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A PRELIMINARY POLICY ANALYSIS OF THE  
HEALTH SECTOR IN EL SALVADOR

by

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TABLE OF CONTENTS

	<u>Page</u>
Introduction	
I.1. Health Sector Goals of the Government of El Salvador and of the U.S. Agency for International Development . . . . .	3
I.2. Health Problems . . . . .	5
I.3. Development of a Program Structure . . . . .	11
I.4. Development of Indicators . . . . .	11
II. Consideration of Alternatives . . . . .	15
II.1. Disease Prevention and Control of the Environment . . . . .	15
II.1.1. Rural Sanitation . . . . .	15
ALTERNATIVE ONE: THE STATUS QUO . . . . .	15
ALTERNATIVE TWO: AN INTEGRATED SANITATION PROGRAM . . . . .	17
II.1.2. Urban Sanitation . . . . .	22
ALTERNATIVE ONE: THE STATUS QUO . . . . .	22
ALTERNATIVE TWO: AN INTEGRATED URBAN WATER SUPPLY PROGRAM . . . . .	23
II.1.3. Control of Industrial Pollution . . . . .	25
ALTERNATIVE ONE: THE STATUS QUO . . . . .	25
ALTERNATIVE TWO: A PROGRAM OF BALANCED PEST CONTROL. . . . .	27
II.1.4. Industrial Hygiene and Occupational Health and Safety . . . . .	31
ALTERNATIVE ONE: THE STATUS QUO . . . . .	31
ALTERNATIVE TWO: AN INTEGRATED INDUSTRIAL HYGIENE PROGRAM . . . . .	32
II.1.5. Communicable Disease and Vector Control Programs . .	33
II.1.5.1. Mass Immunization Programs . . . . .	33
ALTERNATIVE ONE: THE STATUS QUO . . . . .	34
ALTERNATIVE TWO: ENTRUST VACCINATION TO RURAL HEALTH AIDS . . . . .	34
II.1.5.2. Malaria Control . . . . .	35
ALTERNATIVE ONE: THE STATUS QUO . . . . .	35
ALTERNATIVE TWO: INCREASE PRESENT FUNDING LEVELS . . . . .	37
ALTERNATIVE THREE: ABANDONMENT OF PRESENT METHODS IN FAVOR OF AN INTEGRATED VECTOR CONTROL METHOD . . . . .	37

	<u>Page</u>
II.2. The Treatment and Rehabilitation System . . . . .	42
II.2.1. The Self Treatment System . . . . .	42
ALTERNATIVE ONE: THE STATUS QUO . . . . .	42
ALTERNATIVE TWO: DEVELOPMENT OF A MASS MEDIA RURAL HEALTH EDUCATION PROGRAM . . . . .	44
II.2.2.1. Outpatient Care in the Government Sector . . . . .	47
ALTERNATIVE ONE: THE STATUS QUO . . . . .	47
ALTERNATIVE TWO: DEVELOPMENT OF A CAREER STRUCTURE . . . . .	60
II.2.2.2. Outpatient Care in the Private Sector . . . . .	61
ALTERNATIVE ONE: THE STATUS QUO . . . . .	61
ALTERNATIVE TWO: A PROGRAM TO INTEGRATE MIDWIVES INTO THE RURAL HEALTH TEAM . . . . .	65
ALTERNATIVE THREE: PROGRAMS TO UPGRADE THE LEVEL OF CARE GIVEN BY THE PHARMACIES . . . . .	65
II.2.2.3. In Patient Care . . . . .	68
ALTERNATIVE ONE: THE STATUS QUO . . . . .	68
ALTERNATIVE TWO: INSTITUTE A TRAINING AND MAINTENANCE PROGRAM . . . . .	71
ALTERNATIVE THREE: EXPANSION OF THE SOCIAL SECURITY SYSTEM . . . . .	73
ALTERNATIVE FOUR: INSTITUTION OF CITIZEN AND ADMINISTRATIVE BOARDS TO FOSTER INTER-INSTITUTIONAL COOPERATION . . . . .	75
II.3. Training and Research . . . . .	76
II.3.1. Training . . . . .	76
ALTERNATIVE ONE: THE STATUS QUO . . . . .	76
ALTERNATIVE TWO: A PROGRAM TO TRAIN HEALTH ADMINISTRATORS . . . . .	78
ALTERNATIVE THREE: A PROGRAM TO INVOLVE THE UNIVERSITIES IN THE RURAL PENETRATION PROGRAM . . . . .	79
II.3.2. Research and Development . . . . .	80
ALTERNATIVE ONE: THE STATUS QUO . . . . .	80
ALTERNATIVE TWO: A PROGRAM TO IMPROVE THE DESIGN OF THE RURAL HEALTH AID PROGRAM . . . . .	81
III. Financial Constraints . . . . .	81
IV. Policy Conclusions. . . . .	89

APPENDIX A: ESTIMATES AND CALCULATIONS

	<u>Page</u>
I. A Simple Mortality Model of a Rural Population in El Salvador . . . . .	98
II. Effects of a Vaccination Program on Deaths from Infectious Diseases of Childhood . . . . .	101
III. Effects of a Campaign Against Neonatal Tetanus . . . . .	108
IV. The Likely Effect of Comprehensive Medical Care Delivered by Auxiliaries . . . . .	110
V. Estimate of the Effects of Sanitation . . . . .	120
VI. Estimate of Indicators for a Program that Would Reduce Malaria . . . . .	124
VII. Estimation of the Annuity Loss to a Campesino Family Arising from the Premature Death of an Adult . . . . .	124
VIII. Some Present Value Calculations Relevant to the Analysis of Alternative Water Supply Proposals . . . . .	128

APPENDIX B: A COMPENDIUM OF CONSULTANT  
SUGGESTIONS BY PROGRAM CATEGORY

1. Disease Prevention and Control of the Environment . . . . .	150
1.1. Rural Sanitation . . . . .	150
1.2. Urban Sanitation . . . . .	151
1.3. Control of Hazards Created by Industrial Activity. . . . .	153
1.4. Communicable Disease and Vector Control . . . . .	155
2. Treatment and Rehabilitation System . . . . .	157
2.1. The Self-treatment System . . . . .	157
2.2. Outpatient Treatment . . . . .	159
2.3. Inpatient Treatment . . . . .	164
3. Training and Research . . . . .	165
3.1. Training . . . . .	165
3.2. Research . . . . .	167

APPENDIX C: WATER SUPPLY AND DIARRHEAL DISEASE  
by Hinda Ripps, M.A.

## Introduction

Cost-effectiveness, cost-benefit and cost-utility analysis are all based on the philosophy that an expenditure of public funds can be justified only by the social benefits that it ultimately confers on the population. The philosophy is, of course, unimpeachable, but its application is problematic in a Health Sector Assessment. In the first place, the assessment surveys a range of programs with widely disparate sets of effects while mathematical techniques can set priorities only among programs with identical or very similar sets of outcomes.<sup>1</sup> (There is no way, for instance, to unambiguously compare program A which prevents many work-force disability days but which has no effect on mortality and program B which saves many infant lives but has no effect on disability). Second, good analysis demands good cost figures which are only possible when program planning is more advanced than it usually is at the assessment stage. Then there are the problems that plague any attempt to submit health plans to the discipline of economic rationality. Medical knowledge is often incapable of permitting an accurate estimate of the impact of the proposed program. This is particularly true when training and administrative improvements are envisioned. Data are often poor, and time and staff constraints often limit the ability to make the best use even of the poor data presently available. Still, the philosophy prevails, and something must be done.

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<sup>1</sup>Jesse Burkhead and Jerry Miner, Public Expenditure. Chicago: Aldine, 1971, p.213.

Accordingly, the present analysis was undertaken under the assumption that it would be feasible to accomplish the following tasks:

- (1) Develop a program structure which will permit the identification of more limited choice sets within which cost-effectiveness analysis might be feasible.
- (2) Develop a simple mathematical model which will permit cost-effectiveness calculations and perform preliminary cost-effectiveness calculations where possible.
- (3) Identify a wide range of alternatives within each program category.
- (4) Indicate some major considerations that would determine a rational choice within each of the program categories.
- (5) Discuss the major policy implications that seem to emerge from the accomplishment of the first four objectives.

The major organizational vehicle for accomplishing these tasks will be a program structure or a set of categories in which model programs created either from consultant reports, or from an examination of current literature are analyzed to the extent possible at the present time. For some, cost estimates are possible; for others effectiveness estimates are possible. For still others, only qualitative discussions are possible at the present time. The objective is to lay out the major considerations determining choice in a manner that will facilitate program development at a later stage or further analysis if it is considered necessary. It is doubtful that programs in the precise form indicated would be desirable. The programs are the tools of analysis in the following pages.

Part one discusses the health sector goals of the El Salvador Government and of the United States Agency for International Development, identifies the major health sector problems, creates a program structure, and suggests measurable indicators of progress in solving problems. In part two, alternative interventions within each program category are listed and analyzed. In part three, financial constraints are examined, and finally policy conclusions are discussed. In Appendix A a number of illustrative calculations are performed. The bases for many of the effectiveness estimates are also explained. Since no systematic analysis can possibly do justice to all the consultant suggestions, they are summarized in Appendix B. This appendix may well be the most important part of the analysis as the imaginative identification of alternatives is the most vital part of good program development. It is meant to fulfill objective three listed above.

#### I.1 Health Sector Goals of the Government of El Salvador and of the U.S. Agency for International Development

In part IV of the constitution, the Government of El Salvador assumes responsibility for the health of the people and commits itself to give free assistance to indigents who are sick and to inhabitants in general where necessary to prevent the spread of a communicable disease.<sup>2</sup>

Health, it is assumed, must be viewed positively as (1) a subjective sense of well-being and (2) an ability to fulfill expected social roles, that is an ability to contribute to the well-being of one's family, community and nation. This seems to have been the philosophy underlying the specific

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<sup>2</sup> Howard I. Bluestein, Elinor C. Betters, John Cobb, Jr., Jonathan A. Leonard, Charles M. Townsend, Area Handbook for El Salvador. DA-PAM 550-159. Washington, D.C.: Government Printing Office, 1971, p. 91.

objectives proposed by the Ministry of Health in its most recent Five Year Plan.

---to raise the level of health and as a consequence to contribute to an improved way of life for the population in accordance with the national development plan...

Specifically...

1. To reduce mortality among the more vulnerable groups, particularly in rural areas and in the poverty areas of the cities.
2. To reduce the incidence of those diseases susceptible to control by vaccination, by environmental sanitation or by health education.
3. To control the rate of population growth in a way that is in harmony with the social and economic development of the country.
4. To reduce the risk of incapacity, especially among the more vulnerable groups: infants, preschoolers, students, and the economically active.
5. To attend to the health of the whole population with emphasis on those currently deprived of services.
6. Rehabilitation of those currently incapacitated so that they might be re-incorporated into society.<sup>3</sup>

These general goals are most consonant with the mission which the U.S.

Congress entrusted to AID in the Foreign Assistance Act of 1973.

United States bilateral development assistance should give the highest priority to undertakings submitted by host governments which directly improve the lives of the poorest of their people and their capacity to participate in the development of their countries.

Section 104 - In order to increase the opportunities and motivation for family planning, to reduce the rate of population growth, to prevent and combat disease and to help provide health services for the great majority, the President is authorized to furnish assistance on such terms and conditions as he may determine for population planning and health.<sup>4</sup>

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<sup>3</sup> El Salvador, Five Year Health Plan. (which)

<sup>4</sup> Public Law 93-189, 93rd Congress, S 1433, December 17, 1973, pp. 1-2.

## I.2 Health Problems

A health problem is anything which prevents an individual from fulfilling his or her social responsibilities and from making his or her unique contribution to family and society as a worker, child, parent or community member. It can take the form of premature death, total or partial disability, weakness or mental retardation due to malnutrition. The term health problem is usually extended to include environmental factors that threaten the individual's well-being and also to refer to those limitations which hinder a society's ability to protect and care for its own people. Figure one presents a simple framework for identifying health problems, for developing a meaningful program structure and for identifying alternative activities within the categories of that program structure.

A full examination of health problems demands a careful look at the whole system, including the environment, the morbid states that threaten individual health, the individual's ability to perceive such a state as a threat to his well-being, and the ability of the health system to bring the knowledge of modern science to bear on the individual's problem. Hopefully, then, all along the system, areas of intervention can be identified as well as alternative courses of action that will improve the system's efficiency.

The identification of problems must start at the level of the campesino. What are his problems as he sees them? The positive definition of health which guides health policy both for the Government of El Salvador and for the U.S. Agency for International Development seems also to be the definition that informs the judgment of the rural campesinos when asked to comment on their

own health and on that of their mates and children.<sup>5</sup> Table I.1 contains a summary of these judgments from a sample survey of such campesinos.

Table I.1. PERCEPTIONS OF FAMILY HEALTH STATUS

Respondents' Assessment

SEX	of his/her own health			of his/her mates health			of their children's health		
	good	fair	poor	good	fair	poor	good	fair	poor
MEN	5%	75%	-	10%	55%	35%	35%	10%	90%
WOMEN	15	60	25	5	85	10	20	65	15
TOTAL	20	67.5	12.5	7.5	72.5	22.5	27.5	37.5	52.5

Source: Polly Fortier Harrison, The Social and Cultural Context of Health Delivery in El Salvador: Implications for Programming. San Salvador: USAID, March-May, 1976, p. 29.

Very few campesinos, it will be noted, perceive their health as "good". Half of the children are considered to be in poor health. Unfortunately, data on restricted activity days, disability and incapacity are absent. The only other available information on health status is in the form of the customary epidemiological categories.

The major problems by epidemiological category are well known - diarrhea, dental disease, intestinal parasites, influenza, accidents, bronchitis, pneumonia, malaria, and tuberculosis. Childhood infectious diseases were a problem in the early 70's, but they have been rather effectively contained by a vaccination program. The infant death rate, a key traditional health status indicator, is probably about 120 in rural areas. All these problems have been discussed at length in the epidemiological sections of the assessment.

<sup>5</sup>

Polly F. Harrison, The Social and Cultural Context of Health Delivery in Rural El Salvador: Implications for Programming. San Salvador: USAID, March-May, 1976, pp. 27-29.

Premature death that can be prevented by existing technology is, of course, a particularly frustrating health problem. It is necessary, though, to understand the complex way in which death is caused before opting for simple solutions. Death has been defined as "one possible outcome of an encounter between a specific morbid process and a vulnerable human target. It is quite clearly a joint function of the potency of an agent and the vitality of the host."<sup>6</sup> This definition underlines the necessity for care when interpreting cause of death statistics. When, for instance, it is said that a child died of measles, this may hide the fact that bouts with malaria and diarrhea have so weakened the child that the measles infection was really just "the last straw". Epidemiologists and nutritionists have used the word synergism to refer to this process.

When infection aggravates malnutrition or malnutrition lowers resistance to infection, the relationship between the two can be classified as synergistic, i.e., the simultaneous presence of malnutrition and infection results in an interaction that is more serious for the host than would be expected from the combined effect of the two working independently.<sup>7</sup>

For instance, malnutrition was an underlying or associated cause of death in 71 percent of the infant deaths in rural El Salvador studied in the PAHO investigation.<sup>8</sup> Noteworthy for El Salvador is Peter Newman's demonstration that the eradication of malaria reduced the infant death rate in Ceylon and

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<sup>6</sup> Samuel H. Preston, Nathan Keyfitz and Robert Schoen, Causes of Death: Life Tables for National Populations. New York and London: Seminar Press 1972, p. 2.

<sup>7</sup> Nevin S. Scrimshaw, Carl E. Taylor and John E. Gordon, Interactions of Nutrition and Infection. Geneva: World Health Organization, 1968, p. 16.

<sup>8</sup> Ruth Rice Puffer and Carlos V. Serrano, Patterns of Mortality in Childhood Scientific Publication No. 262. Washington, D.C., Pan American Health Organization, 1973, p. 128.

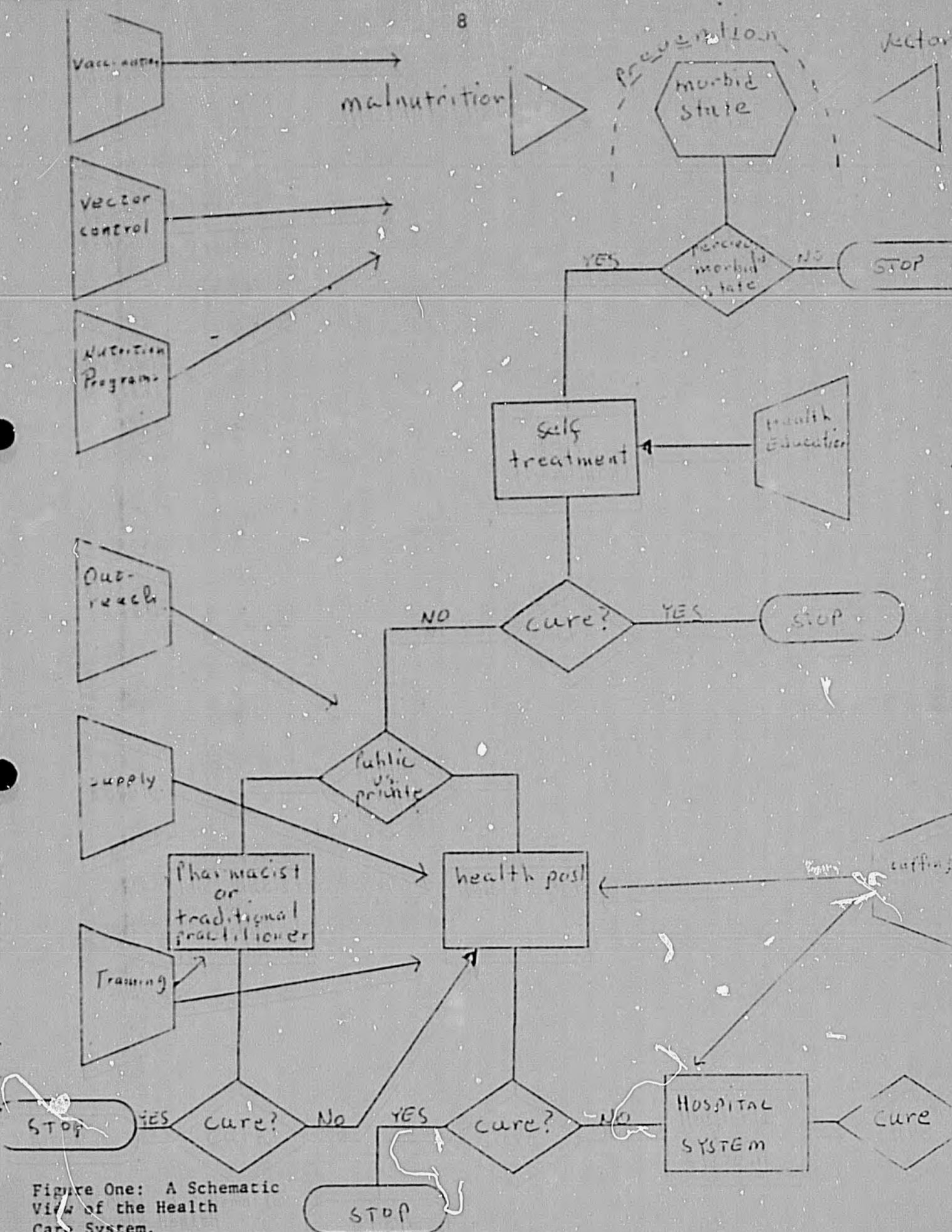


Figure One: A Schematic View of the Health Care System.

New Guinea much further than one would have predicted using malaria death rates alone.<sup>9</sup>

All this is relevant to the series of events schematized in figure one. The hexagon figures indicate areas of intervention. The first series of health problems appear as morbid states. But nutrition programs, vector control or environmental health programs could prevent them. There are obvious problems that might best be approached by nutrition interventions. They are not analyzed here because nutrition is covered in a separate assessment.

Once attacked by disease organisms, a person may or may not perceive his health as threatened. If he does, the first line of defense is the self-treatment system. There are serious problems with this system in El Salvador, at least as described by the anthropologists who worked on the assessment. The appropriate intervention is health education. When self-treatment fails the family may seek outside help. Again, there seem to be problems in the link between the publicly supported health system and the sick people it is supposed to serve. Table I.2. is taken from the PAHO study on infant mortality. Only about 33 percent of the pre-schoolers who died in rural El Salvador had the benefit of hospital care. The Latin American average was 84.5%. Other evidence tends to bear out the suspicion that the treatment and rehabilitation system does not reach enough people, particularly in rural areas.

An average of three dispensary visits per person per year is a generally accepted indicator of adequate health service.<sup>10</sup> In El Salvador, Social Security

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<sup>9</sup> Peter Newman, Malaria Eradication and Population Growth. Ann Arbor: University of Michigan Press, 1967.

<sup>10</sup> J. P. Habicht, G. Guzman, J. M. and Reyna Barrios, "Outpatient Medical Care Provided by Paramedical Staff: Needs, Practicability and Quality Control. Guatemala City: INCAP. Undated (Mimeo), p. 4.

recipients average between four and five visits. Recipients and their families as a group average just over three visits. Urban residents average 0.5 visits per capita and rural residents 0.2. Interventions include outreach activities and improved supply, training and staffing. Outreach attempts to deal with limited access, while the other activities deal with the hypothesis that the government health system's effectiveness may be limited by shortages of supplies and/or appropriately trained staff.

Table I.2.

Percentage of Deceased Children Under Five Years of Age Hospitalized for Underlying Cause of Death in Two Age Groups (All Figures are Percentages)

Area	Total Hospitalized	In Hospital Birth to Death	Other Hospitalization	28 days - 4 years Hospitalize
Total	85.4	66.9	18.3	56.9
North America	98.0	94.6	3.4	52.0
Latin America	84.5	65.0	19.6	57.0
San Salvador	79.4	64.3	15.1	43.0
Rural Municipios of El Salvador	32.6	21.6	11.1	13.0

Source: Puffer and Serrano, p. 308.

The individual may turn to the private sector. Little is known about this. There is a conventional wisdom, belied by the fact that most doctors work only part time for the government, that 90% of the health care is given in the public sector. It is known that rural pharmacists diagnose. There may or may not be a problem depending on the quality of the diagnosis. Problems do exist with rural midwives, however. Interventions include training and regulation.

### 1.3. Development of a Program Structure

A program structure is a set of categories which will facilitate comparison of programs aimed at the same objective. Exhibit one contains the structure developed for the present analysis.

Exhibit One: A Suggested Program Structure

1. Disease Prevention and Control of the Environment
  - 1.1 Rural Sanitation
  - 1.2 Urban Sanitation
  - 1.3 Control of hazards created by productive activity
  - 1.4 Communicable Disease and vector control
2. Treatment and Rehabilitation
  - 2.1 Self-treatment
  - 2.2 Outpatient care
  - 2.3 Inpatient care
3. Training and Research
  - 3.1 Training
  - 3.2 Research and Development

### 1.4. Development of Indicators

Appendix A explains how a mortality indicator was developed so that, where feasible, program impact in terms of lives saved might be estimated. Development of a morbidity indicator presented serious problems given the time and staff constraints on the analysis. The best indicators are couched in terms of social cost--hospital days, workdays lost, degrees of pain and inconvenience, and so forth. Morbidity data in El Salvador are limited to statistics on outpatient visits by cause and official morbidity statistics. The ten major causes of morbidity on each criterion are reproduced in Tables I.3 and I.4.

Table I.3. Ten Major Reasons for Outpatient Consultation in El Salvador\*

Rank	Cause	Visits	
		Number	Percent of total
1	Diseases of Teeth and Gums	215,238	12.1
2	Enteritis and Other Diarrheal Disease	151,917	8.5
3	Acute Respiratory Infections	120,423	6.8
4	Bronchitis, Emphysema and Asthma	79,518	4.5
5	Influenza	54,531	3.1
6	Anemias	43,197	2.4
7	Infections of the Skin and Tissue	36,963	2.1
8	Lacerations and Wounds	34,611	1.9
9	Tuberculosis of the Respiratory System	25,650	1.4
10	Epilepsy	21,384	1.2

Source: Departamento de Estadísticas de Salud, Planificación de Los Servicios de Salud, Ministerio de Salud Pública y Asistencia Social, Anuario: Salud Pública en Cifras 1975. San Salvador: Ministry of Health, 1976, p. 16.

\* Figures do not add because the category "other" has been omitted.

Table 1.4. Ten Primary Infectious and Parasitic Diseases 1971-75

1971 Cases				
Rank	Disease	Number	%	Rate
1	Diarrheal Disease	124,136	30.5	3,400
2	Intestinal Helminths	72,122	17.7	2,000
3	Influenza	67,049	16.4	1,800
4	Malaria	46,858	11.5	1,300
5	Amebiasis and Dysentery	33,605	8.2	900
6	Pneumonia and Bronchitis	12,331	3.1	350
7	Syphilis	9,296	2.3	260
8	Acute Gonococcal Infection	3,365	2.1	90
9	Measles	6,741	1.6	190
10	Tuberculosis of the Respiratory Tract	4,416	1.1	120

1975 Cases				
Rank	Disease	Number	%	Rate
1	Diarrheal Disease	125,799	27.6	2,900
2	Intestinal Helminths	112,453	24.7	2,670
3	Influenza	68,805	19.5	2,100
4	Malaria	33,100	13.2	1,970
5	Amebiasis and Dysentery	13,428	2.9	310
6	Syphilis	7,527	1.7	170
7	Acute Gonococcal Infection	4,248	0.9	100
8	Infectious Hepatitis	3,164	0.7	70
9	Pulmonary Tuberculosis	2,875	0.6	60
10	Syphilitic Cancer	2,475	0.5	50

Source: Departamento de Estadísticas de Salud, Planificación de Los Servicios de Salud, Ministerio de Salud Pública y Asistencia Social, Anuario: Salud Pública en Cifras 1975. San Salvador: Ministry of Health, 1975, p. 11.

\* Rate per 100,000 population

\*\* Figures do not add because the category "other" has been omitted.

It is impossible to develop an estimate of actual morbidity from these statistics because such a small part of morbidity is actually reported. For instance, in 1972, it was estimated that only five per cent of actual measles cases were officially reported.<sup>11</sup>

Morbidity should not be ignored. It is proposed here to develop two separate morbidity indexes. These, in combination with the estimates of lives saved developed in Appendix A, will be used where feasible to assist in developing priorities based on expected program impact. The two indicators will be based on the assumption that priorities in morbidity reduction are determined to some extent by the importance of any particular disease as a cause of outpatient visits and/or as a reported disease. These indexes alone would not account for the fact that some diseases are more serious than others. But it is hoped that the estimate of lives saved will make up this deficiency to some extent because the more serious diseases will also cause more fatalities. The morbidity indexes will be called proportionate reduction indexes. Thus, for instance, an intervention that would reduce diarrheal disease by 50% would have two proportionate reduction scores.

$$\begin{aligned} \text{An Outpatient Visit Score} &= .5 \times 8.5 = 4.25 \\ &(\text{See Table I.3}) \end{aligned}$$

$$\begin{aligned} \text{A Reported Disease Score} &= .5 \times 30.5 = 15.25 \\ &(\text{See Table I.4}) \end{aligned}$$

It must be emphasized that these indexes are not forecasts of reductions in outpatient visits or reported diseases but indexes of disease importance. These, together with the model population death rates developed in Appendix A, and attention to the age groups singled out by the Government of El Salvador

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<sup>11</sup> U.S. Department of Health, Education and Welfare; Public Health Service, Proposal: Mass Immunization Programs for Central America. Atlanta, Georgia, 1972, p. 4.

would permit cost-effectiveness calculations if it were possible to predict the outcomes of the different programs.

These are impact indicators. Other indicators which might be used would include latrines built, population served by household connections and so forth. Such indicators are less desirable than impact indicators which link the proposed intervention to its effect on the health problems that have been identified as critical. They are, however, useful for management control.

## II. Consideration of Alternatives

The technique here involves the development of illustrative programs. It is hoped that in the analysis of these programs the major policy issues will be explored and clarified. The programs as developed are not, obviously, suggested for implementation in their present form.

### II.1. Disease Prevention and Control of the Environment

#### II.1.1. Rural Sanitation

##### ALTERNATIVE ONE: THE STATUS QUO

###### A. Description

Of 2,200 communities with a population less than 2,000, 600 have water supply systems. Another 800 are said to have access to water supply systems. Future plans include a \$9.1 million BID/CIDA/GOES program to build 165 community water systems serving 142,000 people, mostly with household connections. Another six million will be spent to build wells and public standpipe systems for 500 rural communities. The government plans to spend about \$400,000 per year between 1977 and 1986 in a rural latrinization program. This would provide between 300,000 and 350,000 rural latrines. A similar program, initiated in 1973, succeeded in placing only 17,991 out of a planned 60,000 latrines. The latrines will be sold to rural households for about \$4 each.

The shortfall seems due to managerial problems. There are no indications of plans for straightening out the organizational tangles that have hindered previous efforts.

## B. Expected Effects

### (1) Effects on Morbidity and Mortality

It is necessary to distinguish the potential effects of clean water from the expected effects. Potentially, with adequate sanitation measures, provision of water can contribute to the reduction of diseases that are carried by water such as amebiasis, diseases that are filth borne or that can be washed off such as diarrheal diseases, dysentery and many skin diseases. Reduction of morbidity due to "water washed" diseases, however, depends crucially on human behavior.<sup>12</sup> Thus, the potential effects are highly uncertain when there is no accompanying health education component and more uncertain when household connections are not provided.

The indexes calculated in Appendix A are:

Clinic Index.....	5.8.
Reported Disease Index....	31.9.
Death Reduction Range.....	0 to 232.
Uncertainty is <u>High</u>	

The death reduction range of 0 to 232 indicates that an optimist would put life saving at 232 per 100,000 population. A pessimistic estimate would place it at 0. High uncertainty means the pessimist is probably right.

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<sup>12</sup> Robert J. Saunders and Jeremy J. Warford, Village Water Supply: Economics and Policy in the Developing World. Baltimore: Published for the World Bank by the Johns Hopkins University Press, 1976. pp. 31-55.

## (2) Effects on the Distribution of Income

The effect of pollution on income distribution is generally considered to be regressive. This is true also of polluted water.<sup>13</sup> Poor people cannot escape to a cleaner environment, cannot hire a maid to boil water, do not even have access to the educational sources that will tell them why the water should be boiled.

Apart from effects on the morbidity and mortality, real incomes would rise so long as less was charged than people were willing to pay for the water.

### ALTERNATIVE TWO: AN INTEGRATED RURAL SANITATION PROGRAM

#### A. Description

The program would include a supplement so that household connections could go to all families. It would change the latrine design from open pit to water seal. Water seal latrines are no more expensive than open pit latrines, but they effectively prevent flies from moving between feces and food.

It also includes a mass health education component. Radio and/or television could be used to educate the public in sanitary practices and in the nature, prevention and treatment of diarrhetic and other water connected diseases.

Exhibits two, three and four contain cost estimates for the present program. In each case the planned government expenditure is included with the present necessary increase in expenditures.

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<sup>13</sup> E. J. Mishan, The Costs of Economic Growth. New York: Praeger, 1967, p. 73.

EXHIBIT TWO

Program Elements for the Excreta Disposal Component  
of an Integrated Rural Sanitation Program

(Thousands of U.S. Dollars)

Year	ALTERNATIVE ONE		ALTERNATIVE TWO				Total
	Total Cost Less Community Contribution	International Organizations	Peace Corps Coordinators	Motor Scooters	Subsidization of Latrines		
1977	400	1,600	20	1,220	140	3,380	
1978	400	1,600	20		140	2,160	
1979	400	1,600	20		140	2,160	
1980	400	1,600	20		140	2,160	
1981	400	<u>1,600</u>	<u>20</u>		<u>140</u>	<u>2,160</u>	
		<u>8,000</u>	<u>100</u>	<u>1,220</u>	<u>700</u>	<u>12,020</u>	
1982	400						
1983	400						
1983	400						
1985	400						
1986	<u>400</u>						
	<u>4,000</u>						

Exhibit Three. Program Elements of the Rural Water Supply  
Component of an Integrated Rural Sanitation  
Program (Figures in Thousands of U.S. Dollars)

	YEAR					Total
	1978	1979	1980	1981	1982	
1. Alternative One:						
Household Connect- ion type system for 165 rural communities 142,000 people	3,450	3,900	3,463	1,659	1,200	13,672
Public stand- pipe systems for rural communities about 400,000 people	<u>1,200</u>	<u>1,200</u>	<u>1,200</u>	<u>1,200</u>	<u>1,200</u>	<u>6,000</u>
Total Alternative One:	<u>4,650</u>	<u>5,100</u>	<u>4,663</u>	<u>2,859</u>	<u>2,400</u>	<u>19,672</u>
2. Alternative Two:						
AID Supplement so that house- hold connections can be supplied to all families	2,000	2,000	2,000	2,000	2,000	10,000
Total	6,650	7,100	6,663	4,859	4,400	29,672

## Exhibit Four:

## Health Education Component

Cost for one Year

1. Government Plans:		
To have rural health aides instruct the population.		unallocable
2. Alternative two:		
a. That educational radio or T.V. be used		\$60,000
b. Train health educators (6 months)		
	TOTAL	<u>\$60,000</u>
Expected range \$40,000 - \$80,000		

## B. Expected Effects

## (1) Effects on Morbidity and Mortality

The program would bring the maximum effects estimated for alternative one into the realm of the possible. This statement seems to summarize professional judgment in a highly uncertain field. As one recent and exhaustive literature review puts it:

Because health is affected by numerous environmental, social, and cultural factors, it would be speculative to predict what the elimination of potential infection at the "official" water source would mean to the overall health of the community. In some cases an improved water supply might not significantly alter the health of the community; in other climates or types of terrain, however, or with house connections and other sanitary and health education measures taken in conjunction with the improvement of the supply of drinking water, a significant improvement in local health might be achieved. From a general sanitation point of view, permanent improvements in health are unlikely, if not impossible, unless a safe and convenient water supply either precedes or accompanies other sanitary measures.<sup>14</sup>

There is no rigorous way to estimate the effect of household connections vis-a-vis standpipes. Appendix A contains an illustrative attempt to do so for neo-natal deaths.\* One would hesitate to apply it here, however. The

<sup>14</sup> Robert J. Saunders and Jeremy J. Warford, Village Water Supply: Economics and Policy in the Developing World. Baltimore and London: Published for the World Bank by the Johns Hopkins University Press, 1976, pp. 35-36.

\* See Appendix C for a more extended discussion of the evidence in this area.

best course is simply to keep the quantitative estimates of alternative options and change uncertainty to moderate.

As one final note, one might suggest an examination of a change in design to the Eastern type rather than the Western. This suggestion is based on an anthropologist's report.

Latrine projects have encountered resistance in certain parts of rural El Salvador because of costs of construction, odors, expense of maintenance (especially disinfectant), insects, and general displeasure with a seated rather than a squatting posture during defecation.<sup>15</sup>

The water seal latrine, by keeping flies away from the fecal matter, would reduce the probability that an individual would be stricken by a filth borne disease and reduce some of the inconveniences noted by the anthropologist. An Eastern type arrangement would permit a squatting rather than a sitting posture.

## (2) Expected Impact on the Distribution of Income

Although the project should benefit the lower income classes, there is always the danger that free water will actually benefit the richer farmers.<sup>16</sup> This can be prevented by a well worked-out set of tariffs for household connections. One strategy would involve a temporary rise in water tariffs to help cover expansion costs followed by a subsequent reduction as connections were extended to lower income houses, with public standpipes available in the interim period. So long as water rates fall short of the ability and willingness to pay, the government is subsidizing the water user, whether he is rich or poor.

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<sup>15</sup> Gerald F. Murray, Traditional and Modern Strategies of Health Care Delivery Among Peasants in El Salvador. El Salvador: USAID, 1977, p. 93

<sup>16</sup> Saunders and Warford, p. 16.

## II.1.2. Urban Sanitation

### ALTERNATIVE ONE: THE STATUS QUO

#### A. Description

Presently about one half the urban population is served with household water connections, and about one third with sewered excreta disposal systems. Chlorine is used only periodically "to clean out the pipes." The quantity of water demanded exceeds the quantity supplied at present prices. This is one reason why officials of ANDA (The National Water and Sewerage Agency) are reluctant to expand the system. They cannot meet the requirements of users that are currently connected. Spokesmen for the agency have complained of a lack of sanitary, civil mechanical and hydraulic engineers. In addition, they have pinpointed three key problems that will need attention in future years.

(1) providing sufficient water to meet demand; (2) repairing and expanding the water distribution system to meet adequate service levels and (3) providing sufficient sewerage systems to meet consumer demands.<sup>17</sup>

A joint Inter-American Development Bank-Government of El Salvador project was begun in 1976 to build a well field, storage tanks and pump stations designed to meet the demand for water in the San Salvador Metropolitan Area in 1980 (4.2 m<sup>3</sup>/sec--2.2m<sup>3</sup>/sec. above present capacity). The bank loan will be \$50 million and the government is looking for another \$30 million in international loans.

The smaller municipalities are not financially capable of supporting adequate water supply systems, and ANDA is eventually supposed to take over all the municipal water supply systems.

#### B. Effects

##### (1) Effects on Morbidity and Mortality

A - priori one would not expect the present system to have much effect

<sup>17</sup> Victor Wehman, "Water Supply and Environmental Health Sector Assessment," San Salvador: USAID (mimeo), 1977, p. 15.

on morbidity and mortality. Available evidence tends to confirm this suspicion. Table II.1.2 compares the rate of diarrheal disease and amoebiasis in El Salvador to the average for all of Latin America.

Table II.1.2 Amoebiasis and Diarrheal Disease as Cause of Death in Children Under Five in Latin America and El Salvador

Area	Amoebiasis		Diarrhea	
	Number	Rate *	Number	Rate
Latin America	303	14.4	10,052	478.9
San Salvador	65	62.6	1,240	1,193.9
Rural Municipios of El Salvador	22	102.7	559	2,608.5

SOURCE: Puffer and Serrano, p. 138.

\* Rates per 100,000 population.

San Salvador had the highest diarrheal "five and under" death rate of any city in the PAHO sample.<sup>18</sup>

This certainly does not disprove the suspicion that present water policies are not having as great an effect as possible on diarrheal disease.

## (2) Effect on the Distribution of Income

For reasons noted above, pollution of all kinds has a regressive impact. Poor people are usually deprived of the knowledge and resources to escape from it. The effect on the AID target group referred to as "the poor majority" could probably be easily demonstrated with time and data.

## ALTERNATIVE TWO: AN INTEGRATED URBAN WATER SUPPLY PROGRAM

### A. Description

The Program has five components:

- (1) Raise the water rates from four cents to ten cents per cubic meter.

<sup>18</sup> Puffer and Serrano, p. 128.

- (2) Fund, at an estimated cost of \$100,000 a mapping and leak detection survey.\*
- (3) Train 37 engineers - 12 sanitary, 11 hydraulic, 8 electrical and 6 mechanical.
- (4) USAID and GOES should look into the possibility of development of a chlorine plant for El Salvador.

#### B. Expected Effects

##### (1) Impact on Morbidity and Mortality

The impact would be delayed, of course, and the first components would not be expected to have any immediate effect. The second, if cost-effective, might increase the quantity of water available for the same expenditure. Since the quantity demanded now exceeds the quantity available, it would mean a greater water use, and other things being equal, a reduction in morbidity and mortality. The addition of chlorine, however, and the enhancement of the water and sewerage system's administrative and technical capability, should ultimately pay off in the provision of healthier water, and a consequent reduction in morbidity and mortality due to water carried diseases.

##### (2) Income Distributional Effects

An increase in water rates would shift the cost of further expansion into the upper and middle classes who benefit from the tax-subsidized water they now receive. On the other hand, the improvement in health should improve both earning ability and living standards for the poorer elements of the population.

##### (3) Other Considerations

Since wages are presently higher in the private than in the public sector, it may be difficult to retain engineers after they are trained. This would vitiate the effects of a scholarship program. One solution might involve an

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\* See Appendix A for a discussion of the mapping and leak detection survey.

AID supported loan fund with repayment demanded at punitive interest rates if the recipient left government service before 7 or 8 years. But this might still not make the project feasible if government engineer salaries remain too low.

A chlorine plant would make it possible to use more chlorine in the city water supply because the cost of domestically produced chlorine would be significantly less than that of imported chlorine. It would also provide employment and have linkages with laundry powder and other chemical industries.

### II.1.3 Control of Industrial Pollution

#### ALTERNATIVE ONE: THE STATUS QUO

##### A. Description

Industrial pollution in this section will refer to the detrimental effects on air, land, water, humans and other natural resources of industrial and agricultural activity. Industrial pollution in this sense seems to be reaching crisis proportions in El Salvador. The rivers leaving El Salvador in the dry season are about 100% sewage. They are devoid of oxygen, rendering fresh water fishing impossible, contaminating shell fish, and causing sickness to those who drink surface water even when it is boiled. Agricultural pesticides are used in uneconomical quantities that pose a continuing threat to health and contribute to the development of pesticide resistant mosquitoes. By 1990, ground water in El Salvador will be insufficient to meet industrial and household needs, and the country will have to turn to its pesticide infected, sewage drenched, metal contaminated surface water.

##### B. Effects

###### (1) Effects on Morbidity and Mortality

Each year improper pesticide use kills 20 people and makes 5,000 others so sick that they are incapacitated for at least one day. Although there are

no records of it, the incidence of infectious hepatitis and other diseases must be increased by infected shellfish. People who drink and bathe in the polluted water run the risk of contacting skin diseases. Since the soil in El Salvador is quite porous, there is at least a 50% chance that the polluted surface water will seep through, contaminate the ground water, and vitiate many potential health effects of the rural water supply program.

### (2) Effects on the Distribution of Income

The cost of pollution is falling on the poor, especially if they drink the polluted water. The anthropologist reports that although the people in his village did not drink river water; he heard reports that people in other villages did. He reported one unhygienic practice in his village.

There is one link in the chain of tortilla-making which emerges as somewhat problematic. After the family's daily ration of corn has been withdrawn from the granero, the corn will be placed in a huge pot; and is boiled in water into which lime (cal) has also been thrown. The resulting whitened corn (now no longer called maiz, but rather nixtamal) is then poured into a gourde vessel (barco). The general practice is then to take the nixtamal to the river and wash it. As will be seen, the people of Los Guateles do not drink river water, knowing well that it is likely contaminated. Nonetheless, they wash the nixtamal in water which they know to be unsafe for human consumption . . . The mush is patted by the women into the shape of tortillas and placed directly on the comal to be roasted on both sides. But the inner part of the tortilla, of course, receives no direct heat, and it is not clear that microorganisms introduced into the nixtamal during the river washing will be killed by the heat.<sup>19</sup>

He also reported that people bathed and washed dishes in the river<sup>20</sup>

### (3) Other Considerations

Arguments that pollution is a necessary cost of industrial expansion are

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<sup>19</sup> Gerald F. Murray, Traditional and Modern Strategies of Health Care Delivery Among Peasants of El Salvador. San Salvador: USAID, pp. 81-82.

<sup>20</sup> Ibid., p. 89.

weak. For in many instances it can be shown that pollution retards industrial expansion. It can ruin a seafood industry.<sup>21</sup> Econometric studies have demonstrated that property values fall in polluted areas.<sup>22</sup> Pollution imposes an economic cost and retards the development of some industries.

On the other hand, pollution control, it must be admitted, will raise cost for some industries.\* Obviously, production and employment might fall in the polluting industries. It is obviously a question of trade-offs and finding an "optimal" pollution level. At present all evidence suggests that pollution levels are too high in El Salvador.

Finally, implementation of pollution controls is usually quite difficult politically. Strenuous public education efforts are necessary to gain support for such measures.

#### ALTERNATIVE TWO: A PROGRAM OF BALANCED PEST CONTROL

##### A. Description

The program would involve an integrated strategy of spraying with insecticides in patterns carefully designed to minimize the probability of development of immune species. It would also involve the utilization of techniques such as the introduction of predator species, sterilized males and so forth. The program would involve considerable extension work on the part of the government, and some enforcement of industrial hygiene regulations-- for instance fines for not taking workers out of the field when spraying,

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<sup>21</sup> See for instance: James M. Fallows, The Waterlords. New York: Bantam Books, 1971, pp. 8-9.

<sup>22</sup> Ronald G. Ridker and John A. Henning, "The Determinants of Residential Property Values With Special Reference to Air Pollution," Review of Economics and Statistics (May 1967), Vol. 49, No. 2, pp. 246-257. Roy W. Bahl, Stephen P. Coelen and Jeremy J. Warford, Laud-Value Increments as a Measure of the Net Benefits of Urban Water Supply Projects in Developing Countries: Theory and Measurement. Syracuse, New York: Syracuse University Research Corporation, 1972.

\* A scientific pest control program in agriculture might, however, reduce long run costs by facilitating the adoption of new methods and reducing pesticide waste.

for indiscriminate high concentration spraying over dwellings and so forth. Exhibit 5 contains preliminary cost estimates for such a program. (extension agent salaries have been estimated at \$200 per month).

<u>Item</u>	<u>Cost</u>	
	Capital	Recurring
1. Technical Assistance	\$ 70,000	\$ 6,000
2. Addition of 300 extension agents*		360,000
3. 300 motor scooters for extension agents	300,000	
4. Training	20,000	4,000
5. Public relations/** education		15,000
TOTAL	\$390,000	\$385,000
Present value at 10% interest - 4,240,000		
* Assuming an annual salary of 1200 per man per year		
** Assuming a radio-T.V. campaign once every four years		

## B. Effects

### (1) Effects on Morbidity and Mortality

The program should directly reduce the incidence of pesticide intoxication.

Indirectly, it should be of assistance to the control of malaria and other insect-borne diseases.

Since cases of pesticide intoxication did not per se make their way into the official health statistics, they will be reduced to the same base as the reported diseases by dividing through by the total used to create percentages in the official statistics. This seems legitimate as one would assume that were part of the category "other" included in the

official statistics. Since practically all pesticide intoxication cases are treated on an outpatient basis, the numerator for both reported disease and outpatient score will be the same. The morbidity/mortality reduction scores are, then:

Lives Saved - .375 to .5 (Note: This is lives saved per 100,000  
Obviously 15-20 would be expected to  
be saved for the whole country)

Outpatient Visit Score =  $(5000/1,780,059) \times 100 = .28$

Reported Disease Score =  $(5000/455,703) \times 100 = 1.097$

Uncertainty would be low. The death and sickness reported here results completely and entirely from carelessness which can be made to come to an end.

## (2) Effects on the Distribution of Income

In Appendix A, an annuity value for the premature death of an agricultural worker has been calculated. This is the amount of wealth that a campesino family would be expected to lose when an earning member dies prematurely. In addition, the family loses the wages of the worker for at least one day, depending on the length of intoxication. These losses make life harder for the poorest members of the society. This program, by preventing these losses, would supplement the family income by that amount. Consequently, the figures are included as part of the financial gain in Exhibit 6.

Certain objections might be raised to this procedure. However, such objections would have validity only if (1) the contribution of the individual to national income were being considered, or (2) a general equilibrium context were invoked as the universe of discourse. Twenty deaths per year does not seem to merit a general equilibrium context, and the focus here is on the loss to a family of a breadwinner, not on national income.

Exhibit 6. Some Possible Financial Gains of a  
Balanced Pest Control Program  
(U.S. DOLLARS)

	ANNUAL	CAPITALIZED (10% discount rate)
1. Financial Gain to Families of Workers who would have died	\$ 3,748.49	\$ 37,483.9
2. Reduction in Cost of Treating Pesticide Intoxicated Workers (Assuming a 50% Reduction and a \$5 cost per Case Treated)	12,500	1,205,000
3. Salary Gain Assuming Workers who Become Intoxicated Would Lose One Day's Work (Minimum Wage \$2.20 X 2500)	5,500	55,000
4. Reduction in Pesticide Cost due to Scientific Spraying (Assuming an Average of 20% per year)	408,478	4,084,780
	<u>\$430,226.49</u>	<u>\$5,382,263.90</u>

The objections are discussed somewhat further in Appendix A.

### (3) Other Effects

The program could benefit farmers. The estimates of financial gain accruing from reduced pesticide use in Exhibit 6 are based on 1976 expenditures. Some observers have estimated that farmers are currently using two to five times more pesticide than they would need in a balanced program. The estimated financial gain of 20%, therefore, seems quite modest.

On the other hand, political difficulties can be foreseen in the implementation of the program. A rather strenuous education program would be necessary to "sell" the program to the farmers. Once they see the whole program as beneficial, they might be more muted in their opposition to enforcement of safety regulations.

## II.1.4 Industrial Hygiene and Occupational Health and Safety

### ALTERNATIVE ONE: THE STATUS QUO

#### A. Description

The department of industrial hygiene and safety within the Ministry of Labor is staffed by one occupational health physician, two engineers, two secretaries and sixteen inspectors. Current plans for a 6% increase between 1978-1982 imply, given inflationary factors, a government decision to maintain the status quo. Between 1971 and 1976, industrial accidents have increased from 7,000 to 12,000 annually. The department has no authority to fine, close down, or require modifications within a certain time limit.

## B. Effects

### (1) Effects on Morbidity and Mortality

The present system probably has no effect on morbidity and mortality. The staff does not have the laboratory facilities to verify industrial hygiene infringements. It does not have the manpower to enforce regulations. It does not have the legal authority even if it had the manpower.

### (2) Effects on the Distribution of Income

Present conventional wisdom looks upon the industrial worker as rather privileged in the Third World Country. This is a half-truth, however. He is considerably worse off than the industrial worker in the developed countries, and significantly worse off than the wealthy land-owner-industrialist-physician-lawyer class in his own country. The El Salvador worker receives lower wages than industrial workers in most other Latin American countries. He is "privileged" only in relation to the campesino.

The present situation has a negative effect on the distribution of income.

### (3) Other Effects

Fostering an industrial system which ignores healthy working conditions, contributes to political instability, as it plays into the hands of those who maintain that the present system exploits the population for the benefit of the few.

## ALTERNATIVE TWO: AN INTEGRATED INDUSTRIAL HYGIENE PROGRAM

### A. Description

The program would include the following elements.

- (1) Raise the inspector force to 160 by 1980 in steps of 50 per year.

- (2) Purchase six jeep-type vehicles immediately and 135 motor scooters phased in at 45 per year.
- (3) Initiate a TV-radio campaign to disseminate safety tips.
- (4) Construct a more suitable laboratory.

The cost of the program would ultimately raise the division's budget to \$3.8 million in annual increments of \$1.2 million.

#### B. Effects

##### (1) Effects on Morbidity and Mortality

It is difficult to estimate unnecessary (or preventable) accidents from the data presented. One would expect the number of accidents to rise if the number of employees rises. In the past, in the U.S., the rate of industrial accidents has likewise shown a long run tendency to rise.<sup>23</sup>

One would expect an industrial hygiene program to reduce the rate of increase of industrial accidents. But the amount is difficult to quantify given the paucity of available evidence.

##### (2) Effects on the Distribution of Income

By maintaining the earning ability of breadwinners, the program would be expected to have a positive effect on the distribution of income.

##### (3) Other Effects

Again, political difficulties would tend to inhibit implementation of such a policy. On the other hand, continuation of the status quo involves its own political dangers as an inequitably hard and dangerous workplace contributes to attitudes of discontent and rebellion.

#### II.1.5 Communicable Disease and Vector Control Programs

##### II.1.5.1 Mass Immunization Programs

<sup>23</sup> See U.S. President, The President's Report on Occupational Safety and Health. Washington, D.C.: Government Printing Office, 1970, pp. 59-88.

## ALTERNATIVE ONE: THE STATUS QUO

## A. Description

A vertical campaign to control infectious diseases dates from 1973. Activities include vaccinations against measles, polio, diphtheria, whooping cough, tetanus and T.B. The target population comprises children between the ages of six months and two years.

## B. Effects

## (1) Effects on Morbidity and Mortality

According to calculations in Appendix A, the following scores would be given.

Expected	Annual reduction in deaths (growing at 3% per year)	=	24 to 46
	Reported disease score	=	.0267
	Outpatient clinic score	=	.0008
	Uncertainty is <u>low</u>		

## (2) Effects on the Distribution of Income

This program directly reduces the burden of child illness imposed on the poor - the time taken for trips to the dispensary, time spent caring for children, cost of medicines, worry and grief.

## ALTERNATIVE TWO: ENTRUST VACCINATION TO RURAL HEALTH AIDS

## A. Description

The rural health aid would be supplied with vaccines, needles and so forth. The mass campaign would be disbanded.

## B. Expected Effects

## (1) Effect on Morbidity and Mortality

Given the training, supervision, and supply and support systems

available to the rural health aid, the program would probably have no effects whatever. There is a chance that morbidity and mortality might rise as a result of the use of improperly sterilized needles.

(2) Other effects would also seem negligible.

#### C. Other Considerations

This program would not be feasible until the rural health aid system were expanded to the whole country.

#### II.1.5.2 Malaria Control

##### ALTERNATIVE ONE: THE STATUS QUO

#### A. Description

The familiar two-prong strategy of house spraying and chloroquinization is no longer working in El Salvador, and the number of reported cases is rising at an alarming rate. This is due, to a great extent, to the fact that a principal vector is immune to DDT. Propoxur, another insecticide, is much more expensive and it must be used much more often to have the same effect. The status quo could be best defined as one of dissatisfaction and search for a better method.

#### B. Effects

##### (1) Effects on Morbidity and Mortality

If this strategy at present funding levels is maintained, malaria prevalence will increase, eventually reaching El Salvador and causing an epidemic, for immunity levels are low and the population is unprepared.

Actual sickness and death depends on the type of malaria transmitted. Of 533,610 blood samples examined in 1976, 83,290, or 15.6% were positive,

and of those positive, 13,369, or 15.1% of the positive results indicated that the infectious agent was plasmodium falciparum, the cause of malignant tertian or aestivo-autumnal malaria.<sup>24</sup> For this type of infection, the case fatality rate for children and nonimmune adults exceeds 10%.<sup>25</sup>

The other forms are life threatening only for the very young. All forms can induce chills, sweating, nausea and headache-repeated every three days or so for a week or a month.

This may be an instance where synergistic effects render published statistics less trustworthy than usual. The infant death rate may, for instance, be much more influenced by malaria than disease specific rates would indicate. A child who dies of diarrhea, for instance, may not have succumbed at all if not previously weakened by malaria. Nutritional status can also be weakened by malarial fever.

#### (2) Effects on the Distribution of Income

Malaria strikes all income classes equally. The poor and rich both suffer from the disease. However, since poor people earn so little, the sacrifice imposed by reduced wages due to absence from work and debility due to the disease might exceed the sacrifice imposed on the wealthy when they are stricken by the disease. In this case, there would be a negative income distributional effect.

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<sup>24</sup> John Stivers, Malaria Component: Health Sector Assessment. San Salvador: USAID, 1977.

<sup>25</sup> Abram S. Benenson, editor., Control of Communicable Diseases in Man. Eleventh Edition, Washington, D.C.: American Public Health Association, 1970, pp. 140-141.

## ALTERNATIVE TWO: INCREASE PRESENT FUNDING LEVELS

## A. Description

A first glance at government expenditures might indicate that, in fact, expenditures have risen. Table II.1.5.1 reveals, however, that when figures are adjusted for inflation, actual expenditures only increased moderately, and Propuxur is much more expensive than DDT. It must be applied more frequently to keep an equal "kill rate". Consequently, a significant increase in spraying would be necessary to take advantage of the efficacy of propuxur. This would involve increased expenditure levels--significantly larger than those actually attained.

Table II.1.5.1 Malaria Control Budgets in El Salvador  
1971 - 1976 (thousands of U.S. dollars)

Year	Malaria Budget at Current Prices	Expenditure Index at Current Prices	Malaria Budget at 1971 Prices	Expenditure Index at 1971 Prices
1971	1,212	100	1,212	100
1972	1,123	92	1,059	87
1973	1,813	149	1,373	113
1974	2,131	176	1,402	116
1975	2,553	216	1,634	135
1976	2,682	221	1,262	104

Source: Price index was derived from the current and constant budget prices provided. Current prices were derived from John Stivers, Malaria Component of the Health Sector Assessment. San Salvador: USAID, 1977.

## B. Effects

## (1) Effects on Morbidity and Mortality

Here one must deal with probabilities - the probability that new residual insecticides will be developed to which mosquitoes are not immune, the probability that the present methods can effectively reduce

the prevalence of the disease by the continued application of the same techniques that have been used in the past - the probability that the new insecticides developed would be no more expensive than present insecticides.

Any attempt to put reasonable numbers on these probabilities, given the history of malaria eradication efforts in El Salvador, would result in a very low expected effectiveness level for this strategy. A recent report of a PAHO study group gives little encouragement to anyone who would expect new and effective residual insecticides to appear with any great frequency in the future.

Unfortunately since a few years the progress made in the screening and evaluation of new pesticides for residual house spraying has been very modest, for two main reasons. First, the industry is facing rapidly increasing research and development costs and is not keen to invest large sums of money for producing new pesticides which may not find a large market, and malaria control does not constitute a large market. Second, WHO has no longer the resources needed to carry on large scale evaluations.

As far as chemicals for residual applications within houses are concerned, we have a few candidates up to stage IV (which is that of evaluation in specially built houses with exit traps) and only one outstandingly promising, one relatively new pyrethroid which is extremely effective and might be used in very low dosages, its safety margin for mammals is being investigated.<sup>26</sup>

In addition, the El Salvador government has other priorities and so does the Ministry of Health. It is doubtful that dramatic increases in funds will be forthcoming, except periodically during, perhaps, the present coffee boom.

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<sup>26</sup> Study Group on Malaria Control in the Americas, Report to the Director. Washington, D.C.: Pan American Health Organization, 1977, p. 13.

ALTERNATIVE THREE: ABANDONMENT OF PRESENT METHODS IN FAVOR OF AN  
INTEGRATED VECTOR CONTROL METHOD

A. Description

The present methods would be abandoned in favor of a new set of activities:

1. Control of waterways and breeding places by removal of brush and weeds, draining, increase of salt content and so forth.
2. Use of larvicidal oils where waterway control is not enough to prevent mosquito breeding.
3. Resort to adulticiding when neither waterway control nor larviciding is capable of reducing the mosquito control level to acceptable levels.

Implementation of such a policy would demand considerable technical assistance. It would also demand more equipment. The estimated technical assistance costs are presented in Exhibit 7, extra equipment costs in Exhibit 8. This suggestion could be implemented in a number of ways - by exchanging personnel with the U.S. American Mosquito Control Association, by short courses or by some combination of the two.

B. Effects

(1) Effects on Morbidity and Mortality

The effectiveness of the program is proven by history. Questions arise, however, about the ability of the government to staff, fund and support an effective program, given that effective prosecution might demand significantly more in the way of funding than is presently contemplated. Estimates in Appendix A assume a 50% level of effectiveness.

Exhibit 7: Estimated Technical Assistance Costs for A  
Vector Mosquito Control Program in El Salvador

<u>Year</u>	<u>Man-Months</u>	<u>U.S. Dollars (Thousands)</u>
1	18	75.0
2	12	50.0
3	6	25.0
4	3	12.5
5	3	<u>12.5</u>
Total		175.0

Source: John Stivers, Consultant Report

Exhibit 8: Annual Equipment Costs for Five Years  
for a Vector Malaria Control Program

<u>Year</u>	<u>Cost (U.S. Dollars in Thousands)</u>
1	400
2	350
3	120
4	315
5	<u>315</u>
Total	1,500

Deaths  
Prevented = between 1.25 and 2

Reported  
Case  
Index = 9.1

Clinic Out-  
patient  
Index = .02

Uncertainty is moderate

In this case, the moderate uncertainty must indicate that the effects can be larger or smaller than presently estimated. In particular, the present estimated death rate from malaria may be low for two reasons. (1) Malaria is coming back, and diagnosticians may not expect it often enough. This implies a diagnosis of some other cause when malaria is, in fact, the underlying cause. (2) Because of the synergistic effects of malaria, other fevers and malnutrition, it may induce deaths properly attributed to some other underlying cause. Because of doubts about the ability to get the program on the road at present funding levels, however, impacts may be less than those indicated.

(2) Effects on the Distribution of Income.

Effects would seem to be neutral except for those discussed under alternative one.

The cost figures in Exhibits 7 and 8 unfortunately, only give an incomplete picture of the total cost of the program, for it would include a number of projects such as the training and support of full time mosquito control teams at the Cerron Grande Dam, at the Cuscatlan Airport complex, the Jalte Peque Project and in each of the five irrigation districts.

In addition, attempts to control levels and salinity of water sources could conceivably impose external costs on the agricultural industry. It would be more expensive, probably, than alternative one, particularly in sparsely settled areas but estimates can not be developed from available data.

## II.2 The Treatment and Rehabilitation System

### II.2.1 The Self Treatment System

#### ALTERNATIVE ONE: THE STATUS QUO

##### A. Description

The first line of defense is self-treatment or treatment by a family member. Murray cites a number of traditional remedies.<sup>27</sup> As in many societies, some remedies are useful, some have no effect, and others are harmful. Notable among the harmful practices is the custom of withholding water from diarrhetic children. This stops the diarrhea. It also tends to kill the child. In general, the treatments listed by Murray betray an ignorance of the germ theory of disease.

The government can intervene in the self-treatment sector by health education activities.

There is a health education division in the Ministry of Health, and health educators are posted, to all the regions (3 to the metropolitan region, and 2 to the rest). Each year a different topic is chosen for a health education campaign. The topic for 1977 is diarrheal disease. The health education division appears to be under-funded. Central level personnel are not adequately educated. When health division personnel

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<sup>27</sup> Murray, p. 153.

seek funds from the Ministry of Health, there are often delays and denials. Other Ministry of Health departments, such as the Maternal and Child Health division seem better supplied with visual aids, comic books and so forth than the department of health education.

Other groups do health education - the Ministry of Agriculture, the Institute for Social Security, FOCCO, the Union Communal Salvadorena and the Asociacion Demografica Salvadorena.

Ideally every health professional is considered a health educator. Often the graduate nurse is scheduled to give a health talk when the rural health team makes its rounds of the health posts. The physician is usually supposed to explain the etiology of a symptom when he prescribes a treatment, and the new rural health aid is expected to give talks to small groups and make home visits for educational purposes.

Yet most of the consultants for the assessment singled out health education as one of the most underutilized weapons in the struggle against disease in El Salvador. In both sanitation and communicable disease control, it was felt that health education components were not receiving proper emphasis in proposed programs. Most consultants commented that the public health potential of educational T.V. had not been realized. The anthropologists spoke of social distance between health center staff members and campesinos which prevented the former from providing as much information as they could to the latter. A sort of consensus seems to emerge from consultant reports that health education should be an area of high priority in future health policy.

## B. Effects

### (1) Effects on Morbidity and Mortality

The fundamental intervening variable is the behavior of the campesino family. Health education has had a positive effect in the past-- for instance, in supporting the mass vaccination campaign. Still, the average campesino seems to have many unhygienic habits, to be ignorant of the germ theory of disease, and to practice some traditional remedies which are harmful. This is true, for instance, of the custom of withholding food and liquid from diarrhetic children. The extent to which the rural health aid will change this is presently unknown. It will depend on the training he receives, on the support that comes to him from other sources, and on a whole host of unquantifiable social factors.

### (2) Effects on the Distribution of Income

Inadequate health education hurts the poor. It hurts them because it hinders their ability to relieve sickness. It also hurts their income as they must pay for treatment of diseases that might have been prevented by better hygiene.

## ALTERNATIVE TWO: DEVELOPMENT OF A MASS MEDIA RURAL HEALTH EDUCATION PROGRAM

### A. Description

The program would have two fundamental components:

- (a) a mass media component
- (b) a rural health team component

The mass media component would include: (1) development of a mass media education campaign in one area from market research to program development to actual broadcasting by radio or television, (2) training a core of

three health educators to broadcast similar programs in the future.

The rural health team component would include organized efforts to secure the cooperation of rural health aids, nurse auxiliaries, and other health post personnel by means of printed material and short meetings - one day or less in which the cooperation of the health team is elicited, the importance of the operation is emphasized and specific activities are suggested. It would also bring regular staff - physicians and graduate nurses as well as RHA's and auxiliary nurses - into contact with a trained health educator. Exhibit 9 contains a preliminary cost estimate.

Exhibit 9. Estimated Cost of a Health Education Package				
	<u>0</u>	<u>Year</u> <u>1</u>	<u>2</u>	<u>Total</u>
Health Educator	22,000	22,000	22,000	66,000
3 Health* Education Mass Media Packages	70,000	70,000	70,000	210,000
Training for 3 people at the Radiophonic School in Bogota	1,700	1,700	1,700	51,000
Training at Agriculture Radio School in Quiriga	1,250	1,250	1,250	3,750
SUBTOTAL	94,950	94,950	94,950	284,850
Contingencies (20%)	18,990	18,990	18,990	56,970
TOTAL	113,940	113,940	113,940	341,820
*Estimated cost of a Manoff International Radio Series.				

## B. Estimated Effects

### (1) Effects on Morbidity and Mortality

The crucial intervening variables would be the hygienic practices of the people resulting from changed knowledge and attitudes. Mass media could affect the knowledge of about 75 to 90 percent of the target population--at least they would be able to answer questions correctly concerning the particular subject matter of the broadcasts.

Researchers in family planning methods, however, have found a phenomenon which they call the KAP-GAP<sup>28</sup>, the difference between levels of knowledge and attitude on the one hand and practice or adoption on the other. With "correct answers" at 75-90%, adopters of family planning have averaged 8%.

A good strategy, in addition to information about hygienic practices, methods of treatment, and the origins of disease, should include cues to action and possible subsidization of activities, commodities, and equipment that will make the self-treatment system more effective in tackling disease.

Communication channels are also important. While mass media can effectively communicate information, interpersonal channels are generally more effective in inducing behavioral change. This facilitates feedback. It also makes the message more credible for it comes from a source more like the people themselves. Communication theorists refer to this as homophily - the degree of similarity between source and recipient in belief, education and background.

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<sup>28</sup> Everett M. Rogers, Communication Strategies for Family Planning. New York: The Free Press, 1973, pp. 43-69.

## (2) Effects on the Distribution of Incomes

The target group will be those who are too poor to afford a good education. The success of the program would affect not only levels of living, but also earning and adaptive ability to the extent that it would affect the earning ability of the adult family members.

### II.2.2.1 Outpatient Care in the Government Sector

#### ALTERNATIVE ONE: THE STATUS QUO

##### A. Description

The status quo is still one of trial, experiment and "learning by doing". It reflects an official disenchantment with the traditional structure of health posts, health centers and hospitals.

In El Salvador, about half the public health facilities are health posts staffed by one auxiliary nurse, one watchman, one supply person and a fee collector with each post. The posts are visited twice weekly by a registered nurse and physician, usually recent graduates putting in the year of public service required by law. The health post staff reports directly to the regional director as do health centers.

The facility closest to the rural family is the health post, staffed permanently by an auxiliary nurse, a watchman and a fee collector. The post is visited twice weekly by a team consisting of a registered nurse and a physician. The health unit has a lab, a dentist who mainly does extractions, and a pharmacy. The health center is really a small community hospital. Finally, the fourteen major hospitals are autonomous units run independently of the health centers, health units and health posts which are regionally operated.

The government is concerned about the low utilization rates of this system, and has instituted two projects to deal with the problem. In September, 1975, twenty rural health aids were recruited and trained. In the beginning, their tasks were limited to taking a census, giving educational talks and visiting homes to find cases that should be referred to the local health post or health center. In April, 1976, seven nurses were trained for an expanded role in maternal and child health and family planning. They were then dispatched to the health posts to conduct a clinic on the day before the doctor was to arrive.

The first evaluation of the Rural Health Leader was performed in the winter of 1975. John Massey summarized the results of the evaluation as follows.

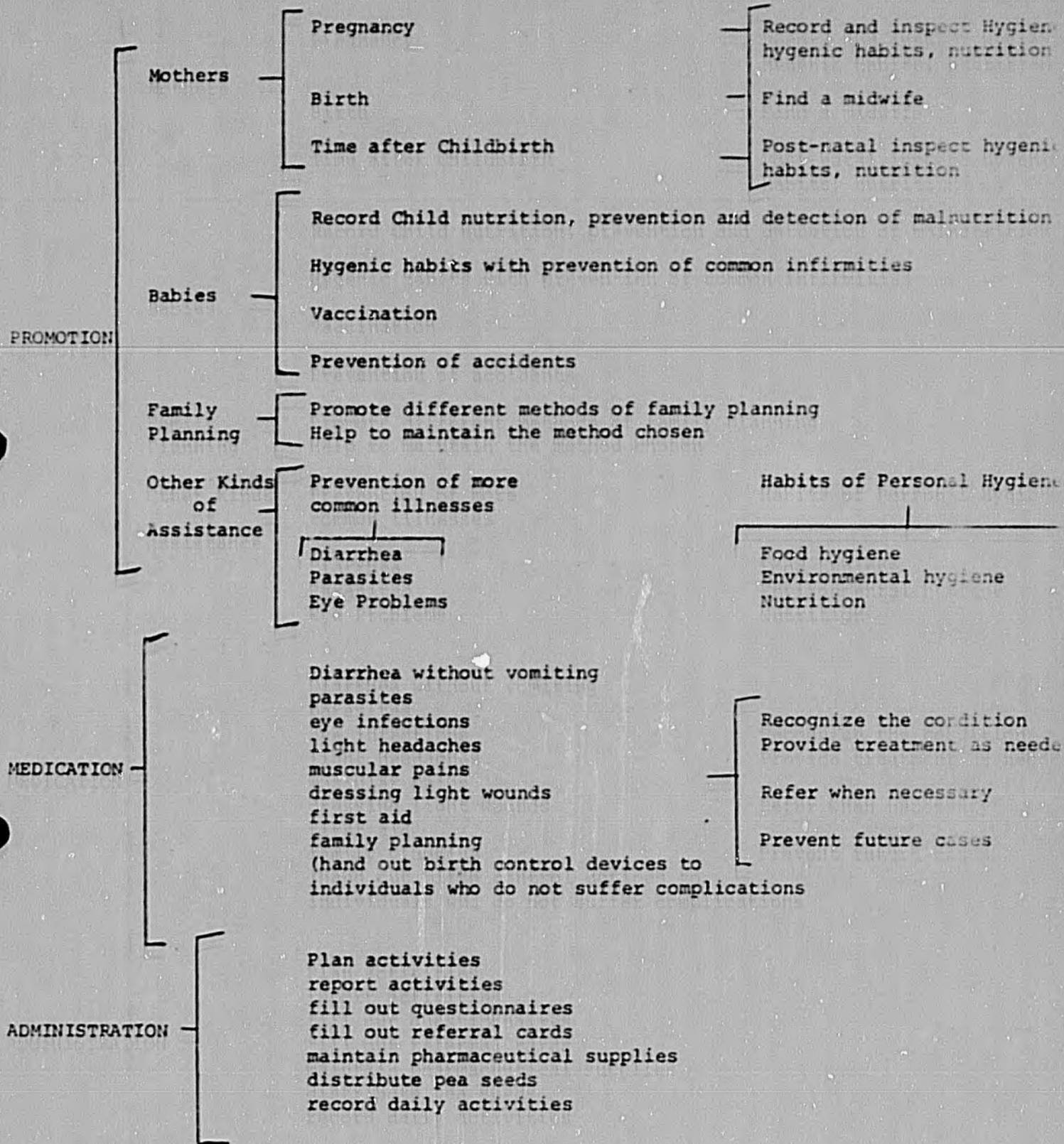
Activity	Goal Week	% Achievement
Home Visits	45	86%
Health Talks	5	41
Group Discussion	3	64

These results suggest that either the Rural Health Leaders sensed the relative worth of the three activities, or they felt more comfortable with one-to-one education activity, and perhaps both. . . . Rural Health Leaders experienced a 24% success rate overall in terms of referrals made and referrals actually seen at the pilot health services facility . . . . Prenatal and well-child visits increased 7% and 8% respectively during the study period. . . . IUD acceptor rates remained essentially static but pill acceptors increased approximately 19% . . . . Increases in health post coverage of eligible populations for various vaccinations. . . . ranged from 4% to 8%.<sup>29</sup>

The job description of the rural health aid has been changed so that, in addition to promotional activities, his assigned set of tasks now includes the provision of simple medical care. The new set of activities is summarized in Figure II.2.1.

<sup>29</sup> John A. Massey, Curriculum Design for the Ayudante Comunal de Salud Washington, D.C.: American Public Health Association, 1976. pp. 12-13

Figure II.2.1



Source: Departamento de Formacion y Adiestramiento de Recursos Humanos, Programa de Adiestramiento Para Ayudantes Rurales de Salud. San Salvador, 1976.

(The Government's plans for expansion of the Rural Health aid are summarized in Table II.2.1).

Table II.2.1 Projected Expansion of the Rural Health Aid Program in El Salvador

Year	Number of New Aids	Total Working Aids
1976	40	40
1977	80	120
1978	180	300
1979	200	500
1980	500	1000

Source: Robert Lawrence, Health Sector Assessment: Human Resources Planning. San Salvador: USAID, 1977 (mimeo) pages unnumbered.

No allowance seems to have been made for death and/or attrition. Nor is the projection tied in with any realistic training scheme. Assuming a 3 percent rate of population growth, and projecting the 1975 population to 1980, an estimate of the total rural population would be  $1.6 \times 4,741,431 = 2,844,859$ , or a need for 2,845 rural health aids, so that between one half and one third of the rural population would be covered by 1980, on the optimistic assumptions included in the table - that no one dies and no one drops out.

The aid is chosen by the local community. He must have at least six years of primary education, and he receives six weeks of training for his job. The Rural Health Aid Training Program seems designed according to

generally accepted principle of setting behavioral objectives and designing course content to "produce" an aid with the competencies designed to do the tasks outlined in the job descriptions.<sup>29</sup>

The rural health aid is to be supervised by the local supervisor of the malaria control program. His salary is about 190 colones (\$80) per month, and he receives a small payment for the contraceptives that he distributes.

The expanded role nurses will be members of the mobile teams that travel from one health post to the other during the course of the week. The nurse arrives a day ahead of the doctor and conducts a clinic. Although official evaluation data are not available, Ministry of Health officials seem satisfied enough with the plan to want to continue the experiment.

#### B. Effects

##### (1) Effects on Morbidity and Mortality

Appendix A summarizes much of the available literature on the topic. The evidence is not conclusive, but it does seem reasonable to assert that a well-organized rural health care program based on physician extenders can reduce the infant death rate, at best, to 55 per thousand. It can also provide effective curative services for a limited range of adult diseases of which tuberculosis is the most notable.

The auxiliaries' effectiveness seems dependent on a number of factors which can be controlled or modified by policy decisions. These include: (1) The method of personnel selection; (2) the number and intensity of services; (3) Training; (4) supervision and motivation; (5) logistical

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<sup>29</sup> John A. Massey, Curriculum Design for the Ayudante Communal de Salud. Washington, D.C.: American Public Health Association, 1976.

support and supply. The probability of success, in so far as it is subject to control, would be increased to the extent that the government takes advantage of present knowledge in these areas. Policies, as they appear at present, will be discussed in each of these areas.

(1) Selection of Personnel

There are two principles of personnel selection in the literature. One is that the physician extender must be capable of learning the tasks he or she is supposed to perform. Fendall suggests a schooling range of from seven to nine years.

There is, however, a certain "trade-off" between rigidity in selection criteria and length and type of training.

. . . schooling must be adequate for superimposing the technical content of training. Provided there is a base-line of reading, writing and arithmetic, limited on-going general education can be incorporated within the technical training courses.<sup>30</sup>

The requirement of six years of primary education does seem adequate measured by this standard.

The second principle is that the physician extender should be acceptable to the local population. The fact that the RHA is chosen by the community should make him acceptable.

(2) Type and Intensity of Services: the Job Descriptions of the Rural Health Aid, and the Other Members of the Health Team

At least one study found that the effectiveness of the system was quite sensitive <sup>31</sup> to the type and intensity of services offered to the

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<sup>30</sup> N.R.E. Fendall, Auxiliaries in Health Care: Programs in Developing Countries. Baltimore: Johns Hopkins Press, 1972, p. 177.

<sup>31</sup> Rural Health Research Center, Narangwal, Punjab, India; The Narangwal Population Study: Integrated Health and Family Planning Services. Baltimore: Johns Hopkins University, Dept. of International Health, 1975, pp. IV.D.1-IV.D.12.

population. For the reduction of infant mortality, infectious disease control activities had a demonstrative effect when combined with intensive home visiting and surveillance. Comprehensive care, as such, seemed to have little effect on infant mortality. Intensive home visiting seemed to have an effect because it increased the probability that a sick child would be seen by someone trained in modern medicine. For pre-schoolers nutrition and supplementary feeding programs had a significant effect when combined with infectious disease control. Positive health as measured by height and weight was fostered more by nutrition services.

The job description of the aid stresses home visiting. Much of the infectious disease control is left to the health posts and nutritional activities are limited to the passing out of peas for the campesinos to plant.

The method of developing a job description in El Salvador uses a laudable incremental approach. It seems deficient, however, from an analytical point of view. All initiatives seem based on the examination of past mistakes. Most needs, of course, are well known. Still a job description based on formal analysis would seem to reduce the possibility of error in many respects. As it is, the Salvadorean process seems to involve considerable effort to "reinvent the wheel."

There is danger that the health aid's job description will fail to maximize his potential.

### (3) Training and Motivation

The job description of the rural health aid has evolved from that of a "promoter" to that of a health auxiliary in the full sense. The training of the auxiliaries in the programs analyzed in Appendix A was considerably

longer than the six weeks presently envisioned for the rural health aids. Fendall suggests three months. The training should include "on-the-job" experience in diagnosis and treatment under the supervision of someone who is both skilled and demanding.

Polly Harrison, in her investigation of the health aids' perceptions of their own performance, found that the aids felt uniformly that the training period had been too short. "In particular, they felt themselves incompetent, on the whole, to deal with sanitation education, to handle small curative demands, to do injections or vaccinations or to give first aid."<sup>32</sup> In a separate survey of community response, she found evidence of considerable misgivings. The campesinos qualified their approval by saying that their use of a rural health aid would depend on his training and experience. Even then, they would only use him as a last resort.<sup>33</sup>

A poorly trained person can not only err in the direction of poor diagnosis, but he can also cause harm by giving injections with unsterilized needles and spreading infectious hepatitis, by inserting the needle into the wrong nerve and causing paralysis, by careless use of antibiotics. It has been shown that with adequate training the potential gains of using an auxiliary outweigh the potential losses. The question is whether the El Salvador rural health aids, in particular, will receive adequate training. There is a distinct probability that their training, even as presently amended, is inadequate.

#### (4) Supervision

Good supervision begins at the highest policy-making levels. As Peter Drucker has written:

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<sup>32</sup> Harrison, p. 152.

<sup>33</sup> Ibid., p. 156.

The first-line supervisor is not, as the overworked catch phrase has it, "management to the worker". The engineering of the job and the organization of people for work; the presence or lack of proper motivation; the employee's economic relations to the enterprise; the spirit, principles and practices of an organization, are not determined by the supervisor or even greatly influenced by him. They originate in top management--and the worker knows it. Even the best supervisor is no substitute for poor principles and practices in managing workers. To overemphasize his importance, as current management oratory tends to do, may cause harm; for it sometimes leads management to content itself with haranguing the supervisor to do a better job in the mistaken belief that it is thereby discharging its responsibility for managing workers.<sup>34</sup>

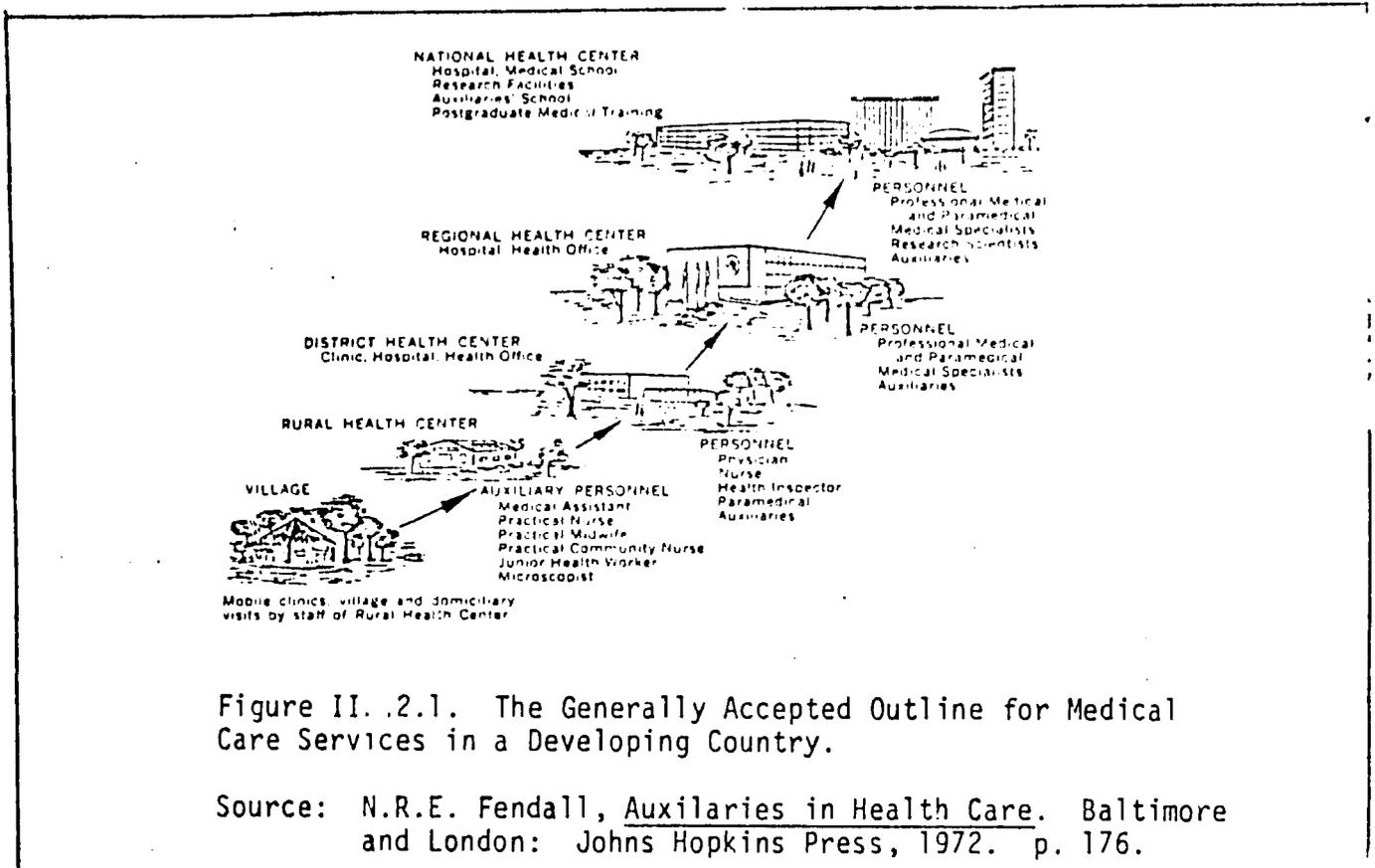
Two reflections are necessary on the supervisory situation in El Salvador. First, the chain of authority and responsibility differs sharply from that of the few rural health systems in which successful disease reduction has been demonstrated. Second, in no system has the job of the supervisor been as adequately defined as Drucker insists that it should be.

The usual chain of supervision and referral is that illustrated in figure II.2.1. The chain of referral leads up from the auxiliary in the village to the health post, to the health center, to the district hospital. The chain of supervision comes down from the national health center to the district hospital and so forth. In El Salvador, the rural health aid is supervised by the local malaria control supervisor, and he refers to the health post. On the other hand there is no referral system from the health post - health center network to the hospitals. There are two possible sets of problems: one arising from the faulty chain of supervision; the other from the faulty chain of referral. The malaria supervisor may not be able to give the type of support needed for one involved in the essentially interpersonal "caring and helping" role which has been

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<sup>34</sup> Peter F. Drucker, The Practice of Management, New York and Evanston: Harper and Row, 1954, p. 319.

given to the rural health aid. In particular, he may not be able to help when the aid is puzzled or confused about a difficult diagnosis or treatment problem. The weak links in the referral chain could mean that a patient who is referred may not receive effective treatment.



An additional problem arises from the fact that the medical doctors and registered nurses who staff the rural outposts are young and inexperienced. The experienced doctors who are capable of supervision are either in private practice or in the hospitals.

In addition, there does not seem to be any opportunity for advancement. This also violates one of Drucker's principles.

Promotional opportunities for the supervisor are also important for his performance as a manager of workers. They largely determine whether he will be motivated to strive for peak performance, or whether he will just strive to get by and stay out of trouble.<sup>35</sup>

Turnover among rural aids is quite high. The aid's logical supervisor is a nurse practitioner. The present system seems to ignore the motivational aspects of keeping either a nurse practitioner or a rural health aid on the job, and of giving them the supervision that will permit them to grow in competence and self-confidence. The evidence that does exist on physician extenders tends to indicate that they achieve their potential only after a considerable amount of supervised experience.

#### (5) Support and Supply

Without modern drugs and medicines, neither modern medical systems nor scientifically trained manpower have much efficacy against the ravages of disease.

The drug and supply system that presently exists is recognized as deficient. Budgeted funds are inadequate.<sup>36</sup> Hospitals order their own drugs and as a result are unable to take advantage of savings from bulk purchases. Finally, there is no system of inventory, storage and control so that many perishable items are kept past their last date of use.<sup>37</sup>

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<sup>35</sup> Drucker, op. cit., p. 323.

<sup>36</sup> Jose Gonzalez, Review of Administrative Practices in Selected Hospitals in El Salvador, as Part of a Health Sector Assessment. San Salvador: USAID, 1977, p. 7.

<sup>37</sup> Robert C. Bradbury, Health Administration in the Ministry of Public Health and Social Welfare in El Salvador. San Salvador: USAID, 1977, p. 29.

Obviously, this reduces the effectiveness of the system.

Table II.2.2 contains a list of the expected annual supply needs for 1500 Rural Health Aids.

Table II.2.2. Estimation of Cost for Contents of First Aid Kits for 1500 Rural Health Aids

Contents of the First Aid Kit	Unit of Measure	Cost Per Unit \$U.S.	Estimated Annual Usage for 1500 Aids	Annual Cost in \$U.S.
Aspirin 0.5 gr.	thousands	\$ 2.00	2,250	\$ 4,500
Aspirin 0.1 gr.	"	3.44	1,125	3,775
Mebendazole	"	60.00	2,025	121,500
Anti-diarrhetic Tablets	"	22.00	2,250	49,500
Anti-diarrhetic Suspensions	litre	1.88	22,500	42,300
Merthiolate	litre	0.96	1,125	1,080
Aplicaps of Cloromycetin	hundred	2.90	11,250	32,625
Surgical Gauze	"	2.34	11,250	26,212
Oral Serum	"	15.20	5,625	85,500
Absorbent Cotton	"	14.00	2,813	39,382
Adhesive Bandages	Roll	0.172	11,250	1,935
Swabs	hundred	0.44	11,250	4,950
				\$413,475
10% increase for special packing				\$ 41,347
TOTAL				\$454,822

Source: MOH Records.

The estimated annual cost for first aid supplies for one aid would be \$303. The list of supplies contains chloromycetin, the Parke-Davis brand name for chloramphenicol, an extremely dangerous drug that can cause aplastic anemia. It should be used only for the treatment of typhoid fever. It is difficult to see why it is included in the Rural Health Aid's kit. Ampicillin, for example, would seem less dangerous and more useful.

### Conclusions

The following factors would tend to enhance the effectiveness of the Rural Health Aid:

- a. The selection mechanism appropriately emphasizes literacy and community acceptability.
- b. An intelligent method of "incrementalism" is being employed to try to develop a "fit" between job description, training and effectiveness.

The following factors would limit his effectiveness:

- a. Methods for developing job descriptions and training curricula are not based on scientific needs assessments. Nor do they take adequate advantage of the experience of other countries.
- b. Supervision is likely to be inadequate.
- c. Support and supply systems seem inadequate.
- d. Training, at present, is inadequate.

The indexes developed in Appendix A are:

Estimated Death Reduction Range	=	0 - 193
Outpatient visit Score	=	0

Reported Disease  
Score = 0

Uncertainty would be high

(2) Effects on the Distribution of Income

By creating a position for a member of the low income rural community, the program, if it pays an adequate salary to the rural health aid, acts directly to correct the distribution of income.

To the extent that it makes the medical care system more accessible to the people toward the bottom of the income distribution ladder, then it makes any improvement in the system beneficial to the lower income classes.

ALTERNATIVE TWO: DEVELOPMENT OF A CAREER STRUCTURE

A. Description

A program that offers possibilities of advancement must have two components - opportunity for in-service education and training, and a strong licensing system. Without the former, personnel have no opportunity to develop a background that will permit advancement. Without the latter, promotions are likely to become automatic, eroding quality and introducing wage inflation. According to Drucker, the important thing for morale is that people have a chance to move up. Whether they actually do so is another matter, particularly if criteria for advancement are both fair and impersonal.<sup>38</sup>

The program would include:

- (1) Salary incentives, opportunities for foreign study and the chance of advancement in the MOH for doctors who take supervisory and training positions in rural areas.

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<sup>38</sup> Drucker, p. 323.

- (2) Short courses for RHA's and auxiliary nurses.
- (3) Scholarships for outstanding auxiliary nurses - to go on for further training, or even to medical school.
- (4) Posting of auxiliary nurses to health posts in pairs.
- (5) Periodic examinations that would permit the RHA to move into the ranks of the auxiliary nurses.

#### B. Effects

##### (1) Effects on Morbidity and Mortality

A priori, one would suspect that in the long run a rural health care system with a career ladder would keep personnel in the system longer, would tend to upgrade their skills and would consequently reduce morbidity and mortality to a greater extent than a system without such a program.

##### (2) Effects on the Distribution of Income

The program would offer a wider set of career possibilities to rural health workers. This automatically affects the stream of expected earnings and the wealth position of the individuals involved.

#### II.2.2.2 Outpatient Care in the Private Sector

##### ALTERNATIVE ONE: THE STATUS QUO

#### A. Description

The private sector would include the set of health care activities performed by physicians on a fee for service basis, by rural curanderos and other traditional practitioners, by midwives and by pharmacists. Little is known about this sector, and some of the conventional wisdom is inconsistent. For instance, it is maintained that 80% or more of the health care is provided by the government, but that neither the Ministry of Health nor the Social Security System has many full time doctors.

The rural curandero, in so far as he depends on traditional medicine, does not seem to command the same respect in El Salvador as he commands in some other Latin American countries. He is called upon for treatment of illnesses believed caused by sorcery. But the average campesino seems convinced of the superiority of modern medicine for the treatment of physical ailments. There are, however, unlicensed practitioners of medicine. Of importance, from the public health point of view, is the inyeccionista, who specializes in giving shots. If this individual is unaware of antiseptic measures necessary to sterilize needles, then he is probably spreading infectious hepatitis.

There is evidence that the physician, when he finishes his required 30 hours in a local health post, will then see patients for a fee. Since the queues are so long during the "fee hours" (there is a nominal charge of one colon per visit during government hours), the patients are turned away and forced to pay to see the doctor in his "moonlight" time.

About three-fourths of the children in El Salvador are born at home. This makes the rural midwife one of the most important members of the non-government health sector. Almost 60% of these midwives are illiterate.<sup>39</sup> In the status quo situation, the government does not ignore midwives. A training manual is being prepared, and the government has offered courses for them in the past. The present (status-quo) alternative would envision a continuation of these efforts. Impartial commentators seem to consider these efforts relatively ineffective in changing the behavior of

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<sup>39</sup> Robert Lawrence, Health Sector Assessment: Human Resources Planning. San Salvador: USAID, 1977, no page numbers.

the midwife. The present strategy seems to have little effect in changing unsanitary practices that must contribute to infant mortality. In addition, it fails to profit from the positive contribution that could be made from the rural midwife if she could be integrated into the health post team as an active member.

Most pharmacists not only sell medicines, but they diagnose and prescribe. An anthropologist describes the process as follows:

It is not reported that they generally go to the patient's houses. The patients come, rather to them. But by the same token perhaps fewer than half of the diagnoses they make are done in the actual presence of the patient. What occurs frequently, rather, is that the patient will be left in the rural canton, and a member of the family will go to town and will describe the symptoms to the pharmacist, who will then prescribe.<sup>40</sup>

The consultation fee appears to be about \$2.00 (₡5). If the patient simply asks for the medicine without the consultation, he does not need to pay this fee. Indeed, the rural dweller will refer to the pharmacist as "doctor privado" or "doctor particular". No one seems to know how much training the pharmacist has. The anthropologist seems to suspect that economic resources are more important than training in the attainment of that position. His evidence is based on his experience in one community in addition to a certain amount of hearsay. However, he himself admits to the existence of rumors that the pharmacist is often a medical student who failed to finish his course, or someone else with a considerable amount of education. Little is known about the pharmacist except that he is a major source of medical care for the rural population.

The major elements of the non-government sector that raise problems for the rational provision of treatment and services are:

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<sup>40</sup> Murray, p. 160.

1. Some folk practices are definitely dangerous to the health of infants, and would yield before a health education campaign.
2. From the government's point of view, the pharmacist is a question mark. The people seem to consider him superior to the health post as a source of medical care, and they are willing to pay for his diagnosis and advice.<sup>41</sup>
3. The midwife could have a significant effect on infant mortality and morbidity, but present government efforts to upgrade her skills have been ineffective.

#### B. Effects

##### (1) Effects on Morbidity and Mortality

On balance, the pharmacist probably reduces morbidity and mortality. There may be some morbidity and mortality arising from incorrect diagnosis or incorrect use of drugs. But this probably happens at the health post also. He makes modern medicines available in the rural areas, and in this sense he may supplement the health post. Bureaucratic tangles and underfinancing undoubtedly lead to drug shortages at the health post level. In addition, the pharmacist seems more capable of helping the laboring man while the government system, with its emphasis on maternal and child health, and regular daytime hours seems more oriented to caring for women and children.

The rural midwives probably reduce some morbidity and mortality also, but their illiteracy and lack of training means that they do not achieve their full potential. They probably cannot spot difficult cases early enough and ignorance of the germ theory of disease and the consequent

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<sup>41</sup> Murray, p. 168.

importance of antiseptic procedures implies that they do not prevent as many infections as they could - and infant infections can be fatal.

## (2) Effects on the Distribution of Income

Pharmacists as well as doctors "moonlighting" cost the campesino more than the "regular" government service. To the extent that he may receive better care in the private sector, however, he may not be worse off. Nevertheless, money spent on medical care is money that cannot be spent on food, clothing and so forth. The private sector would at best have a neutral effect on the distribution of income, and at worst, have a negative effect.

## ALTERNATIVE TWO: A PROGRAM TO INTEGRATE MIDWIVES INTO THE RURAL HEALTH TEAM

The proposed program is reproduced in Exhibit 10.

Exhibit 11 contains a brief list of some anticipated positive and negative points about the program.

## ALTERNATIVE THREE: PROGRAMS TO UPGRADE THE LEVEL OF CARE GIVEN BY THE PHARMACIES

### A. Description

Such a program would seem to include two elements: information and licensing. One consultant has suggested that the pharmacists receive the same manuals that are given to the rural health aids. It could also be possible to make the pharmacist pass a certain test in order to be able to dispense with certain medicines.

### B. Effects

#### (1) Effects on Morbidity and Mortality

The provision of manuals would seem to have a positive effect on morbidity and mortality because they would reduce to an unknown extent the probability of an erroneous diagnosis on the part of the pharmacist.

Exhibit 10: A Program to Integrate Midwives  
Into the Rural Health Team

- a) Establishment of goal of trained, licensed and supervised midwives with explicit ties to health post.
- b) Provision of one bed in health post and permission for use by such midwives for deliveries when conditions of hygiene in the home of the parturient present high risks to health, or when home of the parturient present high risks to health, or when delivery complications arise too late for hospital assistance.
- c) Expansion of trainee universe to younger women, identified by midwives themselves and by health post staff, and to paramedics such as injectionists who are interested and motivated to expand their health skills.
- d) Intensive training in regional offices, with per diem and travel allowances for carefully selected midwife trainees. Precede training with baseline test on beliefs and knowledge so that, if number of personnel permit, the less- and more-advanced can receive the education which accords with their needs. Learning should also be tested during and at end of course and through selective field monitoring.
 

Emphasize areas identified in Claros study as particularly weak, especially danger signals, referrals to clinic or hospital, recommendations for controls, family planning, and sex education. If courses are not to be held in regional offices, design standard curriculum for clinic teaching use which includes summary of Claros findings.
- e) Provision of basic tool kits (scissors, gloves, clock, nail-brush) on credit at low cost, including checklist of other basic supplies, contraceptives, and cap/apron/pin bestowed at end of successfully completed course.
- f) Provide pregnant mothers who are going to use midwife with list of necessary and desirable equipment for both mother and midwife, and promote use of known, trained practitioner.
- g) Sponsor research, perhaps by university level students of botany and pharmacy, into traditional medicines, especially those related to pregnancy and childbirth, with the goal of identifying beneficial, harmless, and dangerous ingredients and uses.
- h) Sponsor investigation into reasons why midwives continue in traditional beliefs and behaviors, the central research question being the degree to which the maintenance of these derives from conviction and the degree to which it derives from lack of knowledge of alternative procedures.

Exhibit 11: Anticipated Positive and Negative Points About  
Integration of Midwives Into the Rural Health Team

1. Positive Points

- a. Reduction in neo-natal death rate due to:
  - gradual termination of unsanitary midwife practices
  - better referral of difficult cases
- b. Reduction in the need for hospital beds.
  - the midwife might be less expensive to the family, and the expressed preference for hospital births might be reduced. (This is a rather complex matter, see Harrison, p. 100).
  - Currently, personnel of the health center are stressing the value of a hospital birth. One would expect, then, over the long run, a tendency for an increase in the percentage of births that take place in hospitals if the midwife were integrated into the team.

2. Negative Points

- a. The cost of midwife services to the family might rise as a result of the professionalization of the midwife.
- b. The operating cost of the clinic might rise, and the budget of the health ministry would need to rise to take account of the training and supply costs for midwives.
- c. There would be a significant and unknown time lag before the beneficial results would become visible. The impact of the training and information would depend on a number of complementary factors - the general educational level of the community, other health education programs, the age of the midwife, experience with new procedures, even when accepted, and so forth.

The effect of licensing is not clear. It is difficult to see how it could improve the situation. It would pose problems from the point of view of the power realities that seem to exist. The pharmacist obviously poses a threat to the government health sector personnel. He delivers what they cannot deliver. Licensing and prescription requirements would definitely limit his ability to respond to the needs of the moment, and hence to reduce morbidity and mortality, especially in emergencies. In addition, licensing would increase the ability of the government sector personnel to gain monopoly power over medical care in rural areas, and hence the "moonlighting" doctors could more easily raise their fees for patients seen outside regular hours.

#### (2) Effects on the Distribution of Income

The effects of handing out manuals or engaging in other educational activities would generally be considered neutral. The only positive effect would seem to arise from the fact that the rural pharmacy is the main source of medical care for the wage-earning population, and anything that would increase the pharmacist's effectiveness would increase his ability to maintain the earning power of the family in the lower levels of the income distribution scale.

### II.2.3 Inpatient Care

#### ALTERNATIVE ONE: THE STATUS QUO

The Ministry of Health provides inpatient care through 14 hospitals and 9 health centers. The largest hospital seems to be Hospital Psiquiatrico with 904 beds, and the smallest, the Hospital of Chalatenango with 109. Ten of the fourteen hospitals have fewer than 500 beds. The number

of beds in the health centers ranges from 60 to 80.<sup>42</sup> The Social Security System operates two hospitals, the Ministry of Defense one, and National Administration of Telecommunications one. The Social Security System, serves about five or six percent of the population and the Ministry of Health is said to serve most of the rest. Utilization rates for various specialties range between 77 and 89 percent.

As noted in the discussion of inpatient care, there are severe coordination problems in the health sector. Hospitals, even in the Ministry of Health, are independent of the Health Post system. They even seem to be independent of one another, leading, it seems, to duplication and waste. The government is quite aware of this, and any description of the status-quo must recognize the fact that as far back as 1974, a National Commission of Health was created and charged with the task of developing a true National Health System.<sup>43</sup>

Facilities and equipment seem to be in universally poor condition. At Santa Ana hospital, which serves the second largest area in the country, the operating room's capacity has been cut in half due to the poor condition of anesthesia machines and accessories. At Usulután Hospital, built only four years ago, there are already several pieces of non-functioning equipment. The lack of trained technicians seems to be seriously reducing the ability of the hospitals to do what they were

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<sup>42</sup> Anuario, Salud Publica in Cifras, pp. 21-22.

<sup>43</sup> Jose Gonzales, Review of Administrative Practices in Selected Hospitals in El Salvador, As Part of a Health Sector Assessment. San Salvador: USAID, 1977, p. 17.

designed to do. In addition, drugs and supplies are often minimal or lacking, administrators untrained and quality control virtually non-existent.<sup>44</sup>

In general, the Social Security hospitals seem to be in better shape than the Ministry of Health hospitals, all of which may indicate that underfunding is at the root of the problem in the Ministry of Health.

The consultant gives the following description of the quality of inpatient care in the hospitals.

There are two obvious levels of patient care provided at all hospitals. Indigent patients are housed in large, often crowded, open wards, with little attention paid to their privacy, dignity or comfort. Some beds sag or are in poor state of repair. Mattresses are often soiled or ripped and are rarely protected by covers. Bedside tables are often not available. In several institutions, beds actually touch each other. In the obstetrical services of most hospitals, one can observe two patients sharing one bed.

Pensionado patients enjoy preferential treatment. They are generally hospitalized in private rooms which also contain a cot for accompanying spouses or relatives. Such accommodations are generally reasonably attractive.

Much of the care provided can be best described as custodial. Few instances were observed of patients actually being treated by a physician or nurse, except for occasional intravenous infusion sets being administered.<sup>45</sup>

Infectious wastes from the hospitals are dumped into ordinary waste disposal areas where the poor people scavenge for items they can use. As a consequence, there is a considerable likelihood that hospitals are spreading disease among the population.<sup>46</sup>

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<sup>44</sup> Ibid., pp. 18-22.

<sup>45</sup> Ibid., p. 23.

<sup>46</sup> Victor Wehman, Water Supply and Environmental Health Sector Assessment. San Salvador: USAID, 1977, p. 42.

## B. Effects

### (1) Effects on Morbidity and Mortality

On balance, the hospitals would seem to be reducing morbidity and mortality. The probability, for instance, of a sanitary birth would still seem higher in a hospital than anywhere else. The skills of a surgeon are still available only in a hospital.

Nevertheless, the potential of the hospital is not realized. If equipment is out of order, it cannot, obviously, serve its purpose of curing and correcting, and hence the efficiency of the hospital is reduced.

More seriously, many of the conditions described above can cause disease and death. Staphylococcus infection is more likely if antiseptic procedures are not carefully enforced, and, given the absence of quality control, they do not seem to be. In addition, there is the possibility that inadequate disposal of wastes spreads disease outside the hospitals and among the poor.

### (2) Effects on the Distribution of Income

In addition to the well known problems of access arising from the fact that hospitals are located in urban areas and hence less available to country than to city dwellers, there is the problem of differential treatment discussed above. It seems obvious that the hospital system serves the poor less adequately than the rich.

## ALTERNATIVE TWO: INSTITUTE A TRAINING AND MAINTENANCE PROGRAM

### A. Description

This could be conceived of as a personnel program. The elements are contained in Exhibit 12.

Exhibit 12: Elements of a Training  
and Maintenance Program

<u>Element</u>	<u>Cost</u>
1. Inservice Training Using AHA Manuals	
(a) Faculty seminars	19,000
(b) Instructor training	38,000
(c) Purchase of manuals	<u>13,000</u>
Sub-total	70,000
2. Training of 14 Maintenance and Sanitation Teams of Three Men per Hospital (two weeks)	3,800
Sub-total	<u>73,800</u>
3. Annual Recurrent Expense	
Salaries	67,200
Refresher Courses	<u>2,000</u>
Total Recurrent	69,200

At a discount rate of 10%, the present value would be 765,800.

## B. Effects

### (1) Effects on Morbidity and Mortality

The program would be expected to reduce morbidity and mortality through two assumed causal sequences. First, by introducing more sanitary measures, the program would reduce the probability of infectious disease arising from faulty sanitary practices. Second, by maintaining more hospital equipment in a working condition, it would increase the effectiveness of the hospital staff in their efforts to treat and rehabilitate.

### (2) Effects on the Distribution of Income

Sanitation, particularly sanitary disposal of hospital wastes, would seem to benefit the poor. The maintenance of equipment would seem to be neutral in effect or to benefit the upper classes, given the differential character of treatment in the hospitals.

## ALTERNATIVE THREE: EXPANSION OF THE SOCIAL SECURITY SYSTEM

### A. Description

Not much in the way of concrete information has been presented about the Social Security System, though all the consultants seem to agree that some advantage would exist in expanding the system.

An expansion would involve first of all an increase in the "covered" population and a consequent increase in revenues for the Social Security System. This would be true no matter what form the expansion might take. The potential methods for using the new funds generated would vary. At one extreme, the Brazilian pattern might be followed and the Social Security System would pay lump sums to the different rural health care institutions.<sup>47</sup>

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<sup>47</sup> M. V. Bastas, "Brazil's Multiple Social Insurance Programs and Their Influence on Medical Care," International Journal of Health Services, (1971), Vol. 1, No. 1, pp. 378-389.

On the other hand, a National Health Service could be created under social security auspices on the Chilean pattern.<sup>48</sup> An elite full-time corps could be developed structured the same as the Ministry of Health rural health teams. Or the Social Security System could purchase pensionado status for its clients. The pros and cons of these and/or other systems could be debated and the system most adapted to the solution of Salvadorean problems could be selected.

## B. Effects

### (1) Effects on Morbidity and Mortality

Since many of the MOH problems seem to proceed from lack of funds, social security funds coming into the system should increase its efficiency, and hence its effect on morbidity and mortality. If a National Health Service, staffed by full time personnel were developed, there would be a power base to bias expenditures in a more preventive direction than now seems possible.

### (2) Effects on the Distribution of Income

As noted earlier the so-called "working class elite" would be considered low income in any realistic value system so some statements about "equality" are somewhat wide of the mark anyway.

Social Security is financed by funds that would not be available for health care if they were not channeled to Social Security recipients. Arguments that social security benefits the few at the expense of the many are, therefore, usually unfounded--Unless the Social Security System

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<sup>48</sup> T. L. Hall and S. Diaz, "Social Security and Health Care Patterns in Chile," International Journal of Health Services, (1970), Vol. 1, No. 4, pp. 362-377.

draws health manpower from equitable activities that serve the poor.<sup>49</sup> This seems unlikely in El Salvador at present since the doctors and nurses serving the poor are fulfilling the requirement for the año social. On the other hand, the payroll tax has a regressive impact and this regressive effect must be weighed against the progressive effect of the improved medical care that could be made available to low income groups.

### (3) Other Effects

Expanded Social Security financing would lead to increased utilization rates and a consequent expansion of investment in the health sector. Social Security financing, in the absence of strong measures, such as the creation of a National Health Service, would tend to foster an emphasis on curative rather than preventive care.

## ALTERNATIVE FOUR: INSTITUTION OF CITIZEN AND ADMINISTRATIVE BOARDS TO FOSTER INTER-INSTITUTIONAL COOPERATION

### A. Description

Two types of organization are envisioned. A national commission for improvement of hospital care would be composed of prominent and distinguished professionals from all walks of life. The commission would consider such topics as minimum standards for hospitals, training programs, replacement of physical plants, changes in social security laws, and so forth.

The other type would be more professional, a hospital association, affiliated with the International Hospital Federation. Its membership would include representatives from all hospitals of all kinds in El Salvador.

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<sup>49</sup> Alan Sorkin, Health Economics in Developing Countries. Lexington, Massachusetts: D.C. Heath, 1976, p. 118.

The Federation "would be in a position to coordinate efforts with the El Salvador Hospital Association toward the development of hospital training programs, scheduling seminars and other activities of value to hospitals, particularly during the developmental phase of the proposed hospital organization."<sup>50</sup>

## B. Effects

### (1) Effects on Morbidity and Mortality

The ultimate effect would be an increase in the ability of the hospitals to treat and rehabilitate. The organizations would be expected to facilitate coordination between institutions, enforce quality control standards and enhance the ability of the Ministry of Health to obtain funds.

### (2) Effects on the Distribution of Income

Generally these programs would benefit those who could afford hospital care.

If the referral and supervision system were affected in some way that would aid the Rural Penetration Program, however, the program might have a beneficial impact on the poor.

## II.3 Training and Research

### II.3.1 Training

#### ALTERNATIVE ONE: THE STATUS QUO

##### A. Description

Health training facilities consist of: a medical school with an attached medical technology school; two schools for registered nurses, one in San Salvador and the other in Santa Ana; four schools for training of

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<sup>50</sup> Gonzalez, p. 27.

auxiliary nurses and; a health training school for short courses. Each year, the system graduates between 250 and 300 doctors, about 100 registered nurses and 200 auxiliary nurses. The health training school gives about 30 short courses averaging 3 to 6 days in duration. In addition, there are the courses for training rural health aids and expanded role nurses mentioned in previous sections.

#### 8. Effects

A number of gaps in the training system have become obvious from an examination of the treatment and rehabilitation system. These include:

1. A shortage of trained administrators at all levels.
2. Unnecessary "social distance" between the members of the health team and the members of the community which they serve.
3. Inadequate training for rural health aides.

##### (1) Effects on Morbidity and Mortality

Obviously the training that the doctors and nurses receive has equipped them to make a significant contribution to the health of the Salvadoreans. Just as obviously poor administration and inadequate preparation to deal with the rural campesino probably prevents them from achieving their full potential.

Often, however, it is difficult to separate poor administration from lack of funds. There is a rather high degree of uncertainty in attributing current problems to lack of training of the personnel involved - when the same type of people successfully administer the social security program.

### B. Effects on the Distribution of Income

Training generally benefits directly those who receive it. RHA training benefits a lower income group. Other training would benefit the richer elements directly by permitting them to fulfill higher career aspirations. It would benefit the poor only to the degree that it would improve the type of health care that they receive.

### ALTERNATIVE TWO: A PROGRAM TO TRAIN HEALTH ADMINISTRATORS

#### A. Description

The program would have the following program components:

1. Set up a number of courses three to six months in length to train intermediate and upper level administrators.
2. Train an initial group of five hospital Administrators in appropriate universities in other Latin American nations.

The first component assumes a number of institutional changes, namely the appointment of regional health administrators and of health center administrators, as well as the use of auxiliary nurses to supervise rural health aids. It also assumes a considerable expansion of staff at the National Health Training School, and the use of nurses to supervise rural health aids. The courses given would include the following subjects:

1. Information Systems and Systems Analysis
2. Planning Methods.
3. Program Budgeting.
4. Supplies, Management and Control
5. Transportation Systems and Programming.
6. Personnel Administration
7. Basic Accounting Procedures

The actual curriculum and the sequence of topics to be covered in each subject area would be determined by the type of "student" in the course. The development of this program component would involve the following steps.

1. Expansion of the staff of the Health Training School.
2. Task Analysis for the following jobs:
  - a. Regional Health Director
  - b. Health Center Director
  - c. Rural Nurse Supervisor

#### ALTERNATIVE THREE: A PROGRAM TO INVOLVE THE UNIVERSITIES IN THE RURAL PENETRATION PROGRAM

##### A. Description

The model for this program is the CRUTAC program in Brazil. The program is described and analyzed in an easily obtained doctoral dissertation.<sup>51</sup>

The basic concept of CRUTAC is the integration of university training with service to rural communities in all the professional areas in which the university functions. The idea is to take students in advanced courses, together with professors to a selected rural community to carry out assigned projects of an in-service training nature and at the same time give to the community needed professional service, be it in the realm of solving health problems, dealing with legal matters, building bridges, or whatever. In short, CRUTAC aims at creating a body of university students in all areas of study whose education includes experience in the practical application of their training. At the same time it provides services for rural Brazilians in the interest of society and of the integrated development of the nation.<sup>52</sup>

##### B. Effects

Such a program, combined with academic inquiry and reflection on factors such as communication would seem to be of assistance in removing

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<sup>51</sup> Ann Q. Tiller, The University as an Agent of Community Health in Brazil with Emphasis on the CRUTAC Program. Houston, Texas: University of Houston Health Center. (Ph.D. Dissertation) 1975.

<sup>52</sup> Ibid., pp. 19-20.

some of the social distance between health center personnel and campesinos.

It might also bring other resources to bear on the whole rural penetration program.

### II.3.2 Research and Development

#### ALTERNATIVE ONE: THE STATUS QUO

##### A. Description

There is very little information about university based research and its relationship to the country's problems. One would presume that academic research is going on. The process by which the rural health aid program was developed can be taken as a case study of more applied research in this area. It is a rather good example of a strategy called incrementalism. A program is started, evaluated rather rapidly, changed according to the evaluation, operated again, evaluated again, changed again, and so forth.

If the research and development cycle can be conceived of as a continuous repetition of design testing and re-design, the program emphasizes testing over design based on rational analysis and recourse to experience elsewhere.

##### B. Effects

This method is quite good at adapting the method to local conditions. There are, however, a number of problems.

1. Results in evaluation are determined by the questions. If the design stage is inadequate, then relevant questions may never be asked. As a consequence, the final design may contain flaws that are unrecognized due to a narrow view at the beginning.

2. Morale problems can arise. In the El Salvador case, the first group of aids considered themselves undertrained. There is no guarantee

that the next group will be satisfied with their training.

3. At some point the system will become institutionalized. The relevant question is: Will the institutionalization come too early?

#### ALTERNATIVE TWO: A PROGRAM TO IMPROVE THE DESIGN OF THE RURAL HEALTH AID PROGRAM

##### A. Description

The objective of this program would be to improve the design and redesign phases of the sequence described under alternative one. The program elements would include:

1. Exploratory trips for MOH personnel to see similar programs in operation and to discuss problems with people operating these programs in other countries.

2. A functional analysis. This is a procedure for scientifically defining the roles of the health team members in terms of specific health needs and identifying training requirements based on these needs. It is described in a recently published book.<sup>53</sup>

A preliminary estimate of program elements and cost is contained in Exhibit 13.

##### B. Effects

Hopefully, this program would improve the ability of the Ministry of Health to prepare job descriptions and field the type of rural health aid that would respond to the needs of the rural population.

### III. Financial Constraints

It is necessary to develop some estimate of the amount of money the Ministry of Health will have available in future years to spend on new

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<sup>53</sup> Department of International Health: The Johns Hopkins University, The Functional Analysis of Health Needs and Services. New York: Asia Publishing House, 1976.

Exhibit 13. Elements of a Program to  
Improve the Design of the  
Rural Penetration Program

Travel Component:

Travel	\$20,000
Per Diem	3,000

Functional Analysis Component:

6 M/M Functional Analysis Consultant	\$20,000
4 Round Trips	2,000
180 Days per diem	7,200
12 M/M Field Supervisor	6,000
48 M/M 4 Interviewers	16,000
12 M/M Research Assistant	6,000
Data Processing	<u>4,000</u>
	\$61,200
	84,200

projects. This section will first project the Ministry of Health budget. Then, allowance will be made for likely committed expenditures in the future. The residual after deduction of committed expenditures will give some notion of the amount of money that the Ministry will have to spend on new projects in coming years.

### Budget Projections

If the government can increase the rate of saving to around five percent of GDP, increase agricultural production by four percent per year and manufacturing exports by seven to ten percent per year, then an average GDP growth of about 5.5 percent seems quite likely.

If this is done, given recent tax reforms and the increased reliance on the income tax, tax collections should rise by about seven percent per year. This implies an increase in the ability to fund health activities of about seven percent per year and an expected rate of increase in the health budget of about seven percent a year.

Proceeding in a different direction, and assuming an automatic increase in the health budget, the average annual increase was calculated by the formula

$$A = \sqrt[11]{\frac{B_{1976}}{B_{1965}}}$$

Where  $B_i$  represents actual expenditure for the  $i$ th year in constant dollars.

A = Average rate of increase

The average using this method is 6.9. A seven percent average annual figure was consequently used to project MOH budgets to the year 2000.

In the absence of assumptions on which to base high and low estimates, a simple statistical technique was used. The squared deviations of the actual from the projected budget figures for the years 1965-1976 were summed, and divided by ten (the number of years less one). It is possible, then, to create high and low figures by adding a multiple of the square root of this number to, and subtracting it from, the projected value. The final high low and expected values are given in Table III.1.

#### Future Commitments

Present organizational structures imply that significant fractions of future budgeted funds will be committed to specific purposes. The MOH will not be free to transfer these funds to other uses.

#### Current Transfers

The item "current transfers" includes payments to the National hospital system, which accounted for over 90% of this category in the most recent budget. To project this into future years, a logarithmic regression line was fitted to current transfers for the years 1965 to 1976. The estimated equation was:

$$\begin{aligned} \ln Y &= 5.592 + .1981X \\ r^2 &= 0.73401 \end{aligned}$$

Trend projection is a very risky way to forecast, but the information on which to base likely behavioral assumptions was simply not available. Table II.2 contains projections to the year 2000. It also deducts this figure from the expected MOH budget figure to give an idea of the residual that will remain after the Ministry fulfills this commitment.

Table III.1

El Salvador: MOH Budget Projections Until the Year 2000  
(millions of 1971 dollars)

Year	Low Estimate	Expected Estimate	High Estimate
1977	17.38	22.59	27.80
1978	18.96	24.17	29.38
1979	20.66	25.86	31.06
1980	22.46	27.67	32.88
1981	24.40	29.51	34.82
1982	26.48	31.68	36.88
1983	28.70	33.90	39.10
1984	31.06	36.27	41.48
1985	33.60	38.81	44.02
1986	36.32	41.52	46.72
1987	39.22	44.43	49.64
1988	42.33	47.54	52.74
1989	45.66	50.87	56.08
1990	49.22	54.43	59.64
1991	53.04	58.24	63.44
1992	57.12	62.32	67.52
1993	61.48	66.68	71.88
1994	66.14	71.35	76.56
1995	71.14	76.34	81.55
1996	76.48	81.69	86.90
1997	82.20	87.41	92.62
1998	88.32	93.52	98.72
1999	94.86	100.07	105.28
2000	101.86	107.07	112.28

Table III.2 Projections of Current Transfers and Calculation of Future Expected Residuals (In Millions of 1971 Dollars)

(1) Year	(2) Expected MOH Budget	(3) Expected "Current Transfers"	(4) Residual (2-3)
1977	22.59	9.100	13.49
1978	24.17	9.229	14.94
1979	25.86	9.351	16.51
1980	27.67	9.466	18.20
1981	29.61	9.576	20.03
1982	31.68	9.680	22.00
1983	33.90	9.780	24.12
1984	36.27	9.876	26.39
1985	38.81	9.968	28.84
1986	41.52	10.056	31.46
1987	44.43	10.142	34.29
1988	47.54	10.224	37.32
1989	50.87	10.303	40.57
1990	54.43	10.380	44.05
1991	58.24	10.455	47.78
1992	62.32	10.527	51.79
1993	66.68	10.598	56.08
1994	71.35	10.666	60.68
1995	76.34	10.733	65.61
1996	81.69	10.798	70.89
1997	87.41	10.861	76.55
1998	93.52	10.923	82.60
1999	100.07	10.983	89.09
2000	107.07	11.042	96.03

Calculated from MOH data produced in Karen Lashman "Budget Analysis, San Salvador: USAID, 1977.

The continual rise in the projected residuals results from the fact that current transfers in the past have not risen as rapidly as MOH budgets. This assumption was automatically included when the regression on past behavior was used to project future expenditures.

It is illegitimate to assume that operating expenditures will increase at a constant rate as they are determined by staffing patterns which depend to a great extent on investment in buildings. Since data on salaries are unavailable, it was assumed that operating expenditures would remain at their 1976 levels. Salaries and equipment costs for rural aids are available. This, of course, underestimates the costs that the program will impose on the system.

Table III.3 calculates the residual after these costs are removed. It is impossible to go further on the basis of available information, but it can be seen that, even carried this far, the analysis demonstrates that the MOH could not take on the recurrent costs imposed if all the preferred alternatives within each program category were implemented. The residual for 1977 is only \$9,000 more than the difference between the expected estimate and the low estimate in Table III.1.

Table III.3 Projected Budget Residuals Assuming a Continuation of Operating Expenditures at 1976 Levels and Accounting for Salaries and Equipment of RHA's

Year	Number of RHA's	Estimated Equipment and Salary Costs	Residual Health Budget	Corrected Residual	Residual After Deducting 1976 Operating Budget
1977	20	.15	13.49	13.34	5.30
1978	300	.37	14.94	14.57	6.53
1979	500	.63	16.51	15.88	7.84
1980	1,000	1.26	18.20	16.94	8.90
1981	1,500	1.89	20.03	18.14	10.01
1982	2,000	2.53	22.00	19.47	11.43
1983	2,500	3.16	24.12	20.96	12.92
1984	3,000	3.79	26.39	22.60	14.56
1985	3,090	3.90	28.84	24.94	16.90
1986	3,182	4.02	31.46	27.44	19.40
1987	3,278	4.14	34.29	30.15	22.11
1988	3,376	4.26	37.32	33.06	25.02
1989	3,478	4.39	40.57	36.18	28.14
1990	3,582	4.52	44.05	39.53	31.49
1991	3,690	4.66	47.78	43.12	35.08
1992	3,800	4.80	51.79	46.99	38.95
1993	3,914	4.94	56.08	51.14	43.10
1994	4,032	5.09	60.68	55.59	47.55
1995	4,153	5.24	65.61	60.37	52.33
1996	4,277	5.40	70.89	65.49	57.45
1997	4,406	5.56	76.55	70.99	62.95
1998	4,538	5.73	82.60	76.87	68.83
1999	4,674	5.90	89.09	83.01	74.97
2000	4,814	6.08	96.03	89.95	81.91

## SOME POLICY CONCLUSIONS

This section is based on the assumption that, although no perfect priority setting algorithm exists, the process, nevertheless, of attempting to apply rational criteria to the priority setting problem will produce valuable information for policy purposes. Consequently, priority setting in El Salvador will be approached first from the perspective of problem size--using morbidity and mortality statistics. Then considerations of program effectiveness will be added. Then costs will be considered in conjunction with effectiveness and finally a number of other factors will be considered. Some of these factors are unquantifiable. Others would have been quantifiable in an analysis that suffered from fewer constraints of time and staff.

IV.1. Priorities Based on Problem Size

Priorities can be established from morbidity and mortality statistics. Then these priorities can be compared with existing plans to find new possible areas of intervention. Diarrhea, the major cause of sickness and death in El Salvador is recognized and receives consideration in many other sections of the present analysis. The following "gaps" in the program structure, however, need further attention if problem size is taken as an indication of health priority.

(a) Dental care. Judging from the number of clinic visits (Table I.3), dental problems seem to be a matter of concern to the people. The government does have a program to fluoridate the teeth of school children. New interventions would include efforts to expand the range of services at the health unit--beyond cleaning and extractions, and the development of specific outreach and education activities.

(b) Nutrition. Under-nutrition was present as an underlying or associated cause of death in 71% of the child deaths in the PAHO study. Program options would include supplementary feeding and extension work. The Rural Health Aid does have a minimum extension role. He passes out pea seeds and encourages the campesinos to plant them.

(c) Accidents. Accidents, particularly among males, are a major cause of death in El Salvador. (Tables A.10 and A.11). Accident prevention programs ranging from traffic control to industrial hygiene to alcohol and drug abuse would seem to merit further investigation.

#### IV.2. Considerations of Effectiveness

It almost goes without saying that the quantitative analyses undertaken in the preceding pages will automate priority setting neither for the Government of El Salvador nor for the U.S. AID Mission. An examination of the estimates in Exhibit 14 bears this conclusion out. First, simply accepting the figures at face value, one can note that:

- (a) If certainty of impact is the criterion, then vaccination of children for infectious diseases would have the highest priority and the rural health aid program would have the lowest.
- (b) If maximum potential life-saving were the criterion, then the Rural Health Aid program would run a close second to the integrated rural sanitation program and the integrated pest control program would rank near the bottom.
- (c) Malaria control, would rank quite low by the deaths prevented criterion, but it would rank quite high, second only to an integrated rural sanitation program by the reported case index criterion.

Exhibit 14				
Some Effectiveness Indicators				
Program	Deaths Prevented per 100,000	Reported Case Index	Clinic Outpatient Index	Uncertainty
Integrated Rural Sanitation	0-232	31.9	5.8	Moderate
Integrated Pest Control	0.375-.05	1.1	0.3	Low
Vaccination Program	24-46	0.3	0.008	Low
Malaria Control	1.3-2	9.1	0.02	Moderate
Rural Health Aid	0-193	0	0	High

The figures, however, cannot be accepted entirely at face value. As noted in the body of the analysis, deaths caused by malaria may exceed deaths attributed to malaria because the fever may weaken infants, thus raising the death rate formally attributed to other causes. The estimate for potential lives saved by the rural health aid is drawn from programs that included infectious disease control so that the upper limit of potential deaths may be an overestimate if a vertical program is operated at the same time as the rural penetration program. On the other hand, there is some possibility that if the rural health aid is given communicable disease control responsibilities with present training and supervision procedures, the program might be ruined. Finally, the uncertainty score is low both for the vaccination program and for the integrated pest control program, but an impartial observer would be much more certain of the impact of the vaccination program.

Nevertheless, the following conclusions seem valid. The integrated rural sanitation program ranks high on all indicators except uncertainty. There is no feasible way to reduce that uncertainty because it is related to doubts about the behavioral adaptation of the campesino family. One would expect, however, a declining uncertainty level over time if educational levels rise in rural areas. A vaccination program centrally supplied and administered is probably advisable for the present. The malaria program can have a significant effect on morbidity, but its impact is, again, uncertain because it involves activities recently untried in El Salvador. The health care element in the rural penetration program could have a significant impact. A reasonable man would not, however, expect it to have much effect at all. But, uncertainty might be reduced by programs discussed in the section on the treatment system and in the section on research.

#### IV.3. Cost Considerations

The expected time stream of costs and benefits differs from program to program. For instance, the relevant costs for a vaccination program are operating costs because capital costs have already been incurred. If a 20 year time span is envisioned, then an annual cost will accompany each set of benefits. On the other hand, decisions about capital costs are relevant to the integrated sanitation program. Extensive expenditures would be made for the next five years and the health "payoff" would continue past the end of the planning horizon, with annual operating costs considerably less than the annual costs during the construction period. The common way to compare costs is to reduce them all to present value at an appropriate discount rate. This is done for three programs at three interest rates in Exhibit 15. All program cost estimates are scaled to a population of 100,000.

## Exhibit 15

The Estimated Cost of Three Programs Serving a Population of 100,000  
(Present Value with a 20 Year Time Horizon)

	Vaccination Program	Rural Health Aid Program	Integrated Sanitation Program
5%	115,828	1,623,456	15,342,992
10%	79,128	1,112,106	14,085,362
20%	45,258	640,210	12,142,062

The vaccination program expense was calculated by dividing the estimate derived in the body of the analysis by 40. This would reduce it approximately to the expense needed for 100,000 people. A population of 100,000 would need approximately 100 rural health aids. Annual salary and supply cost per aid was estimated at \$1,260, training cost at \$16 per week. Six weeks training was assumed in the first period and two weeks every year. The cost of the rural sanitation program was derived by first developing cost estimates for latrines and water supply with household connections for the population of 100,000, summing and adding these to a health education component. These costs are not totally accurate. The cost of the rural health aid omits consideration of the additional costs he would impose on the system - costs of supervision and supply - costs of caring for patients he might refer.

Obviously, it would make no sense to choose the cheapest program, without considering its relative ability to reduce a health problem. If it were assumed that all three programs achieved their potential every year for 20 years, then the cost per life saved would be estimated at \$86 for the vaccination program, \$288 for the rural health aid program and \$3,036 for

the integrated sanitation program. This assumption is, of course, unrealistic but since there is no adequate way of predicting differential time streams of benefits, the simple assumption would not seem to introduce any bias into the comparisons. This would be deceptive, however, because it is not very likely that the rural health aid program will achieve its potential. It is moderately likely that the sanitation program will achieve its potential, extremely likely that it will do something, and almost certain that the vaccination program will achieve its potential. In addition, the calculation leaves out of account the ability of the sanitation program to reduce morbidity by a significant amount. At a minimum, the analysis strengthens the contention that the vaccination program should receive a high priority and that in the case of the rural health aid, priority should lie with programs aimed at reducing the uncertainty surrounding his expected impact. Cost per life saved is an inadequate index of the importance of environmental sanitation because it does not take account of its ability to significantly reduce morbidity.

### IV.3. Other Considerations

#### IV.3.a. Some Conclusions that Seem to Follow from the Analysis

Some rather definite conclusions seem to follow from the analysis even though the results cannot, at present, be couched in rigorously quantitative terms.

##### (1) Household Connections Should be Provided with Rural Water Supply Systems

Rather strenuous efforts, but still unsuccessful, were made in the course of the analysis to develop some method for comparing costs and benefits of water supply with and without household connections. Some of the work can be seen in Appendix C and in attempts to deal with different cost implications in Appendix A. It does seem that with more time and analytical effort, some

estimates might be forthcoming. Nevertheless, even without rigid effectiveness estimates, the following considerations are quite important: First, household connections have a greater potential impact on morbidity and mortality because they improve both the quantity and quality of the water available to the family. Second, although household connections involve a larger capital cost to the agency, water supply without household connections will impose a larger operating cost. Third, there is an income distribution problem here--particularly if common sources are not provided along with household connections, and if tariffs are not carefully worked out, both to avoid subsidizing the rich and to make water available to the poor. Finally, household connections with tariffs permit some attention to consumer preferences.

#### (2) Nutritional Programs Need Intensive Investigation

This follows, not only from the size of the nutrition problem noted above, but also from the results of the studies reviewed in Appendix A. It will be recalled from the discussion of goals in the body of the analysis that the government considers morbidity and mortality among pre-schoolers to be a matter of high concern. Most of the studies reviewed in Appendix A support the contention that nutritional supplementation is probably the most effective of the strategies available to reduce morbidity and mortality in one to three year age group.

#### IV.3.b. Some Non-Quantitative Considerations

##### (1) Questions of Research Design

When both uncertainty and potential effectiveness are high, the classic strategy is the development of a research design which will produce information aimed at reducing the uncertainty and thus, make the potential effect more

likely. This approach seems justified in the case of the malaria control program and in the case of the rural health aid. It seems to be a prime area for international assistance because the argument can be made that a country that faces budget restraints such as those facing El Salvador cannot afford to set up a complex experiment when many of the benefits will accrue to other countries. This is particularly true in the case of malaria control, because as a number of sources testify, many countries are seeking more effective ways to control malaria, and any discoveries made in El Salvador would benefit other countries also. It is also true in the case of the uncertainties surrounding the rural penetration program. Problems of supply, job description and training are not unique to El Salvador. The development of an experimental design that would solve some of these problems would benefit many other countries trying to deal with the problem of providing health care to rural areas.

## (2) Questions of Political Feasibility

When a program would seem to have a beneficial impact, but it cannot be implemented because of political opposition, the appropriate strategy involves attempts to develop a constituency. This would seem to be the case in areas of pollution control and industrial hygiene, and to a lesser extent it would seem to be true of programs that might reduce the autonomy of the hospitals.

International agencies could make a beginning by sponsoring conferences that, if properly covered by the press, would educate the populace to the seriousness of the problems caused by ignoring environmental hazards. In this respect, AID could cooperate with the Pan American Center for Human Ecology and Health. In addition, certain investigations could be initiated

into the cost of industrial accidents, the potential cost reductions possible through an integrated pest control program, and so forth. The results could be publicized so that business interests would learn that pollution costs them money.

In addition, the development of citizen and professional bodies of the type suggested in Section II.2.2.3 can constitute a sort of "first step" in the development of institutional reforms.

## APPENDIX A

## ESTIMATES AND CALCULATIONS

Policy analysis, because it deals with the future, must cope with uncertainty. In most Third World Countries, the problem is compounded by serious statistical problems. And, finally, in the health field, many causal sequences are shrouded in uncertainty. Quantitative estimates of the health impact of various alternatives are, then, of necessity, highly uncertain. It is sometimes helpful, however, to develop quantitative estimates of the expected effect of different interventions on morbidity and mortality if the limitations of these estimates are constantly borne in mind. Even though present knowledge is imperfect, it is the only knowledge we have, and decisions based on imperfect knowledge would seem, a-priori, superior to decisions based on total ignorance.

I. A Simple Mortality Model of a Rural Population in El Salvador

An adequate policy model would include the following elements: (1) a model of the prevention, treatment and rehabilitation systems; (2) a model which would permit estimates of the effect of the system on morbidity and mortality; (3) a method for assessing the social damage of the different diseases; (4) a method for relating specific system changes to morbidity and mortality so that the effects of task specifications, supply and management techniques and personnel policies could be evaluated in terms of their impact on health problems. It is impossible to construct such a model because there is very little information on item (3), and item (4) is essentially the present frontier of research in the rural health delivery area.

In this analysis, staff and time constraints imposed limits on the type of model that could be developed. In particular, without the constant advice of an epidemiologist, it was considered futile to attempt to model morbidity, and the index method described earlier was used.

This appendix develops a simple model of rural mortality patterns, and with the aid of this model, and other information available in the Washington, D.C. area, performs some cost-effectiveness experiments. The model has limitations, of course. No model ever describes the "real world". For one thing, the real world is too complex. Models attempt to extract from the real world only those elements necessary for making an intelligent decision. For another thing, no one knows exactly what is going on in the real world. Intelligent decisions are made, not on the basis of what goes on, but on the basis of what an intelligent man would think goes on based on the best knowledge presently available to him. The best model is, then, a summary of those elements of present knowledge deemed necessary to make contemplated decisions more rational.

No computer was made available for the analysis, and for this reason extremely simple assumptions were used to create an age distribution and age specific death rates for the model population. This would render the model inadequate for estimating demographic effects. It is, however, most probably quite adequate for a simple analysis of health problems.<sup>1</sup> One benefit of this enforced simplicity is that the model is quite easy to understand. Anyone with a knowledge of simple arithmetic should be able to follow the logic employed.

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<sup>1</sup> See United Nations Department of Economic and Social Affairs, The Concept of a Stable Population: Applications to the Incomplete Demographic Statistics. New York: United Nations, 1968, p. 9.

The first step was to create a model rural population. The population size was 100,000. The sex ratio and age structure of the 1971 census were used to develop a sex and age distribution. The implicit assumption - that the rural population structure is the same as the average - is not totally accurate. The inaccuracy, however, should not greatly hinder the purpose of the analysis - to develop a rough and probable profile of death rates by cause in a typical rural population.

Table A.1 illustrates how the age and sex distribution of the model population was developed.\*

For the "lower limit," the official death rates of the 1971 census were used. The true rural death rate would be expected to be above this rate for two reasons. First, it is an amalgam of urban and rural death rates, and rural death rates are higher than urban death rates. Second, the official child death rates diverge considerably from those in the careful PAHO epidemiological study done at the same time.<sup>2</sup> For the upper limit, a United Nations Model Population was chosen.<sup>3</sup> This population shows what the age structure would be if vital rates remained constant. The population for level 65 was selected. The life expectancy (52.5) is slightly higher than the lowest life expectancy estimated for El Salvador (51 for males and 58 for females), but the infant death rates for this model seem above any estimated for El Salvador, (145 for males and 129 for females versus 120 average estimated for El Salvador).

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\* Note: Tables are placed at the end of this appendix. Exhibits are included in the body.

<sup>2</sup> Ruth Rice Puffer and Carlos V. Serrano, Patterns of Mortality in Childhood. Scientific Publication No. 262. Washington, D.C.: Pan American Health Organization, 1973.

<sup>3</sup> United Nations Department of Economic and Social Affairs, The Concept of a Stable Population: Application to the Study of Populations of Countries with Incomplete Demographic Statistics, Population Studies, No. 36, New York: United Nations, 1968, p. 157.

The age specific death rates were applied to the age groups to produce high and low estimates of total deaths in the model population by age groups. Finally, to create a distribution by underlying cause for children under five and infants, proportional deaths by underlying cause were estimated for each age group, using the PAHO study (Puffer and Serrano, op. cit.). These proportions were then applied to the age groups to produce high and low estimates of death by cause.

For those over fifteen, it was necessary to use official death statistics.<sup>4</sup> First, for each age group the number of reported deaths from a specific disease was divided by the total number of deaths in that age group. That is, for instance, total reported deaths in the age group 15-24 would be divided into reported deaths from amebiasis then into reported deaths from measles and so forth, until a complete fractional distribution of deaths in that age group had been created. Then, these fractions were used to apportion the age specific deaths in the models, producing high and low estimates of death by cause in each of the age groups.

## II. Effects of a Vaccination Program on Deaths from Infectious Diseases of Childhood

Reported cases and deaths of infectious childhood diseases declined drastically after the government started a vaccination campaign in 1972.

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<sup>4</sup> World Health Organization, World Health Statistics Annual, 1972. Geneva: World Health Organization, 1975, pp. 126-137.

The decline in reported deaths can be used to estimate the decline in actual deaths. Reported deaths do not form, of course, an unbiased sample of actual deaths. Quite obviously, those with less access to a health institution are less likely to die there. Nevertheless, it is the change in deaths that is important here. Reported deaths would not constitute an adequate basis for reasoning, however, if the decline in reported deaths was not paralleled for some reason by a decline in actual deaths. This could happen either if incidence was larger or smaller in the population from which institutionalized deaths occur than in the larger population, or if coverage differed between the two populations. For children, these two factors would seem to work in opposite directions. The more rural child might have a lower likelihood of exposure than the urban child (and the urban child would be more likely to die in a health institution). On the other hand, the rural child might also have a lower likelihood of being vaccinated. Finally, a higher likelihood of undernourishment or weakness arising from diseases caused by poor sanitation, malaria, or other diseases, would raise the likelihood that the rural child, if the death could be recorded, would be said to have died from measles or diphtheria. In the latter instance, one has a definitional problem. After all objections have been considered, however, the decline in recorded deaths remains the only way to develop estimates of likely deaths in El Salvador.

Exhibit A.1 contains reported deaths for the years from 1972 to 1975. Index numbers have been calculated by dividing the given year by the base year and multiplying by 100.

Exhibit A.1 Reported Deaths from Infectious Childhood Diseases in El Salvador: Absolute Numbers and Index Numbers, 1972-1975 (Base = 1972)

Disease	Deaths by Year							
	1972		1973		1974		1975	
	No.	Index	No.	Index	No.	Index	No.	Index
Measles	743	1.00	639	.860	34	.046	39	.052
Whooping Cough	208	1.00	169	.812	139	.668	179	.861
Diphtheria	82	1.00	49	.598	26	.318	19	.232
Tetanus	312	1.00	292	.936	259	.830	215	.689

SOURCE: Ministerio de Salud Pública y Asistencia Social, Departamento de Estadísticas de Salud, Anuario: Salud Pública en Cifras 1976. San Salvador: Ministry of Health and Social Assistance, 1976, p. 32.

In Exhibit A.2, the index numbers are applied to the model population by the following formula:

Deaths in 1972 x Index number of given year = Estimated deaths in given year

Exhibit A.2 Application of Index Numbers to the Under Five Age Group of the Model Population of 100,000 Rural Salvadoreans

Disease	Estimated Deaths by Year							
	High Death Rate				Low Death Rate			
	Year				Year			
	0	1	2	3	0	1	2	3
Measles	31	27	1	2	16	14	1	1
Whooping Cough	11	9	7	9	6	5	4	5
Diphtheria	4	2	1	1	2	1	1	-
Tetanus	18	17	15	12	9	8	7	6
TOTAL	64	55	24	24	33	28	13	12

It should be born in mind that the model population size is only 100,000. A rough estimate of estimated deaths for El Salvador could be produced by multiplying model population deaths by 40. So for the country as a whole, measles deaths would be estimated to be between 640 and 1240. Exhibit A.3 contains an estimate of lives saved. Deaths without the program are assumed to grow at the rate of 3% per year, the estimated rate of population growth. Lives saved are estimated by deducting deaths with, from deaths without the program.

Assumption	High Death Rate Year				Low Death Rate Year			
	0	1	2	3	0	1	2	3
Nothing Done	64	66	68	70	23	34	35	36
Vaccination Program	54	55	24	24	33	28	13	12
Deaths Prevented	0	11	44	46	0	6	12	24

Some have argued that the tetanus vaccination program has been ineffective. Recorded deaths do not, however, refute the hypothesis that the vaccine has, in fact, been effective when the age distribution of deaths is taken into account.

According to the original plan of operations, the campaign attempts to reach children between the ages of 6 and 24 months.<sup>5</sup> The original plan correctly noted that 75% of tetanus deaths occur before the age of one year, it did not avert to the age distribution within one year, nor to the age distribution after one year. Table A.15 shows that

<sup>5</sup> U.S. Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, Proposal Mass Immunization Programs for Central America, Atlanta, Ga.: Center for Disease Control, 1972, p. 15.

deaths - after one year, are more or less evenly distributed over the age groups. So that the expected 20% reduction<sup>6</sup> could not be immediately expected. However, as the vaccinated children grow, since the vaccine is effective for five or ten years, one would expect a slight decline in reported deaths, and this is exactly what happened.

Within one year, as Exhibit A.4 clearly demonstrates, deaths are concentrated in the neonatal period, and a program which started at age six months would not affect neonatal tetanus.

Exhibit A.4\* Child Deaths from Tetanus in the PAHO Study and in the Model Population

	Under 28 days	28 days - 11 months	1 year	2-4 years	Fatal Under 5
Age Distribution in Puffer Study	28	1	-	-	29
Assumed for Model Population					
High	17	1	-	-	18
Low	9	-	-	-	9

SOURCE: Ruth Rice Puffer and Carlos V. Serrano. Patterns of Mortality in Childhood. Scientific Publication No. 262. Washington, D.C.: Pan American Health Organization, 1973, p. 414.

Since the vaccination program is now operating, capital costs should be ignored in developing cost-effectiveness ratios. Actual operating expenditures are the best cost source, but since these are not available, cost estimates in the original proposal will be used.<sup>7</sup> The estimated annual cost for El Salvador is \$297,600. Assuming a 7.7% annual rate of inflation over the three years, yields a cost estimate of \$371,775.

<sup>6</sup>Ibid., p. 9.

<sup>7</sup>DHEW/PHS, Center for Disease Control, op. cit., Table 6.

\*The absolute number of deaths in the PAHO study is larger than the absolute number in the high death rate population because the susceptible pool in the PAHO study is larger.

Again, since this estimate refers to the whole country, the 100,000 population figure would not do to estimate cost per life saved. The most recent estimate of lives saved will be used. This produces an estimate of cost per death averted that would lie between \$202 and \$387. The program is quite justifiable on cost-benefit grounds as demonstrated in the original proposal. There is no point in repeating these calculations here.<sup>8</sup>

Exhibit A.5 contains data on reported cases. To estimate case reductions for the morbidity indexes, the reported cases for 1972 are projected at a three percent growth rate to 1975 in equation A.1.

$$A.1 \begin{bmatrix} 9,936 \\ 2,999 \\ 176 \\ 189 \end{bmatrix} \times (1.03)^3 = \begin{bmatrix} 10,857 \\ 3,277 \\ 192 \\ 206 \end{bmatrix}$$

Exhibit A.5 Reported Cases of Infectious Childhood Diseases in El Salvador: Absolute Numbers and Index Numbers, 1972-1975 (Base = 1972)

Disease	1972		Cases by Year		1974		1975	
	No.	Index	No.	Index	No.	Index	No.	Index
Measles	9,936	1.00	4,956	0.4988	469	.0472	551	.0554
Whooping Cough	2,999	1.00	1,572	0.5242	951	.3171	1,675	.5585
Diphtheria	176	1.00	38	0.2159	14	.0795	4	.0227
Tetanus	189	1.00	153	0.8095	163	.8624	146	.7729

SOURCE: Ministerio de Salud Publica y Asistencia Social, Departamento de Estadísticas de Salud, Anuario: Salud Publica en Cifras 1976. San Salvador: Ministry of Health and Social Assistance, 1976, p. 32.

<sup>8</sup> Ibid, pp. 4-13.

Mathematically, the reduction in total reported cases divided by total cases will produce the same reported disease score as the method described in the body of the report. Equation A.2 subtracts reported from potential disease cases and sums the differences.

$$\begin{array}{r}
 \boxed{\begin{array}{r} 10,857 \\ 3,277 \\ 192 \\ 206 \end{array}} \\
 \text{A.2}
 \end{array}
 -
 \begin{array}{r}
 \boxed{\begin{array}{r} 551 \\ 1,675 \\ 4 \\ 146 \end{array}}
 =
 \begin{array}{r}
 \boxed{\begin{array}{r} 10,306 \\ 1,602 \\ 188 \\ 60 \end{array}}
 \end{array}$$

Total = 12,156

The reported disease score can then be estimated:

$$\begin{array}{l}
 \text{Reported} \\
 \text{Disease} \\
 \text{Score}
 \end{array}
 =
 \frac{12,156}{455,703}
 =
 .0267$$

To calculate the outpatient visit score, it is necessary to adjust the total by deducting estimated hospital cases. In 1969, there were 3,747 reported cases of measles in El Salvador. Of these, 7,620 were hospitalized.<sup>9</sup>

One would estimate, then, that  $(1 - \frac{7,620}{8,747}) = .1288$  would constant a fair estimate of the fraction of total reported cases that were treated in out patient clinics.

In addition, the figure must be adjusted for the fact that out-patient visits are only available for 1974. The estimate is, then, assuming a three percent growth rate.

$$\begin{array}{l}
 \text{Outpatient} \\
 \text{Visit} \\
 \text{Score}
 \end{array}
 =
 \frac{.1288 \times \frac{(12,156)}{1.03}}{1,780,059}
 =
 .0008$$

---

<sup>9</sup> Ibid, pp. 4 and 12.

### III. Effects of a Campaign Against Neonatal Tetanus

About 30% of infant deaths are classified as neonatal (see Table A.3). This section will investigate neonatal mortality with the goal of developing quantitative estimates of the probable effects of different interventions on neonatal mortality.

It should, however, be noted that the potential for reduction in neonatal is much lower than for reduction in post neonatal infant deaths. As Ascoli and his associates note:

"As a group, they (neonatal deaths) are due to obstetrical causes, prematurity and developmental anomalies which together constitute the hard core of infant mortality, difficult and slow to reduce."<sup>10</sup>

Indeed the potential for death reduction lies in the post-neonatal period.

#### 1) Effect of a Tetanus Vaccination Program on Neonatal Mortality

Of 195 neonatal deaths in the rural municipios of El Salvador, 28, or about 14 percent were due to tetanus. For the model population, this would imply the distribution of deaths illustrated in Exhibit A.5.

Death Rate	Sex		Total
	Male	Female	
High	15	6	21
Low	11	5	16

<sup>10</sup> Werner Ascoli, Miguel Guzman, Nevin S. Scrimshaw and John E. Gordon, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964 IV Deaths of Infants and Preschool Children," Archives of Environmental Health (October, 1967) Vol. 15, p. 443.

Neonatal tetanus usually gains entry through the partially healed umbilical cord. It is common practice, where the prevalence is high to immunize the mother.

This immunization is effective, and it has been shown that with appropriate supervision, literate auxiliaries can effectively immunize large and isolated rural populations.<sup>11</sup> The program in Haiti reduced recorded infant mortality from 144 per 1,000 live births to 34 per 1,000 live births in five years.

To estimate the effect on neonatal deaths in the model populations, it would seem reasonable to assume 100% efficacy and 80% penetration, and a consequent reduction in total deaths of 17 in the high death rate model and 13 in the low death rate model.

Rather than a mass campaign, a door to door coverage for neonatal tetanus might be more effective. In the Haiti program, \$67,000 was spent in four years, and it covered a population of 200,000 people. In four years one would expect  $2 \times 4 \times 21 = 168$  neonatal deaths in a model population of 200,000 as a high estimate. The low estimate would be  $2 \times 4 \times 16 = 128$ . The cost per neonatal death averted, then would be between \$399 and \$523. The per capita cost of protection would be about \$0.33. This assumes a program identical to the Haiti program. A lower cost program might be possible in El Salvador.

It is not possible to extend these figures to other size populations because of possible economies and diseconomies of scale.

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<sup>11</sup> Warren L. Berggren, "Control of Neonatal Tetanus in Rural Haiti through the utilization of Medical Auxiliaries" in Medical Auxiliaries: Proceedings of a Symposium Held During the XIIth Meeting of the PAHO Advisory Committee on Medical Research. PAHO Scientific Publication No. 278. Washington, D.C. Pan American Health Organization, 1974, pp. 40-44.

#### IV. The Likely Effect of Comprehensive Medical Care Delivered by Auxiliaries

The fundamental logic behind programs such as the rural penetration program is that the medical technology exists to drastically reduce the "excess mortality rate" in most Third World Countries. The problem is one of delivering it.

Still, due to the synergistic nature of the causes of death, real questions remain about the correct set of activities and the efficacy of any one taken alone.

The probable effect of the rural penetration program will be estimated by using the results of various studies to infer logically the effects of different types of interventions in El Salvador. One very early study is quite interesting because it involved the introduction of high quality modern medical technology into an area in which poor environmental factors were allowed to remain the same.<sup>12</sup>

The authors themselves explain the significance of the experience.

The observed results could be regarded as characterizing the disease problems that would remain in a rural economically underdeveloped community with unimproved housing after there had been introduced; (i) an adequate supply of food, including high quality protein; (ii) control of all protozoan and helminthic disease such as malaria or hookworm; (iii) a protected water supply at some distance from home; (iv) effective prevention of cigarette smoking and chemical contamination of the air; (v) community hospital facilities 55 and 90 miles away; and (vi) a system of primary medical care, with a clinical physician, nurses, and indigenous health care workers in residence. (ibid. p. 29).

The only qualification that should be made here is that the population had ambulances and automobiles available to take them to the hospitals so that hospital accessibility on the reservation was

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<sup>12</sup> W.M. McDermott, K.W. Deuschle, and C.R. Barnett, "Health Care Experiment at Many Farms," Science. (January 7, 1972) Vol. 175, pp. 23-31.

probably greater than it is in many Third World Countries. With this qualification, the study can be used as a sort of a test of the effect on various indicators of modern high quality medical technology when environmental factors are left unchanged. The authors describe these environmental factors;

The Navajo society at many farms was one of a nonliterate, non-English-speaking people who lived in extended families in one-room, windowless, log and mud dwellings with dirt floors. These dwellings were separated from each other and from any supply of water by one or more miles of intermittently passable dirt roads. The water was pure at the source, but was easily contaminated through the communal dipper in the home. There was no refrigeration. The climate was one of harsh extremes... Six or seven and occasionally as many as 15, persons might sleep in a single, large, poorly ventilated room, meals were not usually served on a table, but were eaten while sitting on the floor. There were no latrines or privies; horses wandered up to the hogan door and dogs roamed freely. (ibid., p. 24).

Mortality statistics for the five year period are reproduced in Exhibit A.7.

Exhibit A.7 Mortality in the Many Farms - Rough Rock Community						
	1957	1958	YEAR 1959	1960	1961	5 year experience
Population	1963	2044	2127	2221	2229	
Deaths	20	15	7	9	14	65 (total)
Infant Deaths	11	7	2	7	7	34 (total)
Infant Mortality	115.8	70	21.3	66.7	76.1	70 (average)
Crude Death Rate	10.2	7.3	3.3	4.1	6.1	6.2 (average)

SOURCE: W.M. Mcdermott, K.W. Deuschle, and C.R. Barnett, "Health Care Experiment at Many Farms," Science. (January 7, 1972) Vol. 175, p. 27.

There is no way, however, using the methods of classical, statistical inference, to conclude that the measured reduction in deaths was due to the intervention of modern medicine in the area. The population was too small for much significance to be attached to the change in death rates and hard data for control comparisons were not available (ibid., p. 27).

The authors draw the following conclusions from their experience in these static conditions.

With no real change in either the home environment or the level of formal education, the wide application of biomedical science and technology through the clinical physician system resulted in:

- 1) A definite reduction in the transmission of tubercle bacilli.
- 2) A definite reduction in otitis media in the fifth year.
- 3) No reduction in the occurrence of active trachoma.
- 4) No reduction in the occurrence of the pneumonia-dysentery complex, which remained the single greatest cause of illness and death.
- 5) The identification of those individuals who need hospital care (35 to 40 persons per 1,000 each year) that is, the establishment of a medical scan.
- 6) A possible slight reduction in crude mortality, despite an infant mortality that persisted at three times the national average. (ibid., p. 27).

Inference from this experience is limited by a number of factors:

First, it is impossible from descriptions to precisely define the mix of services offered. The authors probably felt no necessity to describe them, assuming that everyone would know. Second, one would gather that the nutritional state on the reservation was considerably better than that in El Salvador. Third, the disease mix differs. Trachoma is not a problem in El Salvador. Tuberculosis as a problem is declining.

However, it is relevant that environmental sanitation was ignored, high quality medical care was offered and there was no effect on diarrhea. Secondly, although the drop in infant mortality cannot be attributed to medical care in this instance, similar drops substantiated in similar programs would strengthen the hypothesis that in fact, such a program may have some influence on infant mortality and morbidity.

In fact, there is a general accumulation of corroborating evidence. In the Cornwall Project in Jamaica, in the 0-4 age group dropped by 50% after the introduction of community health aids.<sup>13</sup> However, that program depended heavily on nutritional supplements given to the child. The El Salvador RHA Program has only a minimal nutritional component.

In Iran and also in Guatemala, programs utilizing health auxiliaries actually seemed to reduce infant and adult mortality, see Exhibits A.8 and A.9. On the other hand, the reduction in infant mortality was far less dramatic in other similar projects, as illustrated by Exhibit A.10.

The two missions, Behrhorst and Maryknoll do not have the resources for exhaustive investigation into unreported deaths necessary for adequate estimation of rural death rates. Thus, we must reject the low Maryknoll rate and accept the high Behrhorst rate. All of this would more or less lead one to judge that modern medical care delivered by auxiliaries, could at the best, reduce infant deaths to a level of 55 per thousand. It could also, however, have no visible effect whatsoever. The probability of any value between the two extremes would seem to be equal.

Two well known studies have attempted to deal with the problem of the correct mix and intensity of services. The first, which took place in the Guatemalan highlands, was aimed at comparing nutrition with health care.<sup>14</sup>

<sup>13</sup> Health Improvement of Young Children. Project Paper. Kingston, Jamaica: USAID, June, 1976 (Mimeo), p. 9.

<sup>14</sup> Werner Ascoli, Miguel A. Guzman, Nevin S. Scrimshaw, and John E. Gordon, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964," Archives of Environmental Health (October, 1967), Vol. 15, pp. 439-449.)

## Exhibit A.8

Comparison of Vital Rates in Village Health Worker Villages  
and Control Villages in the Kavar Village Health Worker Project in Shiraz,  
Iran

Mortality and Fertility	VHW Villages	Control Villages
Infant Mortality Rate	64.3/1,000 live births	127.7/1,000 live births
Crude Death Rate	10.2/1,000	17.5/1,000
Fetal Death Ratio <sup>a</sup>	36/1,000 live births	79/1,000 live births
Total Fertility Rate <sup>b</sup>	6.4	6.96
Crude Birth Rate	50.2/1,000	44.9/1,000
Other Demographic Measures		
Median Age Males	12.3	12.5
Median Age Females	12.2	12.7
Literacy Rate Males (percent)	28	33
Literacy Rate Females (percent)	6	7
Dependency Ratio <sup>c</sup>	1,051	1,021

<sup>a</sup> In a census of this nature, it is not possible to distinguish the fetal deaths from deaths very soon after birth. Persons were asked specifically whether the infant was dead at the time of expulsion or extraction. The fetal death ratio is defined as fetal deaths divided by live deaths (times 1,000).

<sup>b</sup> The total fertility rate is the hypothetical number of children born to woman in her lifetime at the correct age-specific birth rate.

<sup>c</sup> Number of persons greater than 15 and less than 64 for every 1,000 persons.

SOURCE: Department of Community Medicine, Pahlavi University School of Medicine, Kavar Village Health Worker Project. June, 1975 and August, 1976. Shiraz, Iran, Pahlavi University, 1976, p. 83.

## Exhibit A.9

Changes in Infant and Preschool Death Rates\* Following  
the Introduction in 1969 of Primary MEDICAL CARE DELIVERED BY PARAMEDICAL  
PERSONNEL

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 Years
 

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Source of Information	Recall of survival 954 infants born to 193 mothers	Vital statistics collected by Program	Official Vital Statistics	
Infant Mortality	138.7	55.4	89.0	84.7
Second Year Mortality	-	15.8	-	-
1-4 year Mortality	27.9	5.9	26.2	22.0

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\*per 1,000 children at risk.

SOURCE: Working Group on Rural Medical Care, "Delivery of Primary Care by Medical Auxiliaries: Techniques of Use and Analysis of Benefits Achieved in Some Rural Villages in Guatemala" in Medical Auxiliaries: Proceedings of a Symposium Held During the Twelfth Meeting of the PAHO Advisory Committee on Medical Research, June 25, 1973. PAHO Scientific Publication No. 278. Washington, D.C.: Pan American Health Organization, 1973, p. 35.

Exhibit A.10 Infant Death Rates in Five Areas in Guatemala Served by Medical Care Teams			
Deaths/100,000 Inhabitants			
	Whooping Cough	Measles	Infant Deaths/ 1,000 births
Plan Tripartito* Interinstitutional	29	115	93
INCAP Microbiology* Division	0	0	74
Division of Human Development (INCAP)	0	0	55
Behrhorst Clinic	66	75	125
Maryknoll	6	7	30

\*Used Physicians

SOURCE: PAHO Advisory Committee on Medical Research, Medical Auxiliaries: Report of a Symposium Held During the Twelfth Meeting. Scientific Publication No. 278. Washington, D.C.: Pan American Health Organization, 1973, p. 35.

The Guatemala study, reported in a series of articles in the Archives of Environmental Health, was aimed at testing the relative effectiveness on pre-school and infant mortality of modern medical care and sanitation on the one hand and of supplementary feeding on the other. Some summary data on infant and pre-school death rates are presented in Exhibits A.11 and A.12.

Time period	Village <sup>1</sup> Santa Maria Cauque			Santa Catarina <sup>2</sup> Barahona			Santa Cruz <sup>3</sup> Balanya		
	Neo-natal	Post-Neo-natal	Total	Neo-natal	Post-Neo-natal	Total	Neo-natal	Post-Neo-natal	Total
May 1950 - April 1958	63	73	136	71	110	182	88	99	185
May 1959 - April 1969	88	21	61	67	79	146	90	101	191

Ascoli et al. p. 442  
 (1) Medical care and sanitation.  
 (2) Supplementary feeding.  
 (3) Control

Time Period	Santa Maria Cauque	Santa Catarina Barahona	Santa Cruz Balanya
May 1950 - April 1959	50	55.6	81
May 1959 - April 1964	34.5	24.3	50

SOURCE: Werner Ascoli, Miguel A. Guzman, Kevin S. Scrimshaw and John E. Gordon, "Nutrition and Infection Field Study in Guatemalan Villages 1959-1964," Archives of Environmental Health (October, 1967) Vol. 15, p. 444.

(1) Medical care.  
 (2) Supplementary feeding.  
 (3) Control.

Some results of the study were unfortunately ruined by the chance occurrence of an acute epidemic of diarrheal disease in the medical treatment village.

In addition, although the medical treatment village was officially billed as a "treatment and environmental sanitation" village, "sanitation" consisted only of building latrines and of some cleaning up of the source for a public standpipe. Household connections were not provided. Villagers did not consistently use the latrines, and the study supervisors could not assure the absence of coliform bacteria in the water supplies.

There is nothing to refute the hypothesis developed from other data presented in this appendix - that medical care alone can at best, cut infant mortality to about 55 per thousand.

Additionally, it should be noted that pre-school mortality was reduced, and that while it could be argued that medical care and sanitation were more effective for reducing mortality among infants, nutritional supplementation seemed more advantageous for pre-schoolers.

The second study, done in India used a considerably more complex experimental design. One significant result of this study was the demonstration of the effect of the intensity of services on mortality.

Table A.15 contains the relevant data from that study. The letters at the top refer to the different combinations of services offered to the various experimental groups, thus FP refers to family planning, WS to Womens' services, NUT to nutritional supplementation, CONT to control. The results are still in an early stage of analysis and further interpretations will be published in the future. The authors sum up the results at this stage.

In summary the health impact of the child care program was as follows:

a. Nutrition services had a demonstrable effect on:

- 1) growth and development as measured by greater weight and height achievements of children in FP and CC and NUT villages.
  - 2) 1-3 year old child mortality when combined with infectious disease control and treatment in FP + WS + CC and FP + CC villages.
- b. Infectious disease control and treatment had a demonstrable effect on:
- 1) 1-12 month old infant mortality when provided through intensive home visiting surveillance visits in FP + CC and IDC villages.
  - 2) 1-3 year old mortality when combined with nutrition<sup>15</sup> services in FP + WS + CC and FP + CC villages.

By simply grouping infant death rates from all the various studies, it is possible to create a probability distribution which can serve to develop an estimate of rural health aid projected effectiveness in reducing infant mortality. The probability distribution and the expected value are contained in Exhibit A.13.

Exhibit A.13 Calculation of Expected Value of the Impact of Infant Mortality of a Well Functioning Medical Care System Using Health Auxiliaries		
Infant Death Rate	Probability	Midpoint* and Probability
50-69	.4	24
70-89	.3	24
90-109	.2	20
110 +	.1	12
Expected Value =		80

\*120 is taken as the midpoint for 110 +.

<sup>15</sup> Rural Health Research Center, Narangwal, Punjab, India, The Narangwal Population Study: Integrated Health and Family Planning Services. Baltimore: The Johns Hopkins University School of International Health, 1975, p. IV.D.12.

These studies were, for the most part, supervised by highly skilled clinical academicians. It would be surprising if any routinely operating program could reach the level of the best of them. El Salvador, as noted in the text of the analysis, suffers from problems of its own. Therefore, the high estimate would assume that infant deaths would drop on an average to 80 per thousand. This would imply a reduction in deaths of 193 in the high death rate model. If the low death rate model described the population, then there would be no reduction.

Deaths  
Prevented = Between 193 and 0.

There is little indication that medical care alone will have much of an effect on morbidity measured in cases. Therefore, the two morbidity indexes would be put at zero. Undertainty, for reasons explained in the body of the paper is high.

#### V. Estimate of the Effects of Sanitation

A 20% sample survey conducted by the Ministry of Health in Panama found that the prevalence of a number of diseases had decreased significantly after the introduction of piped water with household connections. The results of the survey are shown in Exhibit A.14.

In Exhibit A.15, the clinic visit and reported disease indices described in section I.4 are calculated for provision of water supplies with household connections.

Exhibit A.14 Households Reporting Selected Diseases Before and After the Introduction of a Rural Water Supply with Household Connections in Rural Panama

Disease	Before		After		Percentage Reduction
	Cases	%	Cases	%	
Diarrhea	1,035	29.6	441	12.6	57.3
Infections	354	10.2	197	5.9	44.3
Parasites	859	24.5	299	8.5	65.2
Gastroenteritis	310	8.8	133	3.7	57.1
Typhoid	14	0.39	5	0.14	64.2
No Complaint	1,377	39.2	1,961	55.9	-42.4*
Other Diseases	798	22.7	731	20.8	8.3

SOURCE: Ministerio de Salud de Panama, Evaluacion Socioeconomica Rurales en la Republica de Panama. Panama City: Ministry of Health, 1976, (Duplicated), p. 24.

\* The category no complaint, decreased (a negative reduction).

Exhibit A.15 Calculation of the Outpatient Visit and Reported  
Morbidity Indices for the Introduction of Rural Water Supply  
with Household Connections in El Salvador

Disease	Expected Percentage Reduction	Proportion Accounted for		Index	
		In Clinics	In Reported Diseases	Clinic	Reported Diseases
Diarrhea	57.3	.085	.276	4.87	15.8
Infections	44.3	.021		.93	-
Parasites	65.3	-	.247		16.1
Gastroenteritis	57.1	-			
Typhoid	64.2	-			
Total		.106		5.8	31.9

Exhibit A.16 contains an estimate of age-specific death rates in the two model populations. A 57 percent reduction would imply a reduction of 232 deaths in the high death rate population and of 126 in the low death rate population. A number of efforts to develop better estimates failed.

Exhibit A.16 Deaths from Diarrheal Disease in the Model Population						
Age	High			Low		
	Male	Female	Total	Male	Female	Total
0-4	183	163	346	96	82	178
5-14	9	8	17	5	4	9
15-24	1	2	3	1	1	2
25-34	1	2	3	1	1	2
35-44	2	2	4	1	1	2
45-54	2	2	4	2	2	4
55-64	4	3	7	4	3	7
65 +	13	12	25	10	7	17
<b>Total</b>	<b>214</b>	<b>194</b>	<b>408</b>	<b>120</b>	<b>101</b>	<b>221</b>

VI.. Estimate of Indicators for a Program that would Reduce Malaria

Since estimated malaria deaths were not significant for the model populations, they were not included in the tables. Calculation of expected malaria deaths is illustrated in Exhibit A.17. Exhibit A.17 also illustrates how other reported deaths were adjusted to make them consonant with expected age specific death rates. In 1975, there were 83,100 reported cases of malaria, accounting for 18.2 percent of total reported cases. It is difficult to put a number on the expected effectiveness of the new measures. Fifty percent seems rather modest, this would produce the following indexes:

$$\begin{array}{l} \text{Deaths} \\ \text{Prevented} \end{array} = \text{between 1.25 and 2}$$

$$\begin{array}{l} \text{Reported} \\ \text{Disease} \\ \text{Index} \end{array} = \frac{83,100}{1,780,059} \times 0.5 = .02$$

Uncertainty is moderate. There is little doubt about the effectiveness of the procedures. Doubts arise, however, about the ability of the Ministry to solve the logistical problems involved in making the program operational and about its ability to secure funds if financing needs outrun current expectations.

VII. Estimation of the Annuity Loss to a Campesino Family Arising from the Premature Death of an Adult

In the late 1940's, two insurance men published a book in which they illustrated a method for calculating the financial value of a breadwinner to his family.<sup>16</sup> Some years later it was shown that this same method under

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<sup>16</sup> Louis I. Dublin, Alfred J. Lotka and Mortimer Spiegelman, The Money Value of a Man. New York: Ronald Press, 1946.

Exhibit A.17 Estimation of Lives Lost Due to Malaria in the Model Population

Age	Total Reported Deaths (1)	Reported Malaria Deaths (2)	Proportional Rate (2)/(1) (3)	High Model		Low Model	
				Deaths (4)	Expected Malaria Deaths (3)x(4) (5)	Death (6)	Expected Malaria Deaths (3)x(6) (7)
0	8,953	16	.00179	525	0.94	228	0.41
1-4	5,005	15	.00300	184	0.55	116	0.35
5-14	1,937	6	.0031	87	0.27	46	0.14
15-24	1,458	4	.0027	83	0.22	34	0.10
25-34	1,423	2	.0014	70	0.10	39	0.05
35-44	1,752	10	.0057	67	0.38	54	0.31
45-54	1,957	8	.0041	61	0.25	69	0.28
55-64	2,503	3	.0012	92	0.11	94	0.11
65-74	3,190	12	.0038	127	0.48	253	0.79
75 +	4,011	10	.0025	188	0.47		
Total					3.77		2.54

SOURCE: Calculated from World Health Organization, World Health Statistics Annual. Geneva: World Health Organization, 1975, pp. 126 and 128.

certain assumptions could be used to calculate the loss of national income attributable to the premature death of one citizen.<sup>17</sup> It was later used in many instances to calculate a so-called "economic" loss due to premature death. This third use was shown to be illegitimate, at least from the point of view of an economist.<sup>18</sup>

Nevertheless, in an income distribution context, the measure still makes sense. A family deprived of a productive member loses wealth equal to the present value of the individual's earnings. No one pretends that the money would replace the man. It is only a part of the loss imposed by pollution.

Exhibit A.18 The Financial Value of an Agricultural Worker to His Family (assumed - age 35, assumed life expectancy - 36.5 years) at Three Different Assumed Interest Rates and Two Assumptions About Labor Utilization-per day. (U.S. Dollars)		
Days Worked Per Year		
Interest Rate	125 Days - 50% Utilization	250 Days - Full Utilization
5%	4216.55	8492.98
10%	2547.30	4949.48
20%	1266.12	2550.21

<sup>17</sup>

Burton A. Weisbrod, Economics of Public Health. Philadelphia: University Press, 1961.

<sup>18</sup>

E.J. Mishan, "Evaluation of Life and Limb: A Theoretical Approach", Journal of Political Economy (July, 1971), Vol. 79, pp. 687-705.

To calculate an estimated annuity value, the average age in the 15-64 age group was estimated from the 1971 census data to be 33.

To estimate annual earnings, two assumptions were made about labor force utilization in agriculture, assumption one, that participating labor force members would work 125 days per year and assumption two, that they would work 250 days per year. The object was not to take account of disguised unemployment, but rather of expected underutilization. The family of the worker loses even if he is replaced, and 20 deaths are not enough to affect the labor market so they do not serve to increase expected earnings of anyone.

Open unemployment was last recorded as 7.8% in agriculture so;

$$(1 - .078) \times \text{Active Labor Force Days}$$

serves to estimate average expected working days. The life tables available gave life expectancies at only five year intervals.<sup>19</sup> At 30, a male had a life expectancy of 40 years. At 35, it was 36.5 years. The present value calculations were not really sensitive to the difference (differing by 8 or 10 dollars). So the shorter life expectancy was used.

The final calculation can be considered an estimate of the financial burden placed on a poor family by the death of a breadwinner. The results are presented in Table A.18.

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<sup>19</sup> United Nations. Department of Economic and Social Affairs, Statistical Office, Annuaire Demographique, 1975, New York: United Nations, 1976, p. 398.

VIII. Some Present Value Calculations Relevant to the Analysis of Alternat  
Water Supply Proposals

Comparison of capital costs can lead to erroneous conclusions when comparing alternatives. This is true particularly when future operating costs to an agency are compared. Thus, household connections with tariffs would shift the operating cost of the system from the agency to the consumer while the operating costs of a standpipe system must be borne by the agency. If the agency does not bear the operating costs, then the standpipe becomes inoperative and there are no benefits at all.

Exhibit A.19 Discounted Present Value of Per Capita Maintenance Costs at Different Assumed Interest Rates			
Per Capita Maintenance Cost \$ per month	(Time Horizon = 20 years) Discount Rate (percent)		
	Five	Ten	Twenty
\$1.00	149.55	102.16	58.43
\$2.00	299.09	204.33	116.87
\$3.00	448.64	306.49	175.30

In Exhibit A.19, three likely levels of per capita maintenance cost are discounted to the present at three likely interest rates assuming a 20 year time horizon. Since 80% of operating costs can be recovered by tariffs on household connections, some estimates from these figures should be "netted out" when comparing household connection and standpipe systems from the view point of long-range planning for an agency. (An economic

analysis, of course, would attempt to compare social costs and benefits. Even here, however, consumer willingness to pay should bear considerable weight in the final decision).

The discounted present value of future costs would also be relevant to the analysis of the engineer's suggestion that a mapping survey for urban water systems would be advisable. The calculations in Exhibit A.20 illustrate that such a policy would be advisable from a financial point of view only at certain tariffs and for certain interest rates, if the survey costs \$100,000 and reduces the loss by 85 or 90 percent.

Present expected loss is estimated .7 m<sup>3</sup>/sec. The survey would reduce loss through leakage to 10-15% of capacity. 12% is taken as the expected loss. Present system capacity is 2.1 m<sup>3</sup>/sec. The net gain would be estimated present loss less the loss that would remain after the survey, or .7 minus 12% of 2.1. This explains the first calculation in Exhibit A.20. The present charge is \$.04 per m<sup>3</sup>/sec. It has been suggested that the charge be increased to \$.10 per m<sup>3</sup>/sec. so the annual revenue loss is estimated at this charge. Using the same method, the expected annual gain is estimated for a minimum and maximum, expected gain, and the present value is calculated. If the present value exceeds \$100,000, then the investment is considered worthwhile. At a 10% discount rate, if the charge is set at \$.10, it would be worthwhile. On other assumptions, however, it would not be.

Table A.3

Calculation of Expected Deaths in the Model Population  
of 100,000 (upper limit) in Rural El Salvador

Age	<sup>a</sup> Males Death Rates	Population	Deaths	Females Death Rates	Population	Deaths
0	145.05	1,736	259	121.72	1,859	225
1-4	14.15	6,681	94	13.87	6,500	90
5-9	3.44	8,264	28	3.41	7,942	27
10-14	2.34	6,687	16	2.55	6,440	16
15-19	3.78	4,941	19	3.79	5,135	19
20-24	5.48	4,127	23	5.19	4,309	22
25-29	5.63	3,130	18	5.58	3,457	19
30-34	6.00	2,758	16	5.85	2,903	17
35-39	6.77	2,565	17	6.31	2,686	17
40-44	8.41	2,118	18	7.15	2,147	15
45-49	11.22	1,632	18	8.95	1,757	16
50-54	15.43	1,329	20	11.91	1,466	17
55-59	21.65	972	21	16.48	1,028	17
60-64	31.58	962	30	24.70	962	24
65-69	46.92	600	28	38.47	640	25
70-74	71.61	561	40	61.59	549	34
75-79	107.64		86	97.39		
80-84	162.98	481		147.96	615	102
85 +	264.90			254.36		

Source: <sup>a</sup>United Nations, Department of Economic and Social Affairs, The Concept of a Stable Population Application to the Study of Populations of Countries with Incomplete Demographic Statistics. New York: United Nations, 1968. p. 65.

Table A.4

Model Population of 100,000 Rural Residents in El Salvador (lower limit)

Age	<sup>d</sup> Males	Population	Deaths	Females	Population	Deaths
0	70.3	1,786	126	55.1	1,859	102
1-4	8.8	6,681	59	8.7	6,500	57
5-9	1.9	8,264	16	2.1	7,942	17
10-14	1.0	6,687	23 7	0.9	6,440	23 6
15-19	1.6	4,941	8	1.2	5,135	6
20-24	3.5	4,127	22 14	1.5	4,309	12 6
25-29	4.0	3,130	13	1.7	3,457	6
30-34	4.6	2,758	26 13	2.5	2,903	13 7
35-39	6.6	2,565	17	3.7	2,686	10
40-44	8.1	2,118	34 17	4.7	2,147	20 10
45-49	10.7	1,632	17	8.3	1,757	15
50-54	15.4	1,329	37 20	11.4	1,466	32 17
55-59	20.3	972	20	16.2	1,028	17
60-64	31.2	962	50 30	27.6	962	44 27
65-69	43.2	600	26	39.6	640	25
70-74		561			549	
75-79	97.1	481	101	87.4	615	101
80-84						
85 +						

SOURCE: <sup>a</sup>United Nations Department of Economic and Social Affairs, Demographic Yearbook, 1974. New York: United Nations, 1975, pp. 650-651.

Table A. 5

## Distribution of Infant Death by Age for Model Salvadorean Populations

Age Group	Proportion	Male		Female	
		High	Low	High	Low
Under 1	1.000	299	126	226	102
Neonatal	.345	103	43	78	35
Under 7 days	.234	70	29	53	24
Under 1 day	.113	34	14	25	11
1-6 days	.121	36	15	27	12
7-27 days	.110	33	14	25	11
Post-neonatal	.655	196	82	148	67

SOURCE: Proportions Derived from Puffer and Serrano, p. 61.  
Total deaths derived from model populations.

Distribution of Infant Deaths by Cause for El Salvador Model

Cause	Underlying		Male		Female		Associated		Male		Female	
	No.	Prop.	High	Low	High	Low	No.	Prop.	High	Low	High	Low
All causes	648	1.000	299	126	226	102	942	1.000	299	126	226	102
Infectious diseases	416	.642	192	81	145	65	104	.110	33	14	25	11
Nutritional Deficiency	13	.020	6	2	4	2	185	.196	59	25	44	20
Diseases of the nervous system	5	.008	2	1	2	1	14	.015	4	2	3	2
Diseases of the Respiratory system	78	.120	36	15	27	12	135	.143	43	18	32	15
Congenital Anomalies	24	.037	11	5	8	4	18	.019	6	2	4	2
Certain perinatal causes	94	.145	43	18	33	15	139	.148	44	19	33	15
Maternal conditions	16	.025	7	3	6	3	2	.002	6	-	-	-
Difficult labor, birth injury	19	.029	9	4	6	3	3	.003	1	-	1	-
Conditions of placenta & cord	9	.014	4	2	3	1	1	.001	-	-	-	-
Hemolytic disease	-	-	-	-	-	-	1	.001	-	-	-	-
Anoxic, hypoxic conditions	24	.037	11	5	8	4	31	.033	10	4	8	3
Immaturity	5	.008	2	1	2	1	81	.086	26	11	19	9
Other	21	.032	10	4	7	3	20	.021	6	3	5	2
Other Causes	18	.028	8	3	6	3	347	.368	110	46	83	37

Table A.7

Distribution of Neonatal Deaths by Underlying Cause for El Salvador Model Population

Cause	Number	Proportion	Male		Female	
			High	Low	High	Low
All Causes	917	1.000	103	43	78	35
Diarrheal Disease	132	.144	15	6	11	5
Other infectious disease	90	.098	10	4	8	3
Diseases of the Respiratory System	69	.075	8	3	6	3
Congenital anomalies	62	.068	7	3	5	2
Certain perinatal causes	537	.585	60	25	46	21
Maternal conditions	84	.092	9	4	7	3
Complications of pregnancy	117	.127	13	5	10	4
Difficult labor/ birth injury	134	.146	15	6	11	5
Conditions of placenta and cord	43	.047	5	2	4	2
Hemolytic disease	11	.012	1	1	9	-
Anoxic, hypoxic conditions	118	.129	13	5	10	5
Immaturity	11	.012	1	1	1	-
Other	19	.021	2	1	2	1
Other causes	27	.029	3	1	2	1

Derived from Puffer and Serrano, op. cit., p. 95.

Table A.8

Distribution of Deaths by Underlying Cause of Children  
Under Five Years in El Salvador

Cause	No.	Proportion	Male		Female	
			High	Low	High	Low
All causes	1,082		353	185	316	159
Infective and Parasitic Diseases	711	.657	231	122	208	104
Amebiasis	22	.020	7	4	6	3
Diarrheal Disease	559	.517	183	96	163	82
Other Intestinal Infectious diseases	6	.006	2	1	2	1
Tuberculosis	3	.003	1	1	1	0
Diphtheria	5	.005	2	1	2	1
Whooping Cough	17	.016	6	3	5	3
Tetanus	29	.027	9	5	9	4
Septicemia	8	.007	2	1	2	1
Measles	51	.047	17	9	15	7
Congenital Syphilis	-	-	-	-	-	-
Moniliasis	2	.002	1	0	1	0
Helminthiasis	4	.004	1	1	1	1
Other rest of 000-136	5	.005	2	1	2	1
Malignant Neoplasms	-	-	-	-	-	-
Neoplasms, other	1	.001	0	0	0	0
Nutritional Deficiency	88	.081	28	15	26	13
Vitamin Deficiency	-	-	-	-	-	-
Protein Malnutrition	77	.071	25	13	22	11
Nutritional Marasmus	9	.008	3	1	3	1
Other	2	.002	1	0	1	0

Table A.8 (cont)

Cause	No.	Proportion	Male		Female	
			High	Low	High	Low
Endocrine & Metabolic diseases	-	-	-	-	-	-
Deficiency Anemias	-	-	-	-	-	-
Other Diseases of the blood & blood forming organs	1	.001	0	0	0	0
Inflammatory diseases of central nervous system	7	.006	2	1	2	1
Other diseases of nervous system and sense organs	5	.005	2	1	2	1
Diseases of circulatory system	-	-	-	-	-	-
Pneumonia and influenza	66	.061	24	11	19	10
Other diseases of respiratory system	37	.034	13	6	11	5
Diseases of digestive system	3	.003	1	1	1	0
Diseases of genito-urinary system	4	.004	2	1	1	1
Diseases of skin and sub-cutaneous tissue	3	.003	1	1	1	0
Diseases of musculoskeletal system	1	.001	0	0	0	0
Congenital Anomalies	29	.027	11	5	9	4
Nervous System	16	.015	6	3	5	2
Circulatory System	8	.007	3	1	2	1
Respiratory System	-	-	-	-	-	-
Digestive System	2	.002	1	0	1	0
Genito-urinary system	-	-	-	-	-	-
Musculoskeletal system	2	.002	1	0	1	0
Down's disease	1	.001	0	0	0	0

Table A.8 (cont)

Cause	No.	Proport'	Male		Female	
			High	Low	High	Low
Other anomalies	-	-	-	-	-	-
Certain perinatal causes	94	.087	34	16	27	14
Symptoms	8	.007	3	1	2	1
Sudden Death	-	-	-	-	0	-
Other ill-defined conditions	13	.012	5	2	4	2
External Causes	11	.010	4	2	3	2

Derived from Puffer and Serrano, pp. 414-415.

Table A.10

Deaths by Cause in Male Age Groups Five and Over  
in the El Salvador  
Model Rural Population (low estimate)

Cause of Death	Age Group						
	5-14	15-24	25-34	35-44	45-54	55-64	65 +
A5 Enteritis and Diarrhea	5	1	1	1	2	4	10
A6 TB of the Respiratory System	-	-	-	1	1	1	2
A20 Tetanus	-	-	-	-	-	1	-
A25 Measles	1	-	-	-	-	-	-
A31 Malaria							
A58 Other Malignant Neoplasms				3	1	1	2
A64 Diabetes Mellitus	-	-	-	-	-	-	1
A65 Avitaminosis and other nutritional disorders	-	-	-	-	1	1	2
A67 Anemias	1	-	-	-	1	1	3
A70 Neuroses, personality disorders & other mental	-	-	-	1	-	2	-
A72 Meningitis	-	-	-	1	-	2	-
A79 Other Nervous & some diseases	-	-	-	-	-	1	3
A83 Ischaemic Heart Disease	-	-	-	-	1	1	4
A84 Other forms of heart disease	-	-	-	-	1	1	3
A85 Cerebrovascular disease	-	-	-	-	1	2	4
A86 Diseases of Arteries, arterioles & capillaries	-	-	-	-	-	-	1
A90 Influenza	1	-	-	-	-	1	3
A92 Other Pneumonia	1	-	-	-	-	1	3

Table A.10 (cont)

Cause of Death	Age Group						
	5-14	15-24	25-34	35-44	45-54	55-64	65 +
A93 Bronchitis, Emphysema & asthma	-	-	-	-	-	1	3
A96 Other diseases of the respiratory system	-	-	-	-	-	1	2
A101 Intestinal obstructions and hemia	-	-	-	-	-	-	1
A102 Cirrhosis of the liver	-	-	-	1	1	1	1
A104 Other digestive diseases	-	-	1	1	2	3	4
A111 Other diseases of the genito-urinary tract	-	-	-	-	-	-	2
A120 Other diseases of the skin & subcutaneous tissue	-	-	-	-	-	1	2
AE138 Motor vehicle accidents	1	1	2		1	1	1
AE141 Accidental falls		1		1		6	2
AE146 All other accidents	1	1	1	1		1	1
AE147 Suicide and self-inflicted injury	-	2	2	1	1	1	
AE148 Homicide and injury inflicted by other persons	5	6	8	8	4	2	1
Other	7	10	11	14	19	12	40
% unaccounted for	30.4	45.1	42.3	41.2	51.3	24.0	39.6

Derived from: World Health Organization, World Health Statistics Annual 1972. Geneva: World Health Organization, 1975, pp. 126-137.

Table A.11

Deaths by Cause in Male Age Groups Five and Over in the El Salvador Model Rural Population of 100,000 (High Estimate)

Cause of Death	Age							
	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+
A5 Enteritis and other diarrheal diseases	9	1	1	2	2	4	6	7
A6 T.B. of the Respiratory system	-	1	1	1	1	1	1	1
A25 Measles	2							
A47 Malignant Neoplasm of the stomach						1	1	1
A58 Malignant Neoplasm, unspecified				3	1	1	1	1
A64 Diabetes Mellitus						1	1	1
A65 Avitaminosis & other nutritional deficiencies	1				1	1	1	1
A67 Anemias	2	1			1	1	2	1
A70 Neuroses, mental disorders and other non-psychotic disturbances		1	1	3	2	-	1	
A72 Meningitis						2		
A79 Other diseases of the nervous system and sense disorders	1	1				1	2	2
A83 Ischemic heart disease					1	1	2	2
A84 Other forms of heart disease					1	1	2	2

Table A.11 (cont)

Cause of Death	Age							
	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+
A85 Cerebrovascular disease		1			1	2	2	3
A90 Influenza	1					1	2	3
A92 Other Pneumonia	1					1	1	3
A93 Bronchitis, Emphysema & asthma	1					1	1	2
A101 Intestinal obstruction and Hemia							1	1
A102 Cirrhosis of the liver				1	1	1	1	1
A104 Other diseases of the digestive system	1	1	1	1	2	3	2	3
A111 Other diseases of the genito-urinary system							1	1
A122 Non-articular rheumatism & unspecified rheumatism							1	2
A136 Senility without mention of psychosis							2	12
AE138 Motor Vehicle accidents	3	3	2		1	1	1	1
AE140 Accidental Poisoning	1	1						
AE141 Accidental Falls	1	1	1	1		1	1	1
AE143 Accidental drowning and submersion	2	2	1	1				

Table A.11 (cont)

Cause of Death	Age							
	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+
AE146 All Other Accidents	1	2	1	1	1	1	1	1
AE147 Suicide and self-inflicted injury		4	3	1	1	1		
AE148 Homicide and injury inflicted on other persons	10	11	11	8	4	2	1	
AE149 Injury undetermined whether accidental or purposely inflicted	2	2	1	1				
AE150 Injury resulting from operations of war	1	1						
Other Causes	4	8	10	11	17	20	30	33

Derived from: World Health Organization, World Health Statistics Annual 1972, Geneva: World Health Organization, 1975, pp. 126-137.

Table A.12

Distribution of Deaths by Cause for a Model Rural Population  
of 100,000 in El Salvador (Female-Low)

Cause of Death	Age						
	5- 14	15- 24	25- 34	35- 44	45- 54	55- 64	65+
A5 Enteritis and other diarrheal diseases	4	1	1	1	2	3	7
A6 T.B. of the respiratory system			1	1	1	1	
A15 Diphtheria	1						
A25 Measles	2						
A43 Other Helminthiasis	1						1
A47 Malignant Neoplasm of stomach							1
A55 Malignant Neoplasm of cervix uteri					1		
A58 Other unspecified Malignant Neoplasms				1	3	3	3
A61 Benign neoplasms & neoplasms of unspec- ified nature							1
A64 Diabetes Mellitus					1	1	1
A65 Avitaminosis & other nutritional deficiency	1		1			1	1
A67 Anemias	1				1	1	2
A79 Other diseases of the nervous system and sense organs	1				1	1	1
A83 Ischemic Heart Disease					1	1	2
A84 Other forms of heart disease					1	1	3
A85 Cerebrovascular disease					1	2	4

Table A.12 (cont)

Cause of Death	Age						
	5-14	15-24	25-34	35-44	45-54	55-64	65+
A90 Influenza					1	1	4
A92 Non-viral pneumonia					1		2
A93 Bronchitis, Emphysema & Asthma	1				1	1	2
A98 Peptic ulcer							1
A101 Intestinal obstruction or hernia							1
A102 Cirrhosis of the liver					1	1	
A104 Other diseases of the digestive system	1		1	1	2	3	5
A117 Other complications of birth, pregnancy, puerperium		1	1	1			
A120 Other diseases of skin and subcutaneous tissue						1	2
A122 Non-articular & unspecified rheumatism						1	2
A136 Senility without mention of psychosis							
A138 Motor vehicle accidents	1	1					
A141 Accidental Falls							
A146 All other Accidents	1						
Other Causes	8	9	8	15	13	21	54

Derived from: World Health Organization, World Health Statistics Annual, 1972. Geneva: World Health Organization, 1975, pp. 126-137.



Table A.13 (cont)

Cause of Death	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+
AE143 Accidental drowning and submersion	1	1						
AE146 All other accidents	1	1						
AE147 Suicide and self-inflicted injury			2					
AE148 Homicide and injury purposely inflicted by other persons, legal intervention		2	1	1				
AE149 Injury undetermined whether accidental or purposely inflicted		2						
Other	20	15	17	18	15	21	31	66

Derived from: World Health Organization, World Health Statistics Annual 1972. Geneva: World Health Organization, 1975, pp. 126-137.

Table A.14  
Reported Tetanus Deaths in El Salvador, 1972

Age	Reported Deaths	Percentage Distribution
0	234	75.0
1-4	11	3.5
5-14	12	3.8
15-24	8	2.5
25-34	6	1.9
35-44	13	4.2
45-54	8	2.6
55-64	10	3.2
65-74	7	2.2
75 +	3	1.0
TOTAL	312	100.0

SOURCE: World Health Organization, World Health Statistics Annual, 1975.  
Geneva: World Health Organization, 1975, p. 126.

Table A. 15. Results of the Narangwal Study:

INFANT MORTALITY RATES AND THEIR CHANGE BY EXPERIMENTAL GROUP OVER TWO TIME PERIODS  
(Standardized by Caste and Sex Distribution and Differentials)

MORTALITY RATE	EXPERIMENTAL GROUP														Khanra Study* 1957-1959
	FP+NS+CC		FP+WS		NUT+IDC (FP+CC)		NUT		IDC		CONT-P+H		ALL		
	70/71	72/73	70/71	72/73	70/71	72/73	70/71	72/73	70/71	72/73	70/71	72/73	70/71	72/73	
Infant Mortality Rate	78	103	85	81	45	50	81	50	80	82	96	97	69	82	89
Change	+32.1		-4.7		+11.1		-38.3		+2.5		+1.0		+18.8		
Infant Mortality Rate	51	66	58	61	49	55	61	34	60	48	71	56	58	56	74
Change	+29.4		+5.2		+12.2		-44.3		-20.2		-21.1		-3.5		
Neonatal Mortality Rate	55	47	54	56	35	28	40	44	32	13	35	52	43	43	82
Change	-14.6		+3.7		-20.0		+10.0		-59.4		+48.6		-0		
1 Infant Mortality Rate	106	112	113	117	83	82	101	77	91	63	107	108	102	99	156
Change	+5.7		+3.5		-1.2		-23.8		-30.8		+0.9		-2.9		

Source: Rural Health Research Center, Narangwal, Punjab, India, The Narangwal Population Study: Integrated Health and Family Planning Services. Baltimore: The Johns Hopkins University Division of International Health, 1970.

## Appendix C: Water Supply and Diarrheal Disease

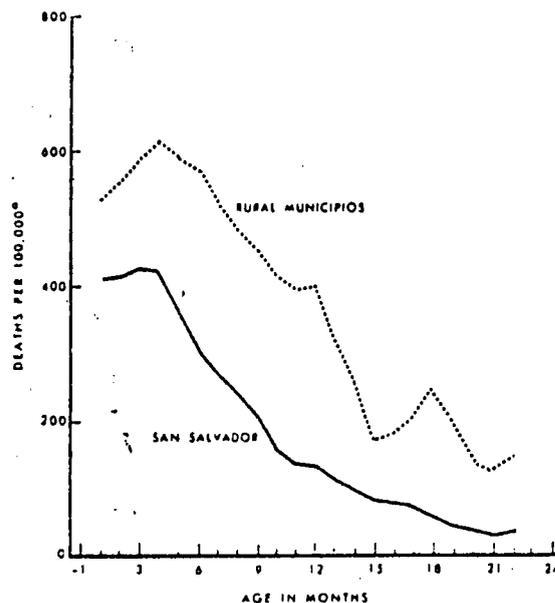
by Hinda Ripps, M.A.

Diarrheal diseases constitute a very serious health problem for children in developing countries. In an effort to develop strategies for the future, we can estimate the effects of this particular health problem on child morbidity and mortality in El Salvador by examining trends and impacts of health programs in other countries. First, however, we must ascertain the etiology of the disease.

In El Salvador, mortality due to diarrheal diseases continues at an inordinate rate, even at eleven months of age and does not show a marked decrease until the end of the second year of life.

Figure 1

Mortality\* from Diarrheal Disease by Month of Age in First Two Years of Life in Two Areas of El Salvador.



\*Smoothed averages of death rates under 1 year per 100,000 live births and 12.23 months per 100,000 population.

SOURCE: Patterns of Mortality in Childhood. Ruth Rice Puffer, Carlos V. Serrano, PAHO, 1973, p. 144.

These early years encompass the period of weaning and if we examine the diarrheal rates in other developing countries we can see a similar pattern for both mortality and morbidity. By comparing diarrheal rates in developing countries to rates in more developed societies, we see that the death rate from diarrheal diseases is 25 times greater in Guatemala than the U.S.

Because diarrheal disease attacks young children most frequently, it is this target population to which effective programs for control should be directed. The presence of diarrhea may be caused by several factors such as the level of nutritional status, medical care, sanitation, quantity, quality and availability of water, personal hygiene practices, and the disease agent. The choice for the best method of attack against diarrhea in El Salvador can be based on progress in other countries.

Studies in which presence (or absence) of water supply are related to the incidence of diarrheal rates, indicate that diarrheal rates decrease with the increased presence of water. Table 1 offers an examination of the incidence of diarrhea in seven countries and in all cases the incidence of diarrhea decreased in the areas with a water supply. Presence of water, however, is a very broadly defined category. Of more significance is the amount, proximity, and type of water to be supplied. Schessman et. al. (1958) and William Stewart et. al. (1955) in separate studies on diarrheal rates, found that these rates decreased as the distance between the household and water supply also decreased. In a WHO report on diarrheal disease on Sudan in 1966, it was concluded that the amount of water is negatively correlated with the prevalence of diarrhea. The proximity to water and the increased amount serves to ease the attainability of water. This, coupled with sanitary educational practices for obtaining and maintaining clean water, should decrease diarrheal rates.

Table 1

INCIDENCE OF DIARRHOEA AND RATES OF ISOLATION OF SHIGELLAE IN CHILDREN<sup>a</sup>

Country	Age-group (years)	No. of children examined		Incidence of diarrhoea (%)		Rate of isolation of shigellae (%)	
		Area with Water Supply	Area without Water Supply	Area with Water Supply	Area without Water Supply	Area with Water Supply	Area without Water Supply
Mauritius <sup>b</sup>	<5	550		2		7.6	
Sudan	<7	239	211	21.8	26.6	6.4	14
UAR	<6	174	317	10	38	3.4	9.4
Ceylon	<10	460	508	2	2	2	4
Iran	<7	453	425	36	48.7	4.7	7.5
East Pakistan	<7	---	668	---	20	---	<1
Venezuela	<7	656	526	39	43	3.0	7.6

a Data collected over a one-month period.

b No separate data from two types of areas.

Source: W. J. Van Zijl, "Studies on Diarrheal Diseases in Seven Countries by the WHO Diarrheal Diseases Advisory Team," Bulletin of World Health Organization, Vol. 35, No. 2, 1966, p. 250.

Table 2: Effect of Location of Water Source on Diarrhea Incidence in Mauritius

Location of water Supply	No. of people examined		Incidence of diarrhea		Rate of isolation of shigellae (children under 12 years old)
	All ages	Under 12 years old	All ages	Under 12 years old	
In the house	371	97	0.5	0	3.1
On premises	942	222	1.5	5.0	3.6
Off premises	820	170	2.9	8.8	6.5

Source: W. J. Van Zijl, "Studies on Diarrheal Diseases in Seven Countries by the WHO Diarrheal Diseases Advisory Team," Bulletin of World Health Organization, Vol. 35, No. 2, 1966, p. 255.

As a case in point of the inadequacy of presence of water alone for reducing the diarrheal problem, in Venezuela, similar studies were conducted on groups with and without a water supply. By comparing water supply with detection of shigellae, a Chi square of 11.6 was obtained, with a p value of less than 0.001, thus indicating a significant reduction in the presence of shigellae for areas with a water supply. However, more importantly, when diarrheal diseases were compared with presence of water, no significant decreases were found in the diarrheal rate.

The particulars of this case which are important to note are that only 70% of the homes in the area with a water supply had water pumped directly into the house. The rest of the homes had only an outside water supply. Furthermore, sanitary measures such as sewage disposal and kitchen facilities were below satisfactory levels. When the Venezuelan study was compared with six other countries, it was evident that while the presence of water reduced both the diarrheal rate and the detection of shigellae, this was not sufficient to decrease the problem noticeably without further sanitary improvements.

The key factor here is easy attainability of water. Hollister et al found that the rate of shigellae infection was less for those individuals who had water available for personal hygiene. The group with an inside faucet had a disease rate of 1.2 percent, while the group with no inside facilities had a disease rate of 5.9 percent. In another study by D.J. Schliessmann, disease resulting from *Ascaris* infestation was three times as great for those individuals with a water supply outside the home.

These findings substantiate the belief that availability is essential. Easier access would allow individuals to use water more freely. For instance washing hands before preparing food may appear to be a frivolous waste of water when this water can only be obtained by carrying clay jars great distances.

Still another problem is proper sanitary education to teach people the necessity of personal hygienal habits once water is readily available inside the home. Clean water may be very quickly contaminated by individual who unknowingly place it into contaminated jars. A WHO summary report on diarrhea diseases reported that diarrheal rates remained high in areas where water was readily available but sanitation was inadequate.

Availability of water for toilets also decreases the diarrheal rate. Information obtained from a WHO Diarrheal Diseases Advisory team confirms this finding.

Table 3

Effect of Type of Excreta Disposal  
on Diarrhea Incidence

Type of Excreta Disposal	Number of Persons Examined	Incidence of Diarrhea (%)
Indoor toilets	194	0.5
Outdoor toilets	1,603	1.9
Water-carriage system	114	0.9
Sugar-cane fields	207	4.8

Source: W.J. Van Zijl, "Studies on Diarrheal Diseases in Seven Countries by the WHO Diarrheal Diseases Advisory Team," Bulletin of the World Health Organization, Vol. 35, No. 2, 1966, p. 256.

In the above table, we can see that the incidence of diarrhea for those using no toilets, or the sugar cane fields, is much greater than the incidence for those using indoor toilets. Computing a chi square, a statistically significant difference was found in the diarrheal rate for these two types of excreta disposal systems.

The transmission of the disease through improper disposal of human excreta, and other wastes, is a major area of concern. Although young infants do not directly make use of indoor toilets, fundamental sanitation practices are extremely important for the adults who come into contact with these children. Direct contact is a chief method of the spread of the disease and the most frequent carriers of pathogens are not the infants, but rather older children and adults. The problem results from a combination of the lack of readily available water for both cleanliness and excreta disposal.

Diarrheal diseases, also associated with nutritional status, are found to occur at a greater frequency among malnourished children than among well-nourished children. The most critical period is the period of weaning when regular foods become a part of the child's diet. As noted previously, diarrheal rates are extremely high between the ages of six and twenty four months.

Scrimshaw et al, in a study on nutrition and infection in a three Guatemalan villages (1959-64), set up three groups; a control group, a group receiving medical care (treatment group), and a group receiving dietary supplements (feeding group). It was found that cases of reported diarrhea were twice as great in the treatment group as in either of the other two groups. Furthermore, within the feeding village, when the percentage of children receiving supplements declined from 51% to 18%, the attack rate of diarrhea increased from 50 to 217 cases per 100 children per year.

During the study, food supplements reached the children over two years of age on a more regular basis than those six to twenty-four months. Comparing the feeding group with the treatment group, stratifying by age, it is evident that the food supplement was more effective in reducing diarrheal rates for those children whose nutritional supplement was more complete.