrition only	Diarrhea only	Respiratory only	Immunizable only	Maln. & immun.	Maln. & diarrhea	Maln. & respiratory	Other comb.
no care								
outpatient								
inpatient								
int. maln.								
present								

2) Range

no care								
outpatient								
inpatient								
int. maln.								

3) Confidence

no care								
outpatient								
inpatient								
int. maln.								

4) Scale

no care								
outpatient								
inpatient								
int. maln.								

Survey Frame # 3

Estimates of the impact of health interventions and socio-economic variables on health program usage.

Table 4-9 gives the survey frame for the participation questions. Two alternative response procedures are used - 1) a best estimate or 2) a scale of 1-10. The scale for the usage questions is given in Table 4-8. The questions are divided into two groups depending on whether it is assumed that present prices and institutional arrangements prevail (table 4-9a) or services are provided free of charge (table 4-9b). The usage questions are asked only of people who are familiar with the health distribution system and current charges in Colombia.

TABLE 4-8

Scale for the Subjective Estimation of the Effect of Socioeconomic Variables and Promotional Activities on Health Service Usage

Scale	Verbal Description of Impact	Approximate Quantitative Interpretation: the participation rate will be,	
		Suggestion	or Other
0	almost no significant impact	1%	—
1	weak	10%	—
2			
3	moderate	30%	—
4			
5	moderately strong	50%	—
6			
7	strong	70%	—
8			
9	extremely strong	90%	—
10	nearly absolute impact	95%	—

Table 4-9a

Name of Participant_____ _____

Usage Response Under Various Situations at Present Prices
(Use % of Eligible Participants or Scale of 1-10)

Usage Category	Present Situation	A Doubling of Present Income	Increase in Average Educational Level of Mother to 4 Years	100% Coverage by Mass Media Program	100% Coverage by Health Promoter Program
1. Prenatal Care - All Women					
2. Prenatal Care Pregnant Women					
3. Curative Care Neonatal					
5. Breast Feeding					
6. Preventative Care Infant					
7. Curative Care Infant					
8. Preventative Care Toddlers					
9. Curative Care Toddler					

Table 4-9b

Name of Participant _____

Usage Response Under Various Situations When Services Are Provided Free of Charge

Usage Category	Present Situation	A Doubling of Present Income	Increase in Average Educational Level of Mother to 4 Years	100% Coverage by Mass Media Program	100% Coverage by Health Promoter Program
1. Prenatal Care - All Women					
2. Prenatal Care Pregnant Women					
3. Curative Care Neonatal					
5. Breast Feeding					
6. Preventative Care Infant					
7. Curative Care Infant					
8. Preventative Care Toddlers					
9. Curative Care Toddler					

Survey Frame # 4

Estimation of Interdisease causal relationships.

Table 4-11 gives the survey frame for the estimation of interdisease causal relationships. The survey form provides for either a scale (see Table 4-10) or a best estimate to be used for responses. It is important to point out that the questions inquire about causation rather than association. Explicitly, the questions are of the form,

Out of 1000 uses of x how may will lead to y?

Note that this question expressly does not ask how many cases of y can be found in 1000 people with x but, instead asks how many cases of y are attributable to having x. That is, the question asks the attributable risk of y given x.

TABLE 4-10

Scale for the Subjective Estimation of the Extent of Interdisease Causal Relationships

Scale	Verbal Description of Extent of Relationship	Approximate Quantitative Interpretation: out of 1000 cases of x approximately ___ will lead to y	
		Suggestion or Other	
0	almost no causal relationship	<10	_____
1	weak causal relationship	50	_____
2			
3	moderate causal relationship	100	_____
4			
5	moderately strong causal relationship	250	_____
6			
7	strong causal relationship	500	_____
8			
9	extremely strong causal relationship	750	_____
10	almost absolute causal relationship	950	_____

Name: _____

TABLE 4-11

Subjective Estimates of Interdisease Causal Relationships

Age Group	Disease A	effects	Disease B	Scale	Best Estimate of Number of Cases of B Caused by 1000 A		Confidence
0-1	l.b.w.		infection				
1-12	malnutrition		diarrhea				
1-12	diarrhea		malnutrition				
1-12	malnutrition		respiratory				
1-12	respiratory		malnutrition				
12-60	malnutrition		diarrhea				
12-60	diarrhea		malnutrition				
12-60	malnutrition		respiratory				
12-60	respiratory		malnutrition				
12-60	malnutrition		inoculable				
12-60	inoculable		malnutrition				
12-60	inoculable		respiratory				

BIBLIOGRAPHY

The bibliography is arranged by subject matter

(general works)

Anderson, M.A.; T. Grewal; eds. (1975) Nutrition Planning in the Developing World. New York: Care.

Benenson, A.S. ed. (1975) Control of Communicable Diseases in Man. Washington D.C.: Am. Pub. Hlth. Assoc.

Chiang, C.L. (1968) Introduction to Stochastic Processes in Biostatistics. New York: John Wiley and Sons.

Correa, H. (1975) Population, Health, Nutrition, and Development. Lexington: D.C. Heath.

Feldstein, M.S.; M.A. Pilot; T.K. Sundaresan. (1973) Resource Allocation Model for Public Health Planning: A Case Study of Tuberculosis Control. Geneva: WHO.

Gopaldas, T.; A.C. Kansra; N. Srinivasan; J. Varadarajan; A.G. Shingwekar; R. Seth; R.S. Mathur; V. Bhargaua. (1975) Project Poshak. 2 vols. New Delhi: Care - India.

Gross, A.J.; V.A. Clark. (1975) Survival Distributions: Reliability Applications in the Biomedical Sciences. New York: John Wiley and Sons.

Jelliffe, D.B. (1966) The Assessment of the Nutritional Status of the Community. Geneva: WHO.

Linstone, H.A.; M. Turoff; eds. (1975) The Delphi Method: Techniques and Applications. Reading: Addison-Wesley.

Mann, N.R.; R.E. Schaffer; N.D. Singpurwalla. (1974) Methods for Statistical Analysis of Reliability and Life Data. New York· John Wiley and Sons.

Morley, D. (1973) Paediatric Priorities in the Developing World. London: Butterworth and Co.

Organizacion Panamericana de la Salud. (1975) Estudios y Estra tegias Necesarios Para Reducir la Morbilidad y Mortalidad por Infecciones Entericas. (Discusiones Técnicas de la XIX Conferencia Sanitaria Panamericana de la OPS) Publicación Cientifica No. 302.

Oyeka, I.C.A. (1977) "Development and Investigation of a Path Model of Child Mortality Determinants in Ghana". Ph.D. dissertation, University of Michigan.

Puffer, R.R.; C.V. Serrano. (1973) Patterns of Mortality in Childhood. Scientific Publication No. 262. Washington D.C.: PAHO.

Report of the Committee on Infectious Diseases. (1974) By Samuel L. Katz, Chairman. Evanston: Am. Acad. of Pediatrics.

Robson, J.R.K.; F.A. Larkin; A.M. Sandretto; B. Tadayyon. (1972) Malnutrition: Its Causation and Control. 2 vols. New York: Gordon and Breach.

Scrimshaw, N.S.; C.E. Taylor; J.E. Gordon. (1968) Interactions of Nutrition and Infection. Geneva: WHO

Shapiro, S.; E.R. Schlesinger; R.E.L. Nesbitt, Jr. (1968) Infant, Perinatal, Maternal, and Childhood Mortality in the United States. Cambridge: Harvard University Press.

Sloan, F. (1971) Survival of Progeny in Developing Countries: An Analysis of Evidence from Costa Rica, Mexico, East Pakistan and Puerto Rico. (A report prepared for AID). Santa Monica: Rand.

Smucker, C.M. (1975) "Socio-economic and Demographic Correlates of Infant and Child Mortality in India." Ph.D. dissertation, University of Michigan.

U.S. Department of Health, Education and Welfare. Public Health Service and Indian Health Service Co-operating. Health Status Maximization and Resource Allocation, by J. Lipscomb; L.E. Berg; V.L. London; P.A. Nutting. A Report to the National Center for Health Services Research. Washington D.C.: Government Printing Office, 1975.

BIBLIOGRAPHY
(Perinatal)

Abramowicz, M.; H.L. Barnett. (1970) "Sex Ratio of Infant Mortality". Am. J. Dis. Child. Vol. 119. pp. 314-315.

Anand, S.; S.S. Paul; S. Kumar; S.L. Bhatia. (1970) "Causes of Death in Low Birthweight Babies". Indian Pediat. Vol. 7. pp. 35-40.

Avery, M.E.· W.A. Hodson. (1966) "The First Drink Reconsidered". J. Pediat. Vol. 68. pp. 1.008-9.

Baertl, J.M.; E. Morales; G. Vertastequi; G.G. Graham. (1970) "Diet Supplementation for Entire Communities. Growth and Mortality of Infants and Children". Am. J. Clin. Nutr. Vol. 23. pp. 707-15.

Banik, N.D.D.: S. Nayer; R. Krishna· L. Raj; A.D. Taskar. (1972) "Some Observations on Low Birthweight Babies during First Year". Indian Pediat. Vol. 9. pp. 95-8.

Baumslag, N.; T. Edelstein· J. Metz. (1970) "Reduction of Incidence of Prematurity by Folic Acid Supplementation in Pregnancy". Br. Med. J. Vol. 1. pp. 16-7.

Bhargava; S.K.; V. Bhargava; S. Kumari; S. Madhaven; S. Ghosh. (1973) "Birthweight Gestational Age and Maternal Factors in Low Birthweight Babies". Indian Pediat. Vol. 10. pp. 161-166.

Boon W.H. (1969) "Child Health in Singapore. Traditional Practices and their Effects". Clin. Pediat. (phila) Vol. 8. pp. 611-6.

Bwibo, N.O. (1970) "Common Causes of Death in Children at Mulago Hospital, Kampala, Uganda". Clin. Pediat. (ph.la.) Vol. 9. pp. 691-4.

Committee on Nutrition. (1969) "Iron Balance and Requirements in Infancy'. Pediatrics. Vol. 43. pp. 134-42.

Gordon. J.E.: S. Singh; J.B. Wyon. (1965a) "Causes of Death at Different Ages by Sex, and by Season, in a Rural Population of the Punjab, 1957-1959; A Field Study". Indian J. Med. Res. Vol. 53. pp. 906-16.

_____; H. Gideon; J.B. Wyon. (1965b) "Midwifery Practices in Rural Punjab, India". Am. J. Obstet. Gynecol. Vol. 93. pp. 734-42.

Gruenwald P. (1969) "The Problem of Prematurity and of Intra-uterine Growth Retardation". Perinatal Factors Affecting Human Development. PAHO #185. pp. 51-3.

Habicht J.P.; A. Lechtig; C. Yarbrough; H. Delgado; R.E. Klein. (1973) "The Effect of Malnutrition During Pregnancy on Survival of the Newborn". Comm. on Nutr. and Human Needs. U.S. Senate. June 5, 1973.

_____; A. Lechtig; C. Yarbrough; R.E. Klein. (1974a) "Maternal Nutrition, Birthweight and Infant Mortality". Size at Birth, Ciba Foundation Symposium 27 (new series). pp. 353-77.

_____; C. Yarbrough; A. Lechtig; R.E. Klein. (1974b) "Relation of Maternal Supplementary Feeding During Pregnancy to Birthweight and Other Sociobiological Factors". Nutrition and Fetal Development. M. Winik (ed.), New York: J. Wiley and Sons, Inc. pp. 127-45.

Hall, S.A. (1969) "Malaria Treatment and Prevention. A Review". East Afr. Med. J. Vol. 46. pp. 553-63.

Holley, W.L.; A.L. Rosenbaum; J.A. Churchill. (1969) "Effect of Rapid Succession of Pregnancy". Perinatal Factors Affecting Human Development. PAHO #185. pp. 41-4.

Holmes, G.E. (1973) "Observations on 1,500 Consecutive African Births in East Africa". East Afr. Med. J. Vol. 50. pp. 498-513.

Jelliffe, E.F.P. (1968) "Low Birthweight and Malarial Infection of the Placenta". Bull.WHO. Vol. 38. pp. 69-78.

Kolach, P.J.; P.A. Master; L.D. Sanghui. (1967) "Congenital Malformations and Perinatal Mortality in Bombay". Am. J. Obstet. Gynecol. Vol. 97. pp. 400-6.

Koten, J.W. (1968) "Perinatal and Infantile Mortality in Nairobi". East Afr. Med. J. Vol. 45. pp. 328-32.

Kumari, S.; S. Ghosh; S.K. Bhargaua; V. Bhargaua. (1972) "Development of Low Birth Weight Babies". Indian Pediat. Vol. 9. pp. 732-6.

Laditan, A.A.O. (1974) "Neonatal Mortality Among the Low Birth Weight Infants Under Special Pediatric Cure". Environ. Child Hlth. Vol. 20. pp. 57-9.

Lechtig, A.; J.P. Habicht; H. Delgado: R.E. Klein; C. Yarbrough; R. Martorell. (1974) "Effect of Food Supplementation During Pregnancy on Birthweight". Pediatrics. Vol. 56. pp. 508-520.

_____; H. Delgado; C. Yarbrough; R.E. Klein; R. Martorell. (1975) "Field Indicators of High Risk of Infant Death Based on Birth Information". Environ. Child Hlth. Vol. 21. pp. 199-202.

_____; J.P. Habicht; C. Yarbrough; H. Delgado; G. Guzman; R.E. Klein. (1975) "Influence of Food Supplementation during Pregnancy on Birth Weight in Rural Populations in Guatemala". Nutrition. Vol. 2. pp. 44-52.

_____; C. Yarbrough; H. Delgado; J.P. Habicht; R. Martorell; R.E. Klein. (1975) "Influence of Maternal Nutrition on Birth Weight". Am. J. Clin. Nutr. Vol. 28. pp. 1,223-33.

_____; J.P. Habicht; C. Yarbrough; H. Delgado; R.E. Lasky; R. Martorell; R.E. Klein. (1974c) "Maternal Nutrition and Birthweight". XIV Congresso Internacional de Pediatria, October 3-9 Buenos Aires.

Lewis, J.R. (1974) "The Birthweights of Babies in the Cameroun Grasslands". Environ. Child Hlth. Vol. 20. pp. 300-1.

Lourdenadin, S. (1969) "Hazards of Child Birth in West Malaysia". Med. J. Malaya. Vol. 23. pp. 239-44.

"Low Birth Weight Babies". (1970) Indian Pediat. Vol. 7. pp. 1-2

Marshall, F.N. (1968) "Tetnus of the Newborn with Special Reference to the Experience in Haiti, W.I.". Adv. Pediat. Vol. 15. pp. 65-110.

"Maternal Dietary Supplementation and Infant Birth Weight". (1973) Nutr. Rev. Vol. 31. pp. 45-7.

Miller, S.A. (1970) "Nutrition in the Neonatal Development of Protein Metabolism". Fed. Proc. Vol. 29. pp. 1,497-502.

Moghissi, K.S.; J.A. Churchill; C. Frohman. (1969) "Relationships of Maternal Amino Acid Blood Levels to Fetal Development". Perinatal Factors Affecting Human Development. PAHO #185. pp. 16-9.

Molteno, C.D.; W. Ahrens; S.C. Higgs; A. J. Malan; H. De V. Heese. (1976) "Infants of Very Low Birthweight". S. Afr. Med. J. Vol. 50. pp. 955-8.

Moore, J.R.; M.F. Lowry. (1975) "Prognosis for Extremely Low Birth Weight Babies in Jamaica". West Ind. Med. J. Vol. 24. pp. 138-143.

Mukherjee, D.K.; N.J. Sethna. (1970) "Birthweight and its Relation with Certain Maternal Factors". Indian J. Pediat. Vol. 37. pp. 460-3.

Omran, A.R. (1966) "Impact of Economic Development on Health Patterns in Egypt". Arch. Environ. Hlth. Vol. 13. pp. 117-24.

Prasad, L.S.; K.P. Sinha; P.K. Sen. (1972) "Tyrosinemia and Tyrosinuria in Low Birth Weight Infants in India". Indian Pediat. Vol. 9. pp. 703-6.

Rahnmtoola, R.J.; S. Mir; S. Baloch. (1968) "Low Birthweight, the 'Small for Date' Syndrome and Perinatal Mortality in a Low Family Income Group". Acta. Paediat. Scand. Vol. 57. pp. 534-6.

Ramaiah, T.J.; V.L. Narasimham. (1967) "Birthweight as a Measure of Prematurity and its Relationship with Certain Maternal Factors". Indian J. Med. Res. Vol. 55. pp. 513-24.

Read, M.S.; J.P. Habicht; A. Lechtig; R.E. Klein. (1975) "Maternal Malnutrition, Birth Weight, and Child Development". Mod. Probl. Paediat. Vol. 14. pp. 203-15.

Rush, R.W.; M.J.N.C. Keirse; P. Howat; J.D. Baum: A.B.M. Anderson; A.C. Turnbull. (1976) "Contribution of Preterm Delivery to Perinatal Mortality". Brit. Med. J. Vol. 2. pp. 965-8.

St. George, J.; E.H. St. John; D. Josa. (1970) "Factors Influencing Birth Weight in Normal Pregnancy". J. Trop. Pediat. Vol. 16 pp. 93-102.

Sampath, S.; P.C. Jain; B.G. Prasad. (1970) "A Study of Infant Mortality in Luckow Cantonment". Indian J. Med. Res. Vol. 58. pp. 772-82.

Scrimshaw, N.S. (1970) "Synergism of Malnutrition and Infection. Evidence from Field Studies in Guatemala". JAMA. Vol. 212. pp. 1,685-92.

Shah, K.P.; P.M. Shah. (1975) "Factors Leading to Severe Malnutrition. A Relationship of Maternal Nutrition and Marasmus in the Infants". Indian Pediat. Vol. 12. pp. 64-7.

Shih, S.C.; T.H. Chang; C. Sung. (1966) "Endeavors to Reduce Perinatal and Maternal Mortality in a Maternity Hospital". Clin. Med. J. Vol. 85. pp. 288-90.

Siegal, E. (1969) "The Biologic Effects of Family Planning. A. Preventive Pediatrics: The Potential of Family Planning". J. Med. Educ. Vol. 44, Supp. 2. pp. 74-80.

Singh, M.; C. Monteiro; O.P. Ghai. (1970) "Early Versus Late Feeding of Low Birth Weight Neonates - A Controlled Study". Indian J. Pediat. Vol. 37. pp. 54-8.

_____. (1970) "Feeding of Low Birth Weight Babies". Indian J. Pediat. Vol. 37. pp. 519-28.

Tafari, N.; G. Sterky. (1974) " 'Early' Discharge of Low Birth-weight Infants in a Developing Country". Environ. Child Hlth. Vol. 20. pp. 73-6.

Van den Berg, B.J. (1968) "Morbidity of Low Birthweight and/or Preterm Babies Compared to that of the 'Mature' ". Pediatrics. Vol. 42. pp. 590-597.

Weiss, W.; E.C. Jackson. (1969) "Maternal Factors Affecting Birthweight". Perinatal Factors Affecting Human Development. PAHO #185. pp. 54-9.

Yarbrough, C.; J.P. Habicht; A. Lechtig; R.E. Klein; R.E. Lasky; H. Delgado. (1973) "Influence of Gestational Nutrition on Birthweight and Other Outcomes of Pregnancy". APHA Meeting, San Francisco, California.

BIBLIOGRAPHY
(Malnutrition)

Akinrele, I.A.; C.C. Edwards. (1971) "An Assessment of the nutritive value for a maize-soya mixture, 'Soy-Ogi' as a weaning food in Nigeria". Brit. J. Nutri. Vol. 26. pp. 177-88.

Asfour, R.Y. (1971) "A new vehicle for supplementing an inadequate diet in children, use in Lebanon". Bull. N.Y. Acad. Med. Vol. 7. pp. 5-16.

Aykroyd, W.R. (1971) "Nutrition and mortality in infancy and early childhood: past and present relationships". Am. J. Clin. Nutr. Vol. 24. pp. 480-7.

Bai, K.I. (1972) "Teaching better nutrition by domicilary management of cases of PCM in rural areas (a longitudinal study of clinical and economic aspects)". J. Trop. Pediat. Vol. 18. pp. 307-12.

Baysal, A. (1968) "Present situation in Turkey regarding malnutrition in infants and preschool children - types of problems, magnitude of problems, location". Turk. J. Pediat. Vol. 10. pp. 73-87.

Beaudry-Darisme, M.; M.C. Latham. (1973) "Nutrition Rehabilitation Centers - An Evaluation of their Performance". Environ. Child Health. pp. 299-332.

Bennett, I.L. Jr. (1969) "Food and Population: an overview". World Rev. Nutr. Diet. Vol. 11. pp. 1-16.

Berg, A. (1970) "Priority of Nutrition in Natural Development". Nutr. Rev. Vol. 28. pp. 199-204.

Bhattachargya, A.K. (1975a) "Studies on Kwashiorkor and Marasmus in Calcutta (1957-1974): I. Aetiological and clinical studies". Indian. Pediat. Vol. 12. pp. 1103-13.

_____. (1975b) "Studies on Kwashiorkor and Marasmus in Calcutta (1957-1974): II. Pathological, biochemcial and metabolic studies". Indian. Pediat. Vol. 12. pp. 1115-23.

_____. (1975c) "Studies on Kwashiorkor and Marasmus in Calcutta (1957-74): III. Theraputic and follow-up studies". Indian Pediat. Vol. 12 pp. 1125-33.

Blankhart, D.M. (1968) "Health Problems in Pre-school Children. 3. Worldwide Experience; Special Problems and Preventive Programs. (5) Central Africa". J. Trop. Pediat. Vol. 14. pp. 249-52.

Brooke, O.G.; E.F. Wheeler. (1976) "High Energy Feeding in Protein-Energy Malnutrition". Arch. Dis. Child. Vol. 51. pp. 968-71.

Brown, R.E. (1965) "Paediatric Post Mortum Survey in Uganda". Trop. Geog. Med. Vol. 17. pp. 289-300.

Burgess, H.J. (1969) "A Brief Follow-up Study of Malnutrition in Village Children in Tanzania". East. Afr. Med. J. Vol. 46. pp. 26-9.

_____; S. Cole-King; A. Burgess. (1972) "Nutritional Status of Children at Namitambo, Malawi". J. Trop. Med. Hyg. Vol. 75. pp. 143-8.

_____; A. Burgess; E.F. Wheeler. (1973) "Results and Appraisal of a Nutrition Survey in Malawi". Trop. Geog. Med. Vol. 25. pp. 372-80.

Bwibo, N.O. (1970) "Common Causes of Death in Children at Mulago Hospital, Kamapala, Uganda". Clin. Pediat. (Phila.) Vol. 9. pp. 691-4.

_____. (1970) "Measles in Uganda. An analysis of children with measles admitted to Mulago Hospital". Trop. Geog. Med. Vol. 22. pp. 167-71.

"Calorie Supplementation and Growth of Pre-school Children". (1974) Nutr. Rev. Vol. 32. pp. 141-3.

Cerny, K.; S. Hajakova; J. Pechar; V. VuVan; A. Rubin; K. Zvolankova. (1968) "A Comparison of the Efficacy of a Soy-Flour Based Milk Substitute in Feeding Malnourished Vietnamese and Eutrophic Czech Infants". J. Trop. Pediat. Vol. 14. pp. 15-26.

Chandra, R,K.; R.R. Paiva; O.P. Ghai. (1968) "Sugar Intolerance in Malnourished Infants and Children". Brit. Med. J. Vol. 4. pp. 611-3.

Chaudhuri, M.K. (1973) "Dietary Appraisal of West Bengal Pre-school Children and its Effect on Growth and Nutrition". Indian J. Pediat. Vol. 40. pp. 276-80.

Chen, K.P. (1968) "Nutrition Proplems and Programs in Taiwan". J. Vitaminol. (Kyoto) Vol. 14 Supp. pp. 10-19.

"Chilhood Diarrhea in Rural Guatemala". (1970) Nutr. Rev. Vol. 28. pp. 61-5.

"Childhood Malnutrition in Iran". (1969) Nutr. Rev. Vol. 27. pp. 69-71.

Crawford, J.; J.V. Willmott. (1971) "Nutritional Status of Young Gilbertese Children in a Transitional Economy". Trop. Geog. Med. Vol. 23. pp. 249-57.

Danileuicius, Z. (1975) "A Call to Recognize PCP". JAMA. Vol. 231. pp. 1168-9.

Davidson, J.C.; K.V. Desai; H.M. Jamal. (1965) "An Analysis of a Hundred Cases of Kwashiorkor". Cent. Afr. Med. J. Vol. 11. pp. 361-2.

Edwards, K. (1972) "More Disadvantages of Bottle Feeding". NEJM Vol. 287. pp. 310-11.

Ferro-Luzzi, G. (1972) "PCM". Lancet Vol. 2. p. 769.

Fonaroff, L.S. (1969) "Settlement Typology and Infant Malnutrition in Jamaica". Trop. Geog. Med. Vol. 21. pp. 177-185.

Gans, B. (1969) "A Biafran Relief Mission". Lancet Vol. 1. pp. 660-5.

Garrow, J.S. (1969) "Treatment of Malnutrition". Lancet Vol. 2. pp. 324-5.

Ghai, O.P.; L. Kumar; V. Kumar; (1969) "Disaccharide Intolerance in Malnutrition". Indian Pediat. Vol. 6. pp. 364-373.

_____. (1975) "PCM in the Community". Indian Pediat. Vol. 12. p. 63.

_____; V.N. Jaiswal (1970) "Relationship of Undernutrition to Diarrhea in Infants and Children". Indian J. Med. Res. Vol. 58. pp. 789-95.

Giok, S.; C.S. Rose; P.H. Liang; P. Gyorgy (1968) "A Study of the Influence of Malnutrition on Some Aspects of the Health of School Age Children". J. Vitaminol (Kyoto) Vol. 14. Supp. pp. 28-34.

Gokulanathan, K.S.; K.P. Verghese. (1970) "Sociocultural Malnutrition Syndrome of Nutritional Imbalance, Growth Disturbances and Chronic Infection". Clin. Pediat. (Phila.) Vol. 9. pp. 439-42.

Gopalan, C.; M.C. Swaninatham; V.K. Kumari; D.H. Rao; K. Vijayaraghauan. (1973) "Effect of Calorie Supplementation on Growth of Undernourished Children". Am. J. Clin. Nutr. Vol. 26. pp. 563-6.

Gordon, J.E.; N.S. Scrimshaw. (1970) "Infectious Disease in the Malnourished". Med. Clin. N. Amer. Vol. 54. pp. 1495-1508.

_____; W. Ascoli; L.J. Mata; M. Guzman. (1968) "Nutrition and Infection Field Study in Guatemalan Villages 1959-1964. IV Acute Diarrheal Disease and Nutritional Disorders in General Disease Incidence". Arch. Enriron. Health. Vol. 16. pp. 424-437.

_____; N.S. Scrimshaw. (1965) "Nutrition and the Diarrheas of Early Childhood in the Tropics". Mil. Mem. Fund Q. Vol. 43. pp. 233-239.

Graham, G.G.; J.M. Baertl; A. Cordano. (1966) "La Diarrea y la Malnutricion Infantil". Bol. Ofic. Sanit. Pan Amer. Vol. 60. pp. 46-50.

Gupta, B.M.; B. Bhanadari. (1973) "Nutritional Assessment of Rural Pre-school Children". Indian J. Pediat. Vol. 40. pp. 142-6.

_____; K.N. Agarwal. (1972) "Nutritional Assessment of Pre-school Children: II. Clinical Assessement of Nutritional Deficiencies". Indian Pediat. Vol. 9. pp. 480-3.

Gurson, C.T.; G. Saner; T. Yuksel. (1975) "Some Etiological Aspects of PCM in the Marmara Region of Turkey". J. Trop. Pediat. Vol. 21. pp. 311-4.

_____; T. Yuksel; G. Saner. (1976) "The Short Term Prognosis of PCM in Marmara Region of Turkey". J. Trop. Pediat. Vol. 22. pp. 59-62.

Gyorgy, P. (1967) "Nutrition Research in Indonesia and Thailand. Introduction." Am. J. Clin. Nutr. Vol. 20. pp. 1258-9.

_____; (1967) "Approach to a Promising Program for the Protection of the Pre-school Child". Am. J. Clin. Nutr. Vol. 20. pp. 1253-5.

Hall, S.A. (1969) "Nutrition and Infection". East Afr. Med. J. Vol. 46. pp. 58-63.

Hanumantha, R.D.; K. Satyanarayana; K. Vijayaraghavan; S.J. Gowrinath; N.A. Nadamuni; M.C. Swaminathan. (1975) "Evaluation of a Special Nutrition Programme in the Tribal Areas of Andhra Pradesh". Indian J. Med. Res. Vol. 63. pp. 652-60.

Hay, R.W.; A.H. Calvert. (1972) "Mortality in PCM". East Afr. Med. J. Vol. 49. pp. 868-73.

Hegsted, D.M. (1972) "Deprivation Syndrome or PCM". Nutr. Rev. Vol. 30. pp. 51-4.

Hendrickse, R.G. (1968) "Health Problems in Pre-school Children. 3. Worldwide Experieance: Special Problems and Preventive Programs. (6) West Africa". J. Trop. Pediat. Vol. 14. pp. 253-6.

Heyworth, B. (1976) "PCM and BCG Vaccine". Lancet Vol. 2. p. 743.

Hijazi, S.S. (1974) "Patterns of PEM in Early Childhood in Jordan". Am. J. Clin. Nutr. Vol. 27. pp. 1254-8.

Horwitz, A. (1969) "The Future of Nutrition Activities in Latin America". Am. J. Public Health Vol. 59. pp. 214-9.

James, J.W. (1972) "Longitudinal Study of the Morbidity of Diarrheal and Respiratory Infections in Malnourished Children". Am. J. Clin. Nutr. Vol. 25. pp. 690-4.

Joseph, S.C. (1974) "PCM in West African Children". Rocky Mt. Med. J. Vol. 71. pp. 390-5.

Katz, M.; E.R. Stiehm. (1977) "Host Defenses in Malnutrition". Pediatrics Vol. 59. pp. 490-5.

Keller, W.D. (1975) "Involvement of Nursing, Paramedical, and Social Workers in Combatting PCM". Indian Pediat. Vol. 12. pp. 111-3.

Kielmann, N.S.; A.A. Kielman; G.K. Grewal. (1976) "Etiological Deterimants of Protein Calorie Under-nutrition in a Rural Child Community". Acta Trop. Vol. 33. pp. 342-68.

Korte, R.; W.K. Simmons. (1972) "The Nutritional Status of Preschool Children in Kenja". East Afr. Med. J. Vol. 49. pp. 513-20.

Kumar, C.M.; N.R. Ramakrichnan. (1973) "Nutritional Status of Rural Preschool Children in West Bengal: II. Clinical Observations". Indian Pediat. Vol. 10. pp. 167-72.

Laugesen, B.M. (1974) "A Weight Chart and Weighing Scale for Nutrition Surveys and Grading of Malnutrition in Clinics". Indian Pediat. Vol. 11. pp. 285-8.

Laugesen, M. (1975) "Child's Bangle for Nutrition Screening". Indian Pediat. Vol. 12. pp. 1261-6.

Lawless, J.; M.M. Lawless; A.S. Garden. (1966) "Admissions and Mortality in a Children's Ward in an Urban Tropical Hospital". Lancet Vol. 2. pp. 1175-6.

Levinson, F.J. (1970) "Our Child Feeding Overseas". J. Am. Dict. Assoc. Vol. 57. pp. 503-8.

Lloyd, A.V. (1968) "Tuberculin Test in Children with Malnutrition". Br. Med. J. Vol. 3. pp. 529-31.

Madhavan, S.; T.P. Susheela; M.C. Swaminathan. (1967) "Association of Growth Status and the Prevalence of Nutritional Deficiency Signs Among Pre-school Children". Indian J. Med. Res. Vol. 55. pp. 497-503.

Madhavi, V.; N.P. Rao; Y.C. Mathur; Y.R. Reddi. (1973) "Brief Communication: Processed Soya Flour as a Substitute for Dry Skim Milk in the 'Protein Packet' in the Treatment of PCM". Indian Pediat. Vol. 10. pp. 191-2.

Malcolm, L.A. (1971) "Growth, Malnutrition, and the Mortality of the Infant and Toddler in the Asai Valley of the New Guinea Highlands". Am. J. Clin. Nutr. Vol. 24. pp. 358-64.

Maletnlema, T.N.; A.L. Marealle. (1973) "The Health and Nutritional Status of Children in the Tabora Region, Tanzania". J. Trop. Pediat. Vol. 19 pp. 14-18.

"Malnutrition and Hepatitis-associated Antigen Infection". (1973) Nutr. Rev. Vol. 31. pp. 310-11.

"Malnutrition in Early Childhood: the Newer Insights". (1967) Clin. Pediat. (Phila.) Vol. 6. pp. 492-500.

"Malnutrition in Uganda". (1972) Nutr. Rev. Vol. 30. pp. 6-8.

Mathew, O.; T. Dev. (1973) "Cutaneous Diptheria". Indian Pediat. Vol. 10. pp. 111-4.

McDowell, I.; D. Clayden. (1974) "Measuring the Recovery Rates of Malnourished Children from their Weight-gains: I: Review of Existing Methods". J. Trop. Pediat. Vol. 20. pp. 751-5.

_____; D. Clayden. (1974b) "Measuring the Recovery Rates of Malnourished Children from their Weight Gains· II. Discussion of a New Technique". J. Trop. Pediat. Vol. 20. pp. 256-60.

McKenzie, H.I.; H.G. Lovell; K.L. Standard; W.E. Miall. (1967) "Child Mortality in Jamaica". Mil. Mem. Fund Q. Vol. 45. pp. 303-20.

McLaren, D.S.; W.W. Read. (1972) "Classification of Nutritional Status in Early Childhood". Lancet Vol. 2. pp. 146-8.

_____; E. Shirajian; H. Loshkajian; S. Shadarevian. (1969) "Short-term Pronosis in PCM". Am. J. Clin. Nutr. Vol. 22. pp. 863-70.

"Measles and the State of Nutrition". (1969) Postgrad. Med. Vol. 45. pp. 253-4.

Mehta, S.; J.S. Teja; N.N. Wig; S. Thukral; S. Pasricha. (1975) "PCM -- A Follow-up Study". Indian J. Med. Res. Vol. 63. pp. 576-82.

Miall, W.E.; P. Desai; K.L. Standard. (1970) "Malnutrition, Infection, and Child Growth in Jamaica". J. Biosoc. Sci. Vol. 2. pp. 31-44.

Morley, D. (1968) "A Health and Weight Chart for use in Developing Countries". Trop. Geog. Med. Vol. 20. pp. 101-7.

_____. (1967) "Measles and Measles Vaccine in Pre-industrial Countries". Mod. Trends Med. Virol. Vol. 1. pp. 141-61.

Musoke, L.K.; (1968) "Health Problems in Pre-school Children. 3. Worldwide Experience, Special Problems and Preventive Programs. (4) East Africa". J. Trop. Pediat. Vol. 14. pp. 245-248.

Namboze, J.M. (1973) "A Rural Nutrition Rehabilitation Project at Kasangati Health Centre". J. Trop. Pediat. Vol. 19. pp. 45-52.

Nammacher, M.A.; R.B. Bradfield; G. Arroyave. (1972) "Comparing nutritional Status Methods in a Guatemalan Survey". Am. J. Clin. Nutr. Vol. 25. pp. 871-4.

Neave, M. (1968) "PCM of Early Childhood in Western Samoa". Trop. Geog. Med. Vol. 20. pp. 191-201.

Nicol, B.M. (1970) "Argiculture, Food and Nutrition in Developing Countries". Proc. R. Soc. Med. Vol. 63. Supp. pp. 1177-81.

Nicole, A.M. (1975) "Ethiopia 1974 - Some Medical Impressions". N.Z. Med. J. Vol. 82. pp. 346-8.

Ogbeide, M.I. (1971) "The Clinical Pattern of the PCM in Ibaden, Nigeria". West Afr. Med. J. Vol. 20. pp. 313-9.

_____. (1968) "The Influence of PCM on the Pattern of Pre-school Childhood Diseases. Observations in Lagos, Nigeria". Clin. Pediat. (Phila.) Vol. 7. pp. 425-31.

Omer, H.O.; M.I. Omer; O.O. Khalifa. (1975) "Pattern of PEM in Sudanese Children and Comparison with Some Other Middle East Countries". J. Trop. Pediat. Vol. 21. pp. 329-33.

Paige, D.M.; E. Leonardo; A. Cordano; J. Nakashima; B. Adrianzen; G.G. Graham. (1972) "Lactose Intolerance in Peruvian Children: Effect of Age and Early Nutrition". Am. J. Clin. Nutr. Vol. 25. pp. 297-301.

Pascual, C.R. (1968) "Nutrition Problems and Programs in the Philippines". J. Vitaminol (Kyoto) Vol. 14. Supp. pp. 30-7.

Peireira, S.M.; V. Benjamin. (1972) "Measles in a South Indian Community". Trop. Geog. Med. Vol. 24. pp. 124-9.

_____; T. Isaac; B. Tewarson; M.E. Dumm. (1965) "Processed Fish Protein in the Treatment of Kwashiorkor". Indian J. Med. Res. Vol. 53. pp. 651-8.

_____; A. Begum. (1974) "The Manifestation and Management of Severe Protein-Calorie Malnutrition (Kwashiorkor)". Wld. Rev. Nutr. Diet Vol. 19. pp. 1-50.

Phillips, I.; S.K. Lwanga; W. Lore; D. Wasswa. (1969) "Methods and Hygiene of Infant Feeding in an Urban Area of Uganda". J. Trop. Pediat. Vol. 15. pp. 167-71.

Poskitt, E.M. (1971) "Effect of Measles on Plasma-albumin Levels in a Ugandan Village". Lancet Vol. 2. pp. 68-70.

_____. (1972) "Seasonal Variation in Infection and Malnutrition at a Rural Paediatric Clinic in Uganda". Trans. R. Soc. Med. Hyg. Vol. 66. pp. 931-36.

"Protein Calorie Malnutrition: Ecology and Management. Suggestion and Recommendations". (1975) Indian Pediat. Vol. 12. pp. 116-7.

Rawson, I.G.; G. Berggren. (1973) "Family Structures, Child Location and Nutritional Disease in Rural Haiti". J. Trop. Pediat. Vol. 19. pp. 288-98.

Robertson, I.; J.D.L. Hansen; A. Moodie. (1960) "The Problem of Gastro-enteritis and Malnutrition in the non-European Pre-school Child in South Africa". S. Afr. Med. J. Vol. 34. pp. 338-344.

Rutishauser, I.H.; R.A. McCance. (1968) "Calorie Requirement for Growth after Severe Undernutrition". Arch. Dis. Child. Vol. 43. pp. 252-6.

Sadre, M.; G. Donoso; H. Hedayat. (1973) "The Fate of the Hospitalized Malnourished Child in Iran". J. Trop. Pediat. Vol. 19. pp. 28-31.

_____; G. Donoso. (1969) "Treatment of Malnutrition". Lancet Vol. 2. p. 112.

Sai, F.T. (1969) "The Problems of Food and Nutrition of West Africa". Wld. Rev. Nutr. Diet. Vol. 10. pp. 77-99.

Saint-Yves, I.F. (1967) "A Pattern of Malnutrition in the Territory of Papua and New Guinea". Med. J. Aust. Vol. 1. pp. 557-60.

Salomon, J.B.; L.J. Mata; J.E. Gordon. (1968) "Malnutrition and the Common Communicable Diseases of Childhood in Rural Guatemala". Am. J. Pub. Hlth. Vol. 58. pp. 505-16.

_____; J.E. Gordon; N.S. Scrimshaw. (1966) "Studies of Diarrheal Disease in Central America. X. Associated Chicken Pox, Diarrhea, and Kwashiorkor in a Highland Guatemalan Village". Am. J. Trop. Med. Hyg. Vol. 15. pp. 997-1002.

Scrimshaw, N.S.; J.B. Salomon, H.A. Bruch; J.E. Gordon. (1966) "Studies of Diarrheal Disease in Central America. VIII. Measles, Diarrhea, and Nutritional Deficiency in Rural Guatemala". Am. J. Trop. Med. Hyg. Vol. 15. pp. 625-31.

Seaman, J.A. (1972) "Relief Work in a Refugee Camp for Bangladesh Refugees in India". Lancet Vol. 2. pp. 866-70.

Seth, V.; O.P. Ghai; R. Rangaswami. (1975) "An Evaluation of Age Independant Anthropomorphic Indices for the Assessment of Nutritional Status in Pre-school Children". Ind. J. Med. Res. Vol. 63. pp. 66-76.

_____; O.P. Ghai. (1972) "Mortality in PCM". Indian Pediat. Vol. 9. pp. 163-6.

Shah, P.M.; P.M. Udani; R.V. Aphale. (1971) "Domicilary Management of Kwashiorkor in a Rural Set Up: a Longitudinal Study of Clinical, Economic and Social Aspects". Indian Pediat. Vol. 8. pp. 805-13.

_____. (1975) "Magnitude of the Problem of Severe Malnutrition". Indian Pediat. Vol. 12. p. 62.

_____; K.K. Wagh; P.V. Kulkarmi; B. Shaw. (1975) "The Impact of Hospital and Domicilary Nutritional Rehabilitation on Diet of the Child and other Young Children in the Family and Neighborhood". Indian Pediat. Vol. 12. pp. 95-8.

Shakir, A. (1975) "The Surveillance of PCM by Simple and Economical Means". J. Trop. Pediat. Vol. 21. pp. 69-85.

Shrivastava, A.K.; K.M. Belapurkar; K.K. Kaul. (1970) "Nutritional Status of Rural Pre-school Children. II. Clinical Observations". Indian Pediat. Vol. 7. pp. 368-73.

Squires, B.T. (1965) "The Protein-calorie Relation in Nutrition". Cent. Afr. J. Med. Vol. 11. pp. 281-6.

Standard, K.L.; P. Desai; W.E. Miall. (1969) "A Longitudinal Study of Child Growth in a Rural Community in Jamaica". J. Biosoc. Sci. Vol. 1. pp. 153-76.

Stanfield, J.P. ed. (1971) "Monograph 13". Environ. Child Health. Vol. 17.

Stapleton, T. (1971) "The Change to a Technological Society". Pediatrics Vol. 47 Supp. 2. pp. 314-9.

Stoughton, R.R. (1975) "Childhood Survival in the Bikita Tribal Trust Land". Cent. Afr. Med. J. Vol. 2. pp. 10-11.

Tahernia, A.C.; F. Moatamed; H. Sharif. (1971) "Some Clinical Observations on Rheumatic Fever in Childhood. Patterns of the disease as seen in Southern Iran". Clin. Pediat. (Phila.) Vol. 10. pp. 530-6.

Tarnow-Mordi, W. (1974) "Infant Malnutrition in Africa: the Role of Artificial Milk Feeds". J. Trop. Pediat. Vol. 20. pp. 239-42.

Taylor, C.E. (1967) "Synergism between Infection and Malnutrition". Arch. Environ. Hlth. Vol. 14. p. 650.

Timmer, M. (1965) "Child Malnutrition in Jogjakarta, Java, Degree and Single Symptoms in Age Groups". Trop. Geog. Med. Vol. 17. pp. 126-34.

Thorburn, H.J.A. (1968) "Causes of Death in Jamaica, 1953-1964. An Analysis of Post-mortum Diagnosis of the University Hospital of the West Indies". Trop. Geog. Med. Vol. 20. pp. 35-49.

Tripathi, A.M.; B.D. Bhatia; K.N. Agarwal. (1975) "Nutritional Anemias in Childhood: a Decade of Progress in India". Indian Pediat. Vol. 12. pp. 343-9.

Truswell, A.S.; W. Wittman; J.D.L. Hansen. (1964) "Protein Malnutrition in Infants with Severe Gastroenteritis". The Role of the Gastrointestinal Tract in Protein Metabolism: CIOMS Symposium (H.M. Munro Ed.) pp. 211-227.

Udani, P.M.; P.M. Shah; S. Mukerji; R.S. Panvalkar; M.M. Kumbhat; R.R. Sanzgiri; C.M. Jain; M.R. Samuel; S.N. Deshpancle. (1968) "Trends in the Treatment of Acute Diarrheas in Infancy". Indian Pediat. Vol. 5. pp. 1-16.

Varauithya, W.; A. Valyaseui; S. Charuchindra. (1971) "Lactose Malabsorbtion in Thai Infants". J. Pediat. Vol. 78. pp. 710-715.

Walia, B.N. (1975) "Feeding Habits and Beliefs in Causation of PCM". Indian Pediat. Vol. 12. p. 71.

_____; S.K. Gambhir. (1975) "The Relationship between Childhood Malnutrition and Maternal Knowledge and Beliefs Regarding Nutrition". Indian Pediat. Vol. 12. pp. 563-8.

Wharton, G.; G. Howells; I. Phillips. (1968) "Diarrhoea in Kwashiorkor". Br. Med. J. Vol. 4. pp. 608-11.

Wicks, A.C.; H.C. Whittle. (1968) "A Comparison of Dried Skimmed Milk and Nutresco as a Protein Supplement for the Treatment of Kwashiorkor". Cent. Afr. Med. J. Vol. 14. pp. 144-7.

Winick, M. (1969) "Malnutrition and Brain Development". J. Pediat. Vol. 74. pp. 667-79.

Wittman, W.; J.D.L. Hansen. (1965) "Gastroenteritis and Malnutrition". S. Afr. Med. J. Vol. 39 . pp. 223-231.

Wyatt, J.L.; G.B. Wyatt. (1967) "An Analysis of the Patients seen at Lgbo Ora Rural Health Centre, Western Nigeria, during the Year from July 1964 to June 1965". Ann Trop. Med. Parisitology. Vol. 61. pp. 224-33.

BIBLIOGRAPHY
(Diarrhea)

Abraham, T.; S.N. Saxena; R. Sen. (1969) "Bacterial and Parasitic Findings in Diarrhea in the Young: A study of 500 consecutive untreated cases in New Delhi". Indian Pediatrics, V. 6, pp. 476-82.

Amin-Zaki, Laman; Salman Taj-Eldin; George Allos; Qussay Al-Rahim (1971) "Infantile Diarrhea in Iraq". Pakist. Pediat. J., V.1, pp. 9-16.

Ariztia, A., (1972) "Diarrheia y Desnutricion Infantiles". Revista Med. Chileana, V. 100, pp. 1293-1297.

Ascoli, Werner; Miguel Guzmàn; Nevin Scrimshaw; John E. Gordon, (1959) "Nutrition and Infection Field Study in Guatemalan Villages: IV Deaths of Infants and Pre-school Children". Arich. Environ. Health, V. 15, pp. 439-449.

_____. Leonardo Mata, (1965). "Studies of Diarrheal Disease in Central America: VII Treatment of Pre-school Children with Paromomycin and Sufanethoxy-pyridazine Under Field Conditions in a Guatemalan Highland Village". Am. J. Trop. Med. Hy., V. 14 #6, pp. 1057-1061.

Aserkoff, Bernard; John Bennett, (1969). "Effect of Antibiotic Therapy in Acute Salmonellosis on the Fecal Excretion of Salmonellae". NEJM, V. 281, pp. 636-640.

Avila-Cisneros, I., (1969). "Estudio Actual del Problema de las Diarreas y Enteritis en la Republic Mexicana". Gac. Med. Mex., V. 99, pp. 135-149.

Aykroyd, W. R., (1971). "Nutrition and Mortality in Infancy and Early Childhood: Past and Present Relationships". Am. J. Clin. Nutr., V. 24(4), pp. 480-7.

Back, E.H.; S.E.H. Brooks, (1962). "The Pattern of Infentile Gastro-enteritis in Jamaica". West Indian Medical Journal, V. 11, pp. 179-187.

Badger, George F.; Lois P. McConkle; C. Curtis; J.H. Dingle; R.G. Hodge; W.S. Jordan, Jr., (1956). "A Study of the Illnesses in a Group of Cleveland Families XIV The Association of Respiratory and Gastrointestinal Symptoms; An Estimation of the Specific Symptomatology". Am. J. Hyg., V. 69, pp. 376-382.

Bagdadiji, T.B.; Soharjono; Aswitha Boediarso; Sonoto, (1975). "Effect of Low Lactose Milk 'Eiwit Melk' (E.M.) on Low Birthweight Infants with Diarrhoea". Paediatr. Indon., V. 15, pp. 198-206.

Banta, James E.; T.G. Akers; H. Arm; N.L. Freeman, (1964). "An Epidemiologic Study of Diarrhea in an Alien Student Population in Cairo, Egypt". Am. J. Pub. Health, V. 54, pp. 940-946.

Behar, M. "Gastroentenologia Nutricion". (Gastroenterology and Nutrition). Bol. Assoc. Med. Pr., V. 62, pp. 260-261. (1970)

_____. "The Role of Feeding and Nutrition in the Pathology and Prevention of Diarrhea Processes". Bull PAHO, V. 9, (1975), pp. 1-9.

Behhehani, A.M.; F. Shafa; F.K. Mirikifani; D.C. Jenkins; H.A. Werner, (1969). "Viral Enteric Infections Among Diarrheal and Non-Diarrheal Infants in Tehran, Iran". J. Trop. Med. Hyg., V. 72, pp. 149-152.

Benavides, Lazzro; A. Heredia; R. Camacho; A.V. Lopez, (1964). "Factores Ambientales de la Morbilidad Infantil, Incidencia de Procesos Diarreicos Entr 87 Familias Durante 10 Mesas de Observacion". Bol. Ofic. Sanit. Panamer., V. 56, pp. 203-212.

Bevan, B., (1962). "The Problem of Gastroenteritis in Infancy and Childhood in Bahrain. Its Relationship to Malnutrition and Anemia". Journal of Tropical Pediatrics, V. 8, pp. 41-44.

Bhandari, B.; M.S. Agarwal, (1973). "A Comparative Clinical Study with Ethaeridine Lactate and a Combination of Chloramphenidol - Streptomycian in the Treatment of Diarrhea". Indian Pediat., V. 10, pp. 725-727.

Bhatia, V.N., (1970). "Role of Enteroviruses in Infantile Diarrhea". Indian J. Med. Sci., V. 24, pp. 742-744.

Biddulph, John; Peter Pangatana, (1971). "Weanling Diarrhoea". Papua New Guin. Med. J., V. 14, pp. 7-13.

Briones, T.N.; A.P. DeRoda; F.M. Reyes, (1963). "Observations and Studies on the Pathogenic Stereotypes of Escherchia Coli and their Relationship with Diarrhea Enteritis". J. Philipp. Med. Assoc., V. 39, pp. 339-346.

Britt, Bonnia; M. Kourany; J.W. Millar, (1973). "A Pilot Search for Environmental Factors Influencing Diarrheal Diseases in Young Children in Panama". J. Trop. Pediat., V. 19, pp. 282-285.

Bruch, Hans; W. Ascoli; N. Scrimshaw; J. Gordon. "Studies of Diarrheal Disease in Central America: V Environmental Factors in the Origin and Transmission of Acute Diarrheal Disease in Four Guatemalan Villages". Am. J. Trop. Med. Hyg., V. 12, pp. 567-579. (1963)

Bwibo, N.O., (1970). "Measles in Uganda. An Analysis of Children with Measles Admitted to Mulago Hospital". Trop. Geogr. Med., V. 22(2), pp. 167-71.

Chardra, R.K.; R.R. Pawa; O.P. Ghai, (1965). "Disaccharide Intolerance in the Aetiology of Chronic and or Recurrent Diarrhoea in Young Children". Ind. J. Med. Res., V. 57, pp. 713-717.

Chandra, H.; T.P. Raghvan; M. Ismail, (1970). "Evaluation of a New Anti-diarrheal Drug (Lomotil)". Indian Pediat., V. 7, pp. 127-130.

_____. R.R. Pawa; O.P. Ghai, (1968). "Sugar Intolerance in Malnourished Infants and Children". Br. Med. J., V. 4(31), pp. 611-13.

Chauhan, R.K.; A.M. Sain; B. Bhandari, (1970). "Berberine in the Treatment of Childhood Diarrhea". Indian J. Pediat., V. 37, pp. 577-579.

Chein, S.T., (1975). "Pneumonia and Diarrhoeas: Killers of Toddlers in Developing Countries". Trop. Geogr. Med., V. 27, pp. 103-108.

Chung, Arthur W., (1948). "The Effect of Oral Feeding at Different Levels on the Absorption of Food Stuffs in Infantile Diarrhea". Journal of Pediatrics, V. 33, pp. 1-13.

_____. Bohumik Vîšcorovà, (1948). "The Effect of Early Oral Feeding Versus Early Oral Starvation on the Course of Infantile Diarrhea". Journal of Pediatrics, V. 33, pp. 14-22.

Contreras, G., (1974). "Sabin's Vaccine Used for Non-specific Prevention of Infant Diarrhea of Viral Etiology". Bull PAHO, V. 8, pp. 123-132.

Couper, M.L.; H.M. Keller; E.W. Walters, (1957). "Comparative Frequency of Detection of Enteropathogenic E. Coli, Salmonella, and Shigella in Rectal Swab Cultures from Infants and Young Children". Pediatrics, V. 19, pp. 411-423.

Cowan, B., (1972). "Malnutrition and Malabsorption Studies in the Punjab". Am. J. Clin. Nutr., V. 25(11), pp. 1234-5.

Cvjetanovic, Branko; P. Kaufman; W.J. VanZijl, (1965). "International Cross-Sectional Studies". Milbank Mem. Fund Qutrly., V. 43, pp. 240-254.

Dammin, Gustave J., (1965). "Pathogenesis of Active Clinical Diarrheal Disease". Federation Proceedings, V. 24, pp. 35-38.

Datta, S.P.; K. Lamba, (1970). "Morbidity Study in Slum Families in South India". Ind. J. Med. Sci., V. 24, pp. 404-413.

Davies, Joan; W.N. Farrant; A.H.C. Uttley, (1970). "Anti-biotic Resistance of Shigella Sonnei". Lancet, V. 2, pp. 1157-59.

Dingle, John; L. McCorkle; G.F. Badger; C. Curtiss; R.G. Hodges; W.S. Jorden, Jr., (1956). "A Study of the Illnesses in a Group of Cleveland Families XIII Clinical Description of Acute Non-Bacterial Gastroenteritis". American J. Hyg., V. 64, pp. 368-376.

Dixon, J.M.S., (1965). "Effect of Antibiotic Treatment on Duration of Excretion of Salmonella Typhimurium by Children". British Med. J., V. 2, pp. 1343-45.

Dodd, Katerine, (1959). "Gastroenteritis of Viral Origin". The Medical Clinics of North America, V. 43 #5, pp. 1349-54.

Ducas, Jean, (1963). "Resolats du Traitment par la Furoxane des Gastro-entertes du Nourrisson". Annales Medicales de Nancy, V. 2, pp. 1014-19.

Durand, C.H.; J.P. Digney, (1963). "Revue de 410 Cases de Diarrhées Aigues Infèctievses Chez le Novrrisson et L'enfant de Moins de Deuxans, Traites Pendant Quatre Ans Dans le Même Service Hospitalier". Semaine des Hospitaux, V. 39, pp. 1386-1393.

Early, J.D., (1970). "The Structure and Change of Imortality in a Maya Community." Milbank Mem. Fund Q., V. 48(2), pp. 167-201.

Ejercito, P.M.; H.N. Hidea; T.P. Pesigan, (1966). "Viral and Bacterial Studies in Diarrheal Diseases in Infants and Young Children". J. Philipp. Med. Assoc., V. 42, pp. 747-762.

Elias-Jones, T.F., (1970). "Anti-Biotics in Diarrheal Illness". Lancet., V. 2, pp. 1308-1309.

Elsdon-Dew, Ronlad, (1940). "Endemic Fulminating Amebic Dysentery". Am. J. Trop. Med., V. 29, pp. 337-340.

Forbes, C.E.; D.W. Scheifele, (1973). "The Management of Measles in Nairobi". Est. Afr. Med. J., V. 50, pp. 159-168.

Fossgert, Henri; L. Briceno Iragorri; C. Ugveto, (1961). "Evolucion de la Etiologia Bacteriana de las Diarreas en Venezuela Ensays de Una Interpretacion". Revista Venezolana de Sanidad y Asistencia Social, V. 26 #4, pp. 687-714.

Fulton, MacDonald, (1965). "Imbalance of the Normal Microbiol Flora". (Microbial Interaction in Gastroenteritis). Am. J. Dig. Dis., V. 10 #10, pp. 870-872.

Ghai, O.P.; V. Kumar, (1969). "Diarrhoea in Infants and Children". Indian J. Pediatrics, V. 36(262), pp. 423-7.

_____.; S.L. Kalra; V.N. Jaiswai, (1969). "Epidemiology of Diarrhoea in Infants and Preschool Children in a Rural Community New Delhi". Indian Pediatrics, V. 6(15), pp. 262-71.

_____; V.N. Jaiswal; V. Seth, (1971). "Infantile Diarrhoea in Relation to Feeding Practices". Ind. J. Ped., V. 30, pp. 354-357.

_____; V. Seth; V.N. Jaiswal, (1971). "Morbidity Pattern in Children Under Five in a Rural Community in Hargana". Ind. Ped., V. 8, pp. 385-387.

_____; V.N. Jaiswal, (1970). "Relationship of Undernutrition to Diarrhoea in Infants and Children". Ind. J. Med. Res., V. 58, pp. 789-795.

Gomez, R.C.; M.I. Beiria. "Sindrome 'diarrea infantil' Consideraciones etiologicas y terapéuticas". Pediat. Panamner, V. 10, pp. 15-34. (1965)

Gorbach, Sherwood L., (1970). "Active Diarrhea-A 'toxin' Disease". NEJM, V. 283, pp. 44-45.

Gordon, Irving, (1955). "The Nonamebic, Nonbacillary Diarrheal Disorders". Am. J. Trop. Med. Hyg., V. 4, pp. 739-755.

Gordon, John H., (1964). "Acute Diarrheal Disease". Am. J. Med. Sci., V. 248, pp. 345-365.

_____; Moisés Béhar, Nevin Scrimshaw, (1964a). "Acute Diarrheal Disease in Less Developed Countries: An Epidemiological Basis for Control". WHO Bulletin, V. 31, pp. 1-7.

_____; M. Guzmàn, W. Hscoli; N. Scrimshaw, (1964b). "Active Diarrhreal Disease in Less Developed Countries: 2. Patterns of Epidemiological Behavior". WHO Bulletin, V. 31, pp. 9-20.

_____; Mossés Béhar, Nevin Scrimshaw, (1964c). "Acute Diarrheal Disease in Less Developed Countries: 3. Methods for Prevention and Control." WHO Bulletin, V. 31, pp. 21-28.

Gordon, J.E.; N.S. Scrimshaw, (1970). "Infectious Disease in the Malnourished". Med. Clin. North Am., V. 54, pp. 1495-1508.

Gordon, John E.; N.S. Scrimshaw, (1965). "Nutrition and the Diarrheas of Early Childhood in the Tropics". Milbank Memorial Fund Quarterly, V. 43, pp. 233-239.

Gordon, John E.; I. Chitkara; J. Wyon, (1963). "Weanling Diarrhea". Am. J. Med. Sci., V. 245, pp. 345-377.

Gracy, Michael; D.E. Stone; J. Papadimitroo; Suharjono; Sunoto, (1975a). "Duovirus in Malnourished Children". Paediatr. Indon., V. 15, pp. 229-231.

_____; Suharjono; Sunoto; D.E. Stone, (1975b). "Microbial Contamination of the Gut; Another Feature of Malnutrition". Paediatr. Indon., V. 15, pp. 181-190.

Graham, George G.; J.M. Baertl; A. Cordano, (1966). "La Diarrea y la Malnutricion Infantil". Bol. Ofic. Sanit Panamer., V. 60, pp. 46-50.

Grant, L.S.; E.A. Belle; C. Ramprashad, (1968). "The Effectiveness of CI 433 Veres Entero-viroform in the Control of Diarrheal Disease". W. Ind. Med. J., V. 17, pp. 31-34.

Guardiola-Rotger, Aida; E.F. Gonzalez; E. Kauder; A. Munoz; V. Lopez; D.E. Gade; M.J. Finkenbusch, (1964). "Studies on Diarrheal Diseases". Journal of Pediatrics, V. 65, pp. 81-91.

Guerrant, R.L.; R.A. Moore; P.M. Kirschenfeld; M.A. Sande, (1975). "Role of Toxicogenic and Invasive Bacteria in Acute Diarrhea of Childhood". NEMJ, V. 293, pp. 567-573.

Guggenbichler, J.P.; G.B. Stickler, (1975). (Past and Present Aspects of Diarrhea Disease in Childhood. Clinical Study and Treatment). Infection, V. 3, pp. 189-201.

Gupta, S.; K. Chopra; S. Aggarwal; A. Vergnese, (1973). "A Study of Neonatal Diarrhea". Indian Pediat., V. 10, pp. 31-34.

Hansen, J.D.; A.S. Truswell; L.R. Purves, (1962). "The Relationship of Diarrhea to Nutritional Disease: Cause and Effect". Pro. Nutr. Soc. Sth. Afr., V. 3, pp. 35-39.

Hardy, Albert V., (1959). "Diarrheal Disease of Infants and Children". Bulletin of WHO, 1959, pp. 309-319.

Heredia-Duarte, A., (1969). "Observaciones Respecto a la Historia Natural de la Diarrea Infecciosa Aguda del nino Lactante". (Natural History of Acute Infectious Diarrhea in New Born Infants). Gac. Med. Mex., V. 99, pp. 941-952.

Heyworth; J. Brown, (1975). "Jejunal Microflora in Malnourished Gambian Children". Arch. Dis. Child, V. 50, pp. 27-33.

Higgens, A.R., T. Floya; M.A. Kader, (1955). "Studies in Shigellosis. III, A Controlled Evaluation of a Monovalent Shigella Vaccine in a Highly Endemic Environment". Am. J. Trop. Med. Hyg., V. 4, pp. 281-288.

Hooja, V.; S. Madhavan; S.H. Ahmad; S. Ghosh. "Outcome and Survival of a Birth Cohort in a Community of South Delhi: Preliminary Report of a Prospective Study". Indian Pediat., V. 9, pp. 495-505. (1972)

Jain, A.M.; J.B. Menta, (1969). "Sulfonamides, Furazolidone and Neomycin in the Treatment of Infectious Diarrhea of Infancy and Early Childhood". Indian Pediatrics, V. 6, pp. 680-685.

James, J.W., (1972). "Longitudinal Study of the Morbidity of Diarrheal and Respiratory Infections in Malnourished Children". Am. J. Clin. Nutr., V. 25(7), pp. 690-4.

James, W.P.T.; B.S. Diasar; C. Miller. "Physiological Mechanism and Pathogenesis of Weanling Diarrhea". Am. J. Clin. Nutr., V. 25, pp. 564-571.

Joseph-Jean P.; S. Sow; H.L. Casey; P.J. Imperato; R.H. Hendersen; J. Noble, Jr., (1969). "A Comparison of Edmonston -B and Schwarz Measles Vaccine in Malian Children". Lancet, V. 1, pp. 665-667.

John, Jacob T.; E. Montgomery; P. Jayabal, (1971). "The Prevalence of Intestinal Parasitism and its Relation to Diarrhea in Children". Indian Pediatrics, V. 8, pp. 137-141.

Kahn, E., (1957). "The Aetiology of Summer Diarrhea". South Africa Med. J., V. 31, pp. 47-54.

_____; H. Stein; S. Wayburne, (1963). "Anti-diarrheal Effects of Anti-Biotics". Lancet, V. 2, pp. 703-706.

Kamath, K.R.; R.A. Feldman; P.S. Rao; J.K. Webb, (1969). "Infection and Disease in a Group of South Indian Families: II General Morbidity Patterns in Families and Family Members". Am. J. Epid., V. 89, pp. 375-383.

Khanduja, P.C.; S.K. Bhargava; H.K. Gour; D.N. Malik, (1969). "Aetiological Aspects of Diarrhea in Infants and Children Under 5 Years". Indian J. Pedia., V. 36(258), pp. 237-41.

Kourany, M.; M.A. Vasquez; L.J. Mata, (1971). "Prevalence of Pathogenic, Enteric Bacteria in Children of 31 Panamanian Communities". Am. J. Trop. Med. Hyg., V. 20(4), pp. 608-15.

Lashbrey, A.H., F. Walt; K.C. Watson; M.A.E. Bennett, (1963). "Diarrhea in Premature Infants: Preventive and Bacteriological Aspects". South African Med. J., V. 37, pp. 155-157.

LaTorre, J.A., (1956). "Mortalidad Por Diarrea: Infeciosa en Ninos Hospitalizados Menores de 2 Anos". Bol. Med. Hosp. Infant (MCK), V. 13, pp. 785-792.

Lepine, P.; J. Samaille; J. Maurin; O. DuBois; M.C. Carré, (1960). "Isolement du Virus Echo 143 au Cours d'Une Epidemie de Creéche de Gastro-Entérites". Annals de l'institut Pasteur, V. 99, pp. 161.

Lie Kian Joe; K. Sahab; Gan-Oei Siok Yauw; Ch. Makaliwy, (1960). "Infantilé Gastroenteritis in a Newborn Ir ant Nursery in Djakarta, Indonesia". J. of Tropical Pediatrics, V. 6, pp. 67-74.

Lubin, Antionio H.; R.A. Girola; S. Grinstein, (1963). "Prevalence of Enteropathogenic Bacteria Isolated from Infants with Diarrhea in Buenos Aires". Am. J. Trop. Med. Hyg., V. 15, pp. 771-774.

Malherbe, H.; P. Roux (1963). "The Role of Enteropathogenic Bacteria and Viruses in Acute Diarrheal Disorders of Infancy and Childhood in Johannesburg: II Non-specific Gastroenteritis". South African Med. J., V. 37, pp. 259-61.

McCorkel, L.; C.F. Badger; C. Curtis; J.H. Dingle; R. Hodges; W.S. Jordan, Jr., (1956). "A Study of the Illnesses in a Group of Cleveland Families XII the Association of Respiratory and Gastrointestinal Symtoms; As Estimation of the Magnitude and Time Relations of the Association". Am. J. Hyg., V. 64, pp. 357-367.

McGregor, I.A.; A.K. Rahman; A.M. Thompson; W.Z. Billewicz; B. Thompson, (1970). "The Health of Young Children in a West African (Gambian) Village". Trans. R. Soc. Trop. Med. Hyg., V. 64, pp. 48-77.

McKenzie, A., (1940). "Nutritional Diarrhea: A Critical Examination". E. African Med. J., V. 17, pp. 30-45.

McLean, D.M.; G.A. McNaughton; J.C. Wyllie, (1961). "Infantile Gastro-enteritis: Further Viral Investigations". Canadian Med. Assoc. J., V. 85, pp. 496-497.

Members of the Association for the Study of Infectious Disease. Joint Project, (1970). "Effect of Neomycin in Non-invasive Salmonella Infections of the Gastro-intestinal Tract". Lancet, V. 2, pp. 1159-1161.

Mendoza-Fuentes, I.; A. Espinosa Morett, (1969). "Antibioticos en el Sindrome Diarreia de Origen Infeccioso en Pediatria" (Antibiotics in Infectious Diarrhea Syndrome in Pediatrics). Prensa. Med. Mex., V. 34(5), pp. 107-26.

Miall, W.E.; P. Desai; K.L. Standard, (1970). "Malnutrition, Infection and Child Growth in Jamaica". J. Biosoc. Sci., V. 2(1), pp. 31-44.

Minck, R.; J.M. Levy; J. Sofatzis; J. Fleck, (1962). "Recherch de Porteurs d'Ecoli de Gastro-énterite Infantile dans l'Entourage Familial dans Enfants Infectés". Annals de l'Institut Pasteur, V. 103, pp. 457-460.

Makerji, S., (1969). "Acute Diarrhea in Children". J. Ind. Med. Assoc., V. 52, pp. 418-19.

Moore, Helen A.; Enrique de la Cruz; O. Vargas-Mendez; F.I. Perez, (1966). "Diarrheal Studies in Costa Rica: II The Prevalence of Certain Enteric Organisms and their Relationship to Diarrhea". Am. J. Pub. Health, V. 56, pp. 442-451.

Moore, Helen A.; Enrique de la Cruz, Oscar Vargas-Mendez, (1965). "Diarrheal Disease Studies in Costa Rica: III Morbidity and Mortality from Diarrhea". Am. J. Epid., V. 82, pp. 143-161.

Morley, David C., (1974). "Measles in the Developing World". Proc. Roy. Soc. Med., V. 67, pp. 1112-1115.

Nalin, David; Steven Richardson, (1973). "Diarrhea Resembling Cholera Induced by Escherchia Coli Culture Filtrate". Lancet., V. I, pp. 677-678.

Nandi, R.L., (1970). "Bacteriology of Diarrhea in Neonates with Special Reference to Enteropathogenic Coli". J. Indian Med. Assoc., V. 54(3), pp. 103-7.

_____, (1970). "Bacteriology of Neo-natal Diarrhoea". Indian Pediat., V. 7, pp. 221-226.

Naruka, B.S.; Usha Sharina; S. Saxena, (1974). "A Clinical Profile of Diarrhea in Infancy and Childhood: A Study of 200 Cases". Indian J. Ped., V. 41, pp. 374-383.

Nehaul, B.B.G., (1960). "Infantile Diarrhoea in British Guiana". West Ind. Med. J., V. 9, pp. 51-54.

Nungester, W.J., (1951). "Mechanism of Man's Resistance to Infectious Disease". Bact. Rev., V. 15, pp. 105-129.

Nutr. Review, (1970). "Childhood Diarrhea in Rural Guatemala". V. 28, pp. 61-65.

Jorge Olarte; E. Galmdo; L. Fillog; Joachin, (1964). "El Papel de las Bactereas en la Etiologia de las Diarreas Infecciosas Infantiles en la Ciudad de Mexico". Rev. Inst. Salvbr. Enferm. Trop. (Mex.), V. 24, pp. 105-111.

Olarte, Jorge; E. Galindo; L. Filloy, (1974). "Neuva Informacion Acerca del Papel Patogeno de Escherichia Coli 0142: K86: H6 en las Diarrheas Infantiles". Bol. Med. Hosp. Infant Mex., V 31, pp. 713-718.

Omanga, M.; I. Nsumu-Disergomoka; E. Nkidiaka; B. Tady, (1973). "Etude de 242 cas de Diarrhees Aigues de l'enfant a Kinshasa". (Zaire). Ann.Soc. Belg. Med. Trop., V. 53, pp. 77-88.

Ordway, Nelson K.; Alfred Yankauer, (1964). "Traitmento de la Deshidracion Diarrcia Mediante et Suministro de Liquidos por via Endovenosa, con Especial Referencia a la Shuacion en la America Latina". Bulletin Pan Am. San. Bur., V. 56, pp. 480.

Ortiz, Antonià, (1965). "Enfoque Practico al Traitmiento de la Deshidratacion en las Diarreas Infantile". Bol. Asoc. M'd. P. Ricor., V. 57, pp. 95-107.

Parks, Wade P.; J.L. Melnick; L.T. Queiroga; H.A. Kahn, (1966). "Studies of Infantile Diarrhea in Karachi, Pakistan. I. Collection, Virus Isolation and Typing of Viruses". Am. J. Epid., V. 84, pp. 382-396.

Parks, Wade P.; L.T. Queivoga, J.L. Melnick, (1967). "Studies of Infantile Diarrhea in Karachi, Pakistan: II Multiple Virus Isolations from Rectal". Am. J. Epid., V. 85, pp. 469-476.

Pelon, W.; V.M. Villarejos; J.S. Rhim; F.J. Payne, (1966). "Coxsackie Group B Virus Infection and Acute Diarrhea Occurring Among Children in Costa Rica". Arch. Dis. Childh., V. 41, pp. 636-641.

Pelon, W., (1965). "Viral Flora of the Human Alimentary Tract". American Journal of Digestive Disease, V. 10 #10, pp. 853-863.

Pierce, V.; W. Ascoli; R. De Leon; J. Gordon, (1962). "Studies of Diarrheal Disease in Central America: III Specific Etiology of Endemic Diarrhea and Dysentery in Guatemalan Children". Am. J. Trop. Med. Hyg., V. II, pp. 395-400.

Piereira, S.M.; V. Benjamin, (1972). "Measles in a South India Community". Trop. Geogr. Med., V. 24(2), pp. 124-129.

Ponnampalm, J.T.; J. Mosa, (1965). "Bacteria Criterits of Infancy and Childhood". J. Trop. Med. Hyg., V. 11, pp. 261-64.

Poskitt, E.M., (1972). "Seasonal Variation in Infection and Malnutrition at a Rural Pediatric Clinic in Uganda". Trans. R. Sos. Trop. Med. Hyg., V. 66, pp. 931-936.

Prakush, O.; S. Payal; S.L. Kalra, (1966). "Bacterial Aetiology of Infantile Diarrhoea in Village Population with Observations on Some Providence Strains Isolated from Some Providence, and Non-produce Strains". Ind. J. Med. Res., V. 54, pp. 705-713.

Prakash, O.; C.V. Prakash; E. Amma; S.L. Kalra, (1963). "Microbial Flora in Cases of Infantile Diarrhea in Delhi". Ind. J. Med. Sci., V. 17, pp. 486-491.

Pusponegoro, S.D., (1972). "Problems and Future of Pediatrics in Pre-industrial Countries: Asia". Helv. Paediatr. Acta., V. 28, pp. 17-22 Supa.

Ramos-Alvarez, M.; J. Ovarte, (1969). "Diarrheal Diseases of Children, the Occurrence of Enteropathoginc Viruses and Bacteria". Am. J. Dis. Chld., V. 107, pp. 218-231.

Ramos-Alvarez, M.; A.B. Sabin, (1958). "Enteropathogenic Viruses and Bacteria. Role in Summer Diarrheal Diseases of Infancy and Early Childhood". JAMA, V. 167, pp. 147-156.

Rapoport, S.; K. Dodd; M. Clark; I. Syum, (1947). "Postacidotic State of Infantile Diarrhea: Symptoms and Chemical Data". Am. J. Dis. Chld., V. 73, pp. 391-441.

Robertson, Isobel, (1957). "An Analysis of Environmental and Other Factors Associated with Deaths from Gastro-enteritis in Capetown in 1956". Sth. Afr. Med. J., V. 31, pp. 441-442.

Robertson, I.; J.D.L. Hansen; A. Moodie, (1960). "The Problem of Gastro-enteritis and Malnutrition in the Non-European Pre-School Child in South Africa". Sth. Afr. Med. J., V. 34, pp. 338-344.

Rodriguez-Leiva, M., (1960). "Escherchia Coli Studies VII Incidence of Entero-pathogenic Escherchia Coli in the Acute Diarrhea of Infants in Santiago Chile". Am. J. Hyg., V. 72, pp. 162-168.

Rosenberg, I.H.; W.R. Beisel; J.E. Gordon; M. Katz; G.T. Keusch; D. Luckey; L.J. Mata, (1974). "Infant and Child Enteritis-Malabsorption-Malnutrition: The Potential of Limited Studies with Low Dose Antibiotic Feeding". Am. J. Clin. Nutr., V. 27, pp. 304-309.

Rosenstein, B.J., (1964). "Shigella and Salmonella Enteritis in Infants and Children". Johns Hop. Hosp. Bull., V. 115.

Ross, C.A.C.; E.A. Dawes, (1954). "Resistence of the Breast-fed Infant to Gastro-enteritis". Lancet, V. 1, pp. 994-998.

Bibliography

Roox, P.; E. Kahn; H. Malherbe; R. Cassel, (1963). "The Role of Enteropathogenic Bacteria and Virus in Allik Diarrhoreal Disorders of Infancy and Childhood in Johannesburg: I Summer Diarrhea. Sth. Afr. Med. J., V. 37, pp. 256-259.

Rowe, B.; J. Taylor; K.A. Bettelheim, (1970). "An Investigation of Travellers' Diarrhea". Lancet, V. 1, pp. 1-5.

Russell, L.B.; C.S. Burke, (1975). "Determinants of Infant and Child Mortality: An Econometric Analysis of Survey Data for San Juan, Argentina". AID Contract No. , AID/CM/otr-C-73-212.

Sabin, A.B., (1963). "Cause and Control of Fatal, Infantile Diarrheal Diseases". Am. J. Trop. Med. Hyg., V. 15, pp. 556-566.

Salomon, J.; J.E. Gordon; N.S. Scrimshaw, (1966). "Studies of Diarrheal Disease in Central America Associated Chickenpox, Diarrhea, and Kwashiorkor in a Highland Guatemalan Village". Am. J. Trop. Med. Hyg., V. 15, pp. 997-1002.

Samadi, A., (1969). "Diarrhoeal Disease of Infancy in Kabul". Indian Pediatrition, V. 6(8), pp. 568-70.

Scheifele, D.W.; C.E. Forbes, (1973). "The Biology of Measles in African Children". East Afr. Med. J., V. 50, pp. 169-173.

Scott, J.A., (1953). "Gastro-enteritis in Infancy". Brit. J. Prev. Soc. Med., V. 7, pp. 194-204.

Scrimshaw, N.; H. Bruch; W. Ascoli; J.E. Gordon, (1962). "Studies of Diarrheal Disease in Central America: IV Demographic Distributors of Acute Diarrheal Disease in Two Rural Populations of the Guatemalan Highlands". Am. J. Trop. Med. Hyg., V. 11, pp. 401-409.

Scrimshaw, N.S.; M. Guzman; M. Flores; J.E. Gordon, (1968). "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964 V Disease Incidence Among Pre-school Children under Natural Village Conditions, with Improved Diet and with Medical and Public Health Services". Arch. Environ. HHh, V. 16, pp. 223-234.

Scrimshaw, N.; J. Salomon; H. Bruch; J. Gordon, (1966). "Studies of Diarrheal Disease in Central America: VIII Measles, Diarrhea, and Nutritional Deficiency in Rural Guatemala". Am. J. Trop. Med. Hy., V. 15, pp. 625-631.

Scrimshaw, N.S., (1970). "Synergism of Nutrition and Infection. Evidence from Field Studies in Guatemala". JAMA, V. 212, pp. 1685-92.

Seck, B.; P. Cantrelle; I. Niang; E. Bouthrevil; P. Sarge, (1969). "A Propos des Problemes de l'enfance entre 0 et 5 ans dans un Fauboorg de Dakar (Problems of Children up to 5 years in a Suburb of Dakar)". Bull. Soc. Med. Afr. Noire Lang. Fr., V. 14, pp. 639-652.

Sen, R.; S. Lapage; M. Glassett, (1963). "The Aetrology of Diarrhoeal Diseases in Children at Ibaden, Nigeria". J. Trop. Pediact., V. 9, pp. 25-32.

Bibliog

Sen, R. "Bacterial Aetrology of Diarrheal Diseases at Ibadan, Nigeria". Indian J. Path. Bact., V. 5, pp. 111-117.

Shaker, Y.; R. Aziz; A. Abu; E. Naga, (1966). "A Preliminary Study of Infantile Diarrhea in Kuwait". Am. J. Qub. Hlth., V. 56, pp. 1580-1587.

Sharda, D.C., (1970). "Berberine in the Treatment of Diarrhoea of Infancy and Childhood". J. Ind. Med. Assoc., V. 54(1), pp. 22-24.

Sharma, R.; C.K. Joshi, R.K. Goyal, (1970). "Berberine Tannate in Acute Diarrhoea". Ind. Pediat., V. 7, pp. 496-501.

Solomon, P.; L. Weinstein; S.M. Joress, (1961). "Studies of the Incidence of Carriers of Enteropathogenic Escherchic Coli in a Pediatric Population". J. Pediat., V. 38, pp. 716-721.

Sommerville, R.G. (1958). "Enteroviruses and Diarrhea in Young Persons". Lancet, V. 2, pp. 1347-49.

Srivastava, J.R.; V. Verma; B.K. Garg, (1968). "Acute Diarrhoea in Childhood. A Clinical and Bacteriological Study". Indian J. Pediat., V. 35, pp. 217-225.

Stott, E.J.; E.J. Bell; M.B. Eadie; C.A.C. Ross; N.R. Guist, (1967). "A Comparative Vivological Study of Children in Hospitals with Respiratory and Diarrheal Illnesses". J. Hyg. (lond.), V. 65, pp. 9-23.

Suharjono, S.; A. Boediarso; H. Hendarkji; Soegiharto, (1975). "Refeeding with Free Lactose Milk (Al-110 Nestle) in Children Suffering from Gastro-enteritis and Dehydration". Paediatr. Indo., V. 15, pp. 191-197.

Sunoto; Suharjono; J. Mangiwa; Sutedijo, (1971). "Lactose Intolerance in Chronic Diarrhea among Indonesian Children". Paediatr. Indones., V. 11(5), pp. 1-6.

Sunoto; Suharjono; Sutedjo, (1973). "Two Year Study on Sugar Intolerance in Indonesian Children". Paediatr. Indon., V. 13, pp. 241-249.

Taylor, I., (1957). "The Changing Epidemiology of Sonne Dysentery". (Abridged). Proc. Rog. Soc. Med., V. 50, pp. 31-36.

Tervel, J.R.; V.A. Gomes, J.L. Nogueira, (1973). "Distribuiçã Estacional dos Obitos por Diarreia e por Desnutriçao na Infancia". Revue do Inst. Med. Trop. San Paulo., V. 15, pp. 289-297.

Thompson, S., (1955). "The Role of Certain Varieties of Bacterium Coli in Gastroenteritis of Babies". J. Hyg., V. 53, pp. 357-

Truswell, A.S.; W. Wittmann; J.D.L. Hansen, (1964). "Protein Malnutrition in Infants with Severe Gastroenteritis". CIOMS Symposium, pp. 211-227.

Tuchmon, E.; P.A.L. Chapple; L.M. Franklin; I.N. Nanser; J.T. Woodall; K.J. Randall; J.C. McDonald, (1962). "Acute Gastro-intestinal Illness in General Practice". Brit. Med. J., V. 1, pp. 135-141.

Vanecek, K.; C. Kaiyl, (1971). "Diarrhoeal Disease of Children in Southern Tuniseia". J. Hyg. Epid. Micron. Immuno., V. 13, pp. 308-315.

Varauithya, W.; A. Valyasevi; S. Charuchinda; J. Pediat., (1971). "Lactose Malabsorption in Thai Infants". J. Pediat., V. 78, pp. 710-715.

Verhoestrate, L.J.; R.R. Puffer, (1958). "Diarrhoel Disease with Special Reference to the Americas". WHO Bull., V. 19, pp. 23-51.

Walia, V.N.S.; S.P. Gopte; S. Mehta; K.C. Aggarwal, (1971). "Chronic Diarrhea in North Indian Children". Indian J. Med. Res., V. 59, pp. 1448-1453.

Walker, S.J.; D.M. McClean; I.E. Roy; G.A. McNaughton; J.N.R. Tibbles, (1960). "Infantile Gastroenteritis: A Search for Viral Pathogens". JCMA, V. 83, pp. 1266-67.

Watt, J.; A.C. Hollister, (1953). "Diarrheal Diseases in Fresno County California". Am. J. Pub. Hlth., V. 43, pp. 728-741.

Wharton, B.; G. Howells; I. Phillips, (1968). "Diarrhoea in Kwashiorkor". Br. Med. J., V. 4(631), pp. 608-11.

WHO Expert Committee, (1964). "Enteric Infections". WHO Tech. Rprt. Ser. 1964 #288.

Wittman, W.; J.D.L. Hansen, (1965). "Gastroenteritis and Malnutrition". Sth. Afr. Med. J., V. 39, pp. 223-231.

Wolff, H.L.; W.J. VanZijl; M. Roy, (1969). "Houseflied, the Availability of Water, and Diarrheal Diseases". WHO Bull, V. 41, pp. 952-959.

Wright, P.A., (1971). "Diarrhoea; A Specific Treatment Programme in Palestinian Refugee Camps". Nurs. Times., V. 67(30), pp. 915-918.

Yekuttel, P.; E. Peritz; J. Mandel, (1958). "A Field Study of Infantile Diarrhoea in Israel". J. Trop. Pediat., V. 3, pp. 175-183.

Young, V.M.; R.B Lindberg; A. Ortiz; D. Janiel; M.R. Sachard; J.H. Hamphill, (1962). "Studies of Infectious Agents in Infant Diarrhea III Bacteria, Viral, and Parasitic Agents in Feces of Puerto Rican Children". Am. J. Trop. Med. Hyg., V. 11, pp. 380-388.

Yow, M.; J. Melnick; R. Blattner; L. Rasmusen, (1963). "Enteroviruses in Infantile Diarrhea". Am. J. Hyg., V. 77, pp. 283-292.

Van Zijl, W.J. (1969). "Studies on Diarrheal Diseases in Seven Countries by the WHO Diarrheal Diseases Advisory Team". WHO Bull., V. 35, pp. 249-261.

BIBLIOGRAPHY
(Respiratory Disease)

Ackerman, Bruce D.; (1968) "Treatment of Undifferentiated Respiratory Infections in Infants," Clinical Pediatrics (Phil.), vol. 7, pp. 391-395.

Agarwal, S.C.; R.C. Mahajan; J.N. Bardoli; N.K. Ganguly; (1971) "Antibodies to respiratory syncytral virus in a normal community in Chandigarh area, northern India," Bull.WHO, vol. 45, pp. 143-5.

Agarwal, S.C.; S. Sehgal; (1971) "Para-influenza virus infection in respiratory illnesses of infants and children," Indian J. Med. Res., vol. 59, pp. 206-212.

Agarwal, S.; K.C. Agarwal; O.N. Bhakoo; (1969) "A bacteriological study of acute lower respiratory tract infections in infancy and childhood," Indian Pediatr., vol. 6, pp. 747-758.

Aldy, G.: Aldy, L.; (1976) "Treatment of Pneomocystis carmii pneomonia in infancy," Nat'l. Cancer Inst. Monogr., vol. 43, pp. 201-9.

Barratt, N.; (1971) "The Role of parainfluenza viruses in respiratory disease in Trinidad," West Indian Medical Journal, vol. 20, pp. 279-287.

Bateson, E.M.; Woo-Ming, M.; (1976) "Destroyed Lung: A report of cases in West Indians and Australian Aborigines," Clinical Radiology, vol. 27, pp. 223-226.

Bhandari, N.R.; G.P. Patel; (1973) "Dietary and feeding habits of infants in various socioeconomic groups," Indian Pediatr., vol. 10, pp. 233-238.

Biskind, M.S.; Martin, W.C.; (1954) "The use of citrus flavonoias in respiratory infections," Amer. Journal Digestive Disease," vol. 21, pp. 177-

Bisno, A.L.; N.P. Barratt; W.H. Swanston; L.P. Spence; (1970) "An outbreak of acute respiratory disease in Trinidad associated with para-influenza virus," Am. J Epid, vol. 91, pp. 68-77.

Boris, M.; B.M. Thomason; V.D. Hines; T.S. Montague; T.F. Sellers, Jr.; (1964) "A community of anteropathogenic escherichia coli gastroenteritis associated with asymptomatic respiratory infection," Pediatrics, vol. 33, pp. 18-29.

Bwibo, N.O.; (1971) "Whooping cough in Uganda," Scandinavian Journal of Infectious Disease, vol. 3. pp. 41

Chanock, R.M.; R.H. Parrott; (1965) "Acute respiratory disease in infancy and childhood: present understanding and prospects for prevention," Pediatrics, vol. 36, pp. 21-39.

Chanock, R.; L. Chanbon; W. Chang, F.F. Goncalves; P. Gharpone; L. Grant, J. Hatem; I. Iman; S. Kalra; K. Lim; J. Madatengortia; L. Spence; P. Teng; W. Ferreira, (1967) "WHO respiratory disease survey in children: a serological study," Bull.WHO, vol. 37 (3), pp. 363-9.

Chatterjee, P.K.; (1968) "Respiratory emergencies," J Indian Med.Assoc.,vol. 50, pp. 555-7.

Chernenkoff, W.; (1974) "Should my patient travel by air?" J Indian Med.Assoc., vol. 63, pp. 173-175 (reprint Canadian Family Physician, June 1974).

Chetty, A.; (1974) "Pathogenesis and treatment of Bronchitis," Indian Pediatr., vol. 11, pp. 315-318.

Chin-Yon,L.G.; F. Glenn; C. Sheng-Tu; H. Yong-Tsung; W. Huo-Yao; (1973) "An outbreak of respiratory syccytial virus infection in an infant nursery," J Formosan Med.Assoc, vol. 72, pp. 39-46.

Christie, A.B.; ( ) "The public Health Importance of respiratory virus disease in the developed and the developing countries," , pp. 79-85.

Clarke, S.K.R.; B.D. Corner; D.M. Gambler; J. Macraie; D.B. Peacock; (1964) "Viruses associated with acute respiratory infections," British Medical Journal, vol. 1, pp. 1536-1539.

Coriell, L.L.; (1967) "Clinical Syndromes in Children caused by respiratory infection," Med.Clin.N.Amer., vol.51, pp. 819-829.

Court, S.D.N.; H. Jackson; G. Knox; (1953) "The recognition of whooping cough," Lancet, vol. 2, pp. 1057-1060.

Cramblett, H.G.; H.L. Moffet; G.K. Middleton; J.P. Black; H. Shulenberger; A. Yongue; (1962) "ECHO 19 virus infections: Clinical and laboratory studies," Arch. Internal Medicine , vol. 110, pp. 574-579.

Datta, S.P.; K. Lamba; (1970) "Morbidity study in slum families in south India," Indian J. Med. Sci.; vol. 24, pp. 404-13.

Davis, S.P.; R. Wedgewood; (1965) "Anti-biotic Prophylaxis in Acute Viral Respiratory Diseases," Am. J. Dis. Child, vol. 109, pp. 554 - 560

Disney, M.E.; B.R. Sandiford; J. Cragg; J. Wolff; (1960) "Epidemic Bronchiolitis in infants," Brit. Med J., vol. 1, pp. 1407-1411.

Donald, A.B.; (1938) "The diagnosis of whooping cough," British Medical Journal, vol. 2, pp. 613-618.

Dutz, W.; C Post; E. Jennings-Khodad; T. Fakouhi; E. Kohaut; B. Bandarizadeh; (1976) "Therapy and Prophylaxis of Pneumocystis and Carnii Pneumonia," Nat'l. Cancer Inst Monogr, vol. 43, pp. 179-185.

Elderkin,F.M.; P.S. Gardner; P.C. Turk; A. White; (1965) "Aetiology and management of Bronchiolitis and Pneumonia in Childhood," British Med. J, vol.2, pp. 722-

Fletcher, C.M.; (1965) "Some recent advances in the prevention and treatment of chronic bronchitis and related disorders with special reference to the effects of cigarette smoking," Proc R. Soc Med, vol. 58, pp.918-28.

Freyre, E.A.: O. Rondon; J. Bedoya; M. Herena; M. Tamayo; (1973) "The incidence of bacterioria and pyuria in Peruvian children with malnutrition," J.Pediatr. vol. 83, pp. 57-61.

Fulginiti, V.A.; J.J. Eller; O.F. Sieber; J.W. Joyner; M. Minamitani; G. Meiklejohn; (1969) "A Field trial of two inactivated respiratory syncytial vaccines," Amer J Epid, vol. 89, pp. 435-448.

Gaise, S.K.: ( ) "Levels and Patterns of Infant and Child Mortality in Ghana," , pp. 21-34.

Ghai, O.P.; V. Seth; V.N. Jaiswal; (1971) "Morbidity Pattern in Children under five in a rural community in Haryana," Indian Pediatrics, vol. 8, pp. 385-387.

Giglioli, G.; (1972) "Changes in the pattern of mortality following the eradication of hyperendemic malaria from a highly susceptible community," Bull WHO, vol. 46, pp. 181-202.

Goldsmith, R.; F. Stark; C. Smith; G.Healy; E. Donegan; V. Juchau; A. Steilcup; (1976) "Orphan Airlift: Enteric pathogens isolated from Vietnamese children immigrating to the United States," Journal of the American Medical Association, vol. 235, pp. 2114-2116.

Gomez, F.; (1956) "Chronic severe infantile malnutrition," Ann.NY Acad. Sci., vol. 69, pp. 969-981.

Gordon, J.E.; (1971) "Diarrhea, disease of early childhood--worldwide scope of the problem," Ann.NY Acad.Sci., vol. 176, pp. 9-15.

Guha, N.; A.K. Choudhury; (1972) "Pulmonary Affection by Staphylococcus Aureus," J Indian Med.Assoc., vol. 58, pp. 383-5.

Guha, D.K.; A. Rashmi; M. Kochar; (1973) "Relationship between the length of gestation, birthweight and certain other factors," Indian J. Pediatr., vol. 40, pp. 44-53.

Gupta, B.M.; M. Singh; (1975) "Mortality and Morbidity. Patterns in Measles in Tanga District, Tanzania," Trop.Geog.Med., vol. 27, pp. 383-386.

Gupta, U.; S. Vaishanava; A.K. Gulati; (1975) "Mycoplasma pneumoniae infections in infants and children," Indian Journal of Medical Research , vol. 63, pp. 385-389.

Hamdi, T.; A.A. Abdulrahman; (1972) "Acute Myelitis in Iraq," Mater.Med.Pol., vol. 4 (4), pp. 210-212.

Hansman, D.; H. Glasgow; J. Sturt; L. Devitt; R. Douglas; (1971) "Increased resistance to penicillin of pneumococci isolated from man," N.Eng. J Med., vol. 284, pp. 175-177.

Haycock, J.B.; T.C. Noble; (1962) "1230 Cases of Acute Bronchiolitis in infancy," Brit.Med.J. vol. 2, pp. 879-881.

Hills, W.D.; M.R. Cooper; F.B. Bang; A.K. Dey; K.U. Shah; (1971) "Respiratory syncytral virus infection in children in West Bengal," Indian J Med. Res. vol. 59 (9), pp. 1354-1364.

Holdaway, D.; A.C. Romer; P.S. Gardner; (1967) "The diagnosis and management of bronchiolitis," Pediatrics, vol. 39, pp. 924-928.

Holzel, A.; L. Parker; W.H. Patterson; D. Cartmel; L.L.R. White; R. Dundy, K.N. Thompson; J. O'H. Tobin; (1963) "Virus isolations from throats of children admitted to hospital with respiratory and other diseases, Manchester, 1962-4," British Medical Journal , vol. 1. pp. 614-619.

Hood, C.; (1971) "Social and Cultural Factors in health of children of immigrants," Arch.Dis.Child, vol. 46, pp. 371-375.

Hoojao, V.; S. Madhavan; S.H. Ahmad; S. Ghosh; (1972) "Outcome and survival of a birth cohort in a community of South Delhi: preliminary report of a prospective study," Indian Pediatr., vol. 9 (9), pp. 495-505.

Hughes, J.R.; S.K. Bose; W. Kloene; D.P. Sinha; M.R. Cooper; (1966) "Acute Lower respiratory tract infections in Calcutta children: An etiological study," Indian Pediatrics, vol. 3, pp. 201-211.

Hughes, J.R.; D.P. Sinha; M.R. Cooper; K.V. Shah; S.K. Bose; (1969) "Lung tap in childhood. Bacteria, viruses, and mycoplasmas in acute lower respiratory tract infections," Pediatrics, vol. 44, pp. 477-485.

Hyon, W.K.; J.G. Canchola; C.D. Brandt; G. Pyles; R. M. Chanock; (1969) "Respiratory synctiae virus disease in infants despite prior administration of antigenic inactivated vaccine," Am.J.Epid, vol. 89. pp. 422-434.

James, J.W.; (1972) "Longitudinal study of the morbidity of diarrhea and respiratory infections in malnourished children," Am. J. Clin. Nutr., vol. 25, pp. 690-694.

Kamath, K.R.; R.A. Feldman; R.P.S.S. Sundar; J.K.G. Webb; (1969) "Infection and disease in a group of South Indian families. General Morbidity patterns in families and family members," American Journal of Epidemiology, vol. 89, pp. 375-383.

Kapikian, A.Z.; R.H. Mitcell; R.M. Chanock; R.A. Shredoff; G.E. Stewart; (1969) "An epidemiological study of altered clinical reactivity to respiratory syncytral virus infection in children previously vaccinated with RSV vaccine," Am.J Epid., vol. 89, pp. 405-421.

Kloene, W.; F.B. Bang; S.M. Chakraborty; M.R. Cooper; H. Kulemann; K.V. Shah; M. Ota; (1970), "A two year respiratory virus survey in four villages in West Bengal, India," Am.J Epid. vol. 92, pp. 307-320.

Lang, J.R.; (1970) "A further study on fetal loss and child mortality in the north of Nigeria," J Obstet. Gynaecol. Br Commonw., vol. 77, pp. 427-434.

Lawson, J.S.; (1967) "Acute infections of the lower part of the respiratory tract in Papvan infants and children," Med. J Aust., vol. 1, pp. 49-51.

LeRitchie, H.; A.A. Kinnear; R.J. Smit; (1956) "The Diepkloof nutrition and health study on Bantu boys," Can. Med. Assoc. J, vol. 74, pp. 130-135

Lewis, K.H.; (1968) "Anti microbial therapy in Respiratory Tract Disease," Pediad. Clin. N. Amer., vol. 15, pp.197-

Lexomboon, U.; C. Duangmani; V. Kusalasai; P. Sonakorn; L.C. Olson; H.E. Noyes; (1971) "Evaluation of orally administered anti-biotics for treatment of upper respiratory infections in Thai Children," J Pediat, vol. 78, pp. 772-778.

Maddocks, J.; (1974) "Patterns of Disease in Papva New Guinea," Med. J Aust, vol. 1, pp. 442-446.

Madharan, H.N.; J. Badrinath; S.C. Agarwal; (1974) "Sero-epidemiological survey of respiratory syncytial virus infection in Pondicherry area-South India," Indian Journal of Medical Research, vol. 62, pp. 1804-1807.

Malhotro, P.; B.G. Prasad; (1066) "A study of morbidity among children below 5 years of age in an urban area of Delhi, Part III," Ind. J Med. Research, vol. 54, pp. 285-314.

Manube, G.M.; J. Babigumira; B.E. Henderson; P. Lobo; A.D. Soneji; (1970) "Association of an enterovirus infection with a respiratory enteric disease in an orphanage in Kampala, Uganda," East Afr. Med. J, vol. 47, pp. 258-264.

McCorkle, L.P.; G.F. Badger; C. Curtiss; J,H, Dingle; R.G. Hodges; W.S. Jordan, Jr.; (1956) "A study of illness in a group of Cleveland families XII. The association of respiratory and gastrointestinal symptoms; an estimation of the magnitude and the time relations of the association," Am. J. Hyg V64 pp. 357-367

McLean, D.M.; "Adenovirus Pneumonia," Can.Med.Assoc.J, vol. 108, pp. 413-418

Miall, W.E.; P. Desai; K.L. Standard; (1970) "Malnutrition, Infection and Child Growth in Jamaica," J Biosoc.Sci., vol. 2, pp. 31-44.

Monto, A.S.; K.M. Johnson; (1968) "Respiratory infections in the American tropics," Am. J Trop. Med. Hyg., vol. 17, pp. 867-874.

Morley, D.C.; W.J. Martin; Margaret Woodland; (1966) "Whooping cough in Nigerian children," Trop. Geogr. Med., vol. 18, pp. 169-182.

Mortimer, E.A., Jr.; (1968) "Rational Use of Prophylactic Anti-biotics in Children," Pediat.Clin.N.Amer, vol. 15. pp. 261-273.

Mutie, D.M.; D. Metselaar; E.S. Hillman; K. McDonald; (1976) "Isolation of respiratory syncytial virus from patients with lower respiratory tract infections in a paediatric observation ward in Kenya," E.African Medical Journal, vol. 53, pp. 320-325.

Neave, Margaret; (1968) "Protein and caloric malnutrition of early childhood in Western Samoa," Trop. Geogr. Med., vol. 20, pp. 191-201.

--------, "To breast-feed or not?" (1972) Nutrition Review, vol. 30, pp. 112-114.

Naidu, M.L.; K.V. Rao; R. Radha; (1972) "Isolation and significance of candia species in different bronchopulmonary diseases," Indian J Chest Dis, vol. 14, pp. 61-71.

Ogbeide, M.I.: (1968) "The influence of protein-calorie malnutrition on the pattern of pre-school childhood disease. Observations in Lagos, Nigeria," Clin. Pediat. (Phila), vol. 7, pp. 425-431.

O'Leary, P.; (1970) "Respiratory obstruction in Children in Nigeria," J Ir. Med.Assoc., vol. 63, pp. 223-225.

Ong, S.B.; K.L. Lam; S.K. Lam; (1975) "Respiratory virus disease in Malaysian children: a serological study," Bulletin of the WHO, vol. 52, pp. 376-378.

Ota, W.A.; F.B. Bang; (1972) "A continuous study of viruses in the respiratory tract in families of a Calcutta bustee. I. Description of the study and patterns of virus recovery," Am.J Epid., vol. 95, pp. 371-383.

Ota, W.K.; F.B. Bang; (1972) "A continuous study of viruses in the respiratory tract in families of a Caldutta bustee II. Family patterns of infection and illness in a crowded environment," Am.J Epid., vol. 95, pp. 384-391.

Post, C.; T. Fakouhi; W. Dutz; B. Bandarizadeh; E.E. Kohoot; (1971) "Prophylaxis of Epidemic Infantile Pneomocystosis with a 20:1 sulfadoxine and pyrimethamine combination," Curr.Ther.Res., voo. 13, pp. 273-279.

Preston, N.W.; (1970) "Technical problems in the laboratory diagnosis in prevention of whooping cough," Lab. Pract., vol. 19, pp. 482-486.

Pretorius, P.J.; H. Novis; (1965) "Nutritional marasmus in Bantu infants in the Pretoria area," S. African Med.J, vol. 39, pp. 237-238.

Ramachandran, N.; (1972) "The problem of acute respiratory illness in the paediatric age group in general practice," J Indian Med.Assoc, vol. 58, pp. 371-373.

Ramkissoon, R.; M.F. McDowall; (1968) "Respiratory disease in children caused by parainfluenza viruses. Description of acute outbreak, " Clin. Pediatr. (Phila.), vol. 7 (9), pp. 518-524.

Rashmi, A.; D.K. Guha; P.C. Khanduja; (1971) "Post measles pulmonary complications in children," Indian Pediatr., vol. 8, pp. 834-838.

Ripley, G.D.; (1972) "An evaluation of unmedicated chewing gum in the prophylaxis of Infections in Children," J R. Coll. Gen. Pract., vol. 22, pp. 61-62.

Rosenberg, I.H.; W.R. Beisel; J.E. Gordon, M. Katz; G.T. Keusch; T.D. Luckey; L.J. Mata; (1974) "Infant and child enteritis-- malabsorbtion-- malnutrition: The potential of limited studies with low dose antibiotic feeding," Am. J Clin. Nutr., vol. 27, pp. 304-309.

Ruiz-Gomez, J.; M.T. Alvarez; F. Serafin; G. Gutierrez; F. Resano; (1970) "Infecciones Agudas Del Fracto Respiratorio Inferior en Ninos. I Etiologia," Gac. Med. Mex., vol. 100, pp. 1279-1286.

Salas-Martinez, M.; (1973) "Processos infecciosos polmonares como causa de muerta en los ninos," Gac. Med. Mex., vol. 106, pp. 393-397.

Salomon, J.B.; L.J. Mata; J.E. Gordon; (1968) "Malnutrition and the common communicable diseases of childhood in rural Guatemala," Am J Public Health, vol. 58, pp. 505-516.

Samuel, A.M.; B.D. Patel; N. Makodi; (1972) "A study of immunoglobulins in protein calorie malnutrition," Indian J Med. Res., vol. 60. pp. 1278-1283.

Satapathy, R.K.; (1971) "A health survey of the 'Wada-Baji' children of Ganjam," Indian J Pediatr., vol. 38, pp. 368-371.

Seck, B.; Cantrelle, P.; I. Niang; E. Boothreuil; P. Satge; (1969) "A propos des problèmes de l'enfance entre 0 et 5 ans dans un faubourg de Dakar," Bull. Soc. Med. Afr. Noire Lang. Fr., vol. 14, pp. 639-652.

Senecal, J.; L. Aubry; S. Falade; (1962) "Infectious diseases in the child of pre-school age in Senegal," W. African Medical Journal, vol. 11, p. 93.

Serafin, F.J.; G. Gutierrez; J. Ruis-Gomez; M.T. Alvarez; (1970) "Infecciones agudas del tracto respiratorio inferior en ninos. II Estudio Clinico," Gac. Med. Mex., vol. 100, pp. 1287- 1295.

Singh, M.; (1972) "Antibiotics in pediatric practice," Indian J Pediatr., vol. 39, pp. 246-251.

Sodipo, J.O.; (1975) "A paediatric respiratory intensive care unit in Lagos," Resuscitation, vol. 4, pp. 39-43.

Spence, J.C.; W.S. Walton; F.J. Miller; S.D.M. Court; (1959) "A thousand families in Newcastle upon Tyne. An approach to the study of health

and illness in children," Oxford University Press, London.

Sterner, G.; G. Tunerall; (1962) "Acute respiratory illness in children. A combined bacteriological and virological study," Acta Pediat. Stockh, vol. 51. pp. 349-358.

Tan Kh; Boo PK; (1974) "Perinatal mortality," Journal of Singapore Paediatric Society, vol. 16, pp. 95-101.

Thorburn, M.J.; J.A. Hayes; (1968) "Causes of Death in Jamaica, 1953 to 1964. An analysis of past-mortem diagnosis at the University Hospital of the West Indies," Trop. Geogr. Med., vol. 20, pp. 35-49.

Tjaij, J.K.; S. Tarigan; T.T. Kie; H. Sinegar; S.M. Manoeroeng; (1969) "Pediatrics in Medan and surroundings," Paediatr. Indones, vol. 9, pp. 255-263.

Townsend, E.H. Jr.; J.F. Radebough; (1962) "Prevention of complications of respiratory illness in pediatrics," New Eng. J Med, vol. 266, pp. 683-

Urquhart, G.E.D.; M.A.J. Moffat; M.A. Colder; G.M. Cruickshank; (1965) "An etiological study of respiratory infection in children, Edinburg City Hospital, 1961-1963," J Hyg. (Lond), v. 63, pp. 187-200.

Uttley, K.H.; (1960) "The epidemiology and mortality of whooping cough in the Negro over the last 100 years in Antigua, British West Indies," W. Ind. Med. J, vol. 9, pp. 77-93.

Verma, I.C.; (1969) "Upper respiratory tract infections," Indian Journal of Pediatrics, vol. 36, pp. 130-137.

Weinstein, L.; (1968) "Common sense (Clinical Judgement) in the diagnosis and anti-biotic therapy of etiological undefined infetiosis," Pediat Clin. N. Amer., vol. 15, pp. 141-156.