12-1991

Preliminary Epidemiological Interpretation of the Intrinsic and Extrinsic Factors Contributing to the Coverage and Participation Rates of the Vaccination Program in Arssi, Ethiopia

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PRELIMINARY EPIDEMIOLOGICAL INTERPRETATION OF THE INTRINSIC AND EXTRINSIC FACTORS CONTRIBUTING TO THE COVERAGE AND PARTICIPATION RATES OF THE VACCINATION PROGRAM IN ARSSI, ETHIOPIA

A Thesis

Presented to

the Faculty of the Department

of Environmental Health

East Tennessee State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Environmental Health

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by

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December 1991

APPROVAL

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The committee read and examined his thesis, supervised his defense of it in an oral examination, and decided to recommend that his study be submitted to the Graduate Council and the Associate Vice-President for Research and Dean of the Graduate School, in partial fulfillment of the requirements for the degree of Master of Science in Environmental Health.

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ABSTRACT

PRELIMINARY EPIDEMIOLOGICAL INTERPRETATION OF THE INTRINSIC AND EXTRINSIC FACTORS CONTRIBUTING TO COVERAGE AND PARTICIPATION RATES OF THE VACCINATION PROGRAM IN ARSSI, ETHIOPIA

by

Muchie Kidanu

Many immunization programs in developing countries are now undergoing a period of rapid utilization. Innovative strategies, such as immunization holidays, are being tried. Political commitment and enthusiasm are high. There is a strong desire by health professionals to protect the lives of many children from the untimely death and/or disability resulting from infectious diseases preventable by vaccination.

Evaluation of an immunization program can benefit other elements of the health system, particularly those that are not amenable to objective evaluation as immunization. In this case, immunization can serve as an indicator of the overall performance of the health system. The problems revealed by evaluation of the immunization program could therefore be taken as problems generic to the health services as a whole. In remedying the problems for immunization, approaches that would improve the health services as a whole should be sought.

The primary purpose of this study was to determine the intrinsic and extrinsic factors contributing to coverage and participation rates of the vaccination program in Arssi, Ethiopia. Vaccination program participation is relatively easy to estimate, although its importance should not be over-emphasized as the primary goal of immunization programs is the reduction in mortality, morbidity, and disability resulting from infectious diseases preventable by vaccination.

The survey questionnaire, adopted by the World Health Organization (WHO), was one of the instruments used for this project. Results of the evaluation in 1988 showed that only 66.5% of the children surveyed were fully vaccinated, while 26.9% were partially vaccinated, and 16.6% were not vaccinated at all. Comparisons of the survey results between the years 1983, 1985, and 1988 was made to determine whether

or not there was improvement in vaccination coverage between the years. Decisions about the differences of the survey results in population proportions between the years were based on whether or not the differences were scientifically significant, leading us to the rejection of the null hypothesis of no difference (zero), and whether or not the results were scientifically important (whether or not the results showed an increase in vaccination coverage). An increase in usage rate was noticed more in 1988 than the previous survey results of 1985 and 1983.

Mothers or guardians were asked about the possible reasons of immunization failures when their children or themselves were found partially or not-vaccinated. The reasons included such facts as lack of information, lack of motivation, obstacles/barriers, and wrong/improper vaccination techniques.

Based on the literature review and the survey results, recommendations were made to help correct the observed problems and achieve a higher level of vaccination coverage.

DEDICATION

This study is sincerely dedicated to my wife, Beletech Mengistu, and to my children, Martha and Gedeon, for their love, support, encouragement, and understanding throughout my stay in the United States. May God bless and brighten their futures.

ACKNOWLEDGMENTS

My sincere gratitude goes to Ms. Donna Garland Robbins, the committee chairperson, for her assistance and guidance in this research. I am very grateful for her patience, sincerity, concern, and encouragement throughout the research. I would like to express my deepest appreciation to Dr. Creg Bishop, for his most valuable understanding and encouragement, starting from my undergraduate years. His unreserved assistance in my graduate studies and in the preparation of this research project is highly appreciated. I would like to extend my sincere gratitude to Dr. R. Dean Blevins for his most valuable encouragement and assistance during my school years. My deepest appreciation goes to Dr. Guy Lanza, Dean, School of Public and Allied Health, Dr. M. T. Morgan and Dr. Al. F. Iglar for their encouragement and support.

Deepest thanks to the Ministry of Health in general, and Epidemiology Department in particular for giving me the chance to pursue my education at East Tennessee State University.

Special thanks to my brother, Terefe Kidanu, including all his family members, my friends, and relatives who supported my family during my absence. My special thanks to Tesfa Terefe and Ruth Asfaw for their moral and material support during my stay in the United States. Last but not least, I would like to express my gratitude to all my friends at E.T.S.U. for their unreserved encouragement.

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CHAPTER 1

Introduction

Background

Except for smallpox, for which the stated objective was eradication, most national immunization programs for other infectious diseases aim for a significant percentage reduction of morbidity, mortality, and disability. In doing so, due regard should be paid to operative constraints, epidemiological factors, and the effectiveness and potency of the vaccines. In planning a national program the following points should be taken into consideration:

1. Cost-effectiveness and cost-benefit of immunization programs;

2. Epidemiological assessment of diseases to be controlled by immunization (Islam 1977).

The Immunization Program in Ethiopia was integrated with the basic health services. It was an active component of the routine activities of the health facilities in the country. Ethiopia had six levels of health services, which as a whole, were oriented to Primary Health Care approach. The approach emphasized the expansion of rural health services, disease prevention and control, and promotion of self-reliance and community involvement in health activities. Thus, the health service system has a pyramidal arrangement with the community health and health stations being the broad bases, the health centers and rural medium sized hospitals forming the third and the forth levels, respectively. The regional and the referral hospitals are the fifth and sixth levels (Planning and Programming Bureau, Ethiopia, p. vi).

The other units of health services that have important functions are the specialized institutions such as malaria, tuberculosis, and leprosy clinics, which provide direct health services to the people.

Ethiopia is located in the north-eastern part of Africa, in the area widely known as "The Horn of Africa" (Health Manpower Committee, Ethiopia 1980). According to the Planning and Programming Bureau:

> Ethiopia has an area of 1,252,200 square kilometers, and an estimated population of 45,958,716 in 1987, giving a density of 36.7 persons per square kilometer. The urban and rural populations comprise 10.2% and 89.8% of the total population, respectively. The annual rate of population growth of 2.9% is only an estimate, owing to the absence of a previous national census and, thus, the lack of baseline data. The present health policy places great importance on the provision of essential health care to the people of Ethiopia. The policy stresses the expansion of rural health services, disease prevention and control, promotion of self-reliance, and community involvement in health activities. (1988, p. vi)

The basic principles and strategies underlying the Ethiopian policy of health are consistent with the Primary

Health Care approach to achieve the goal of "Health for all by the year 2000" (Primary health Care Review Committee, Ethiopia 1985).

Demographic Data

The key demographic data and health indices follow a typical pattern of less developed countries. Ethiopia, like many other less developed countries, has a high birth rate and a relatively high death rate; therefore, a young population exists. This broad-based age pyramid should be taken into consideration in planning the provision of health services since different age groups have different health risks and needs (Zein and Kloos 1988).

As indicated in Table 1, children below one year of age constituted 3.6% of the total population, and 7% of the population were children under two years of age. About 17.8% of the population were children four years of age or less. Women of child-bearing age made up 20.2% of the entire population. The crude birth rate was 46.9 per 1000 persons, and the crude death rate was 18.4 persons per 1000 individuals. The annual population increase (growth rate) was 2.9%. One hundred forty-four infants die out of evey 1000 children (less than one year of age). Out of every 1000 children between the ages of one to four, 92 die. The average life expectancy at birth is 47 years.

Table 1. Key demographic data and health indices

Subject	Rate
Population <1 year of age	3.6/100
Population <2 years of age	7.0/100
Population <4 years of age	17.8/100
Women 15 to 44 years of age	20.2/100
Crude birth rate	46.9/1000
Crude death rate	18.4/1000
Natural growth rate	2.9/100
Infant mortality rate	144/1000
Child mortality rate (1 to 4 yrs)	92/1000
Life expectancy at birth	47 years

Source: Ministry of Health, 1985.

The following formulas were used to calculate the above mentioned demographic data and health indices:

$$\text{Crude Birth Rate} = \frac{\text{No. of live births during the year}}{\text{Average (midyear) Population}} \times 1000$$

$$\text{Crude Death Rate} = \frac{\text{No. of deaths during the year}}{\text{Average (midyear) Population}} \times 1000$$

$$\text{Infant Mortality Rate} = \frac{\text{No. of deaths in a year in children <1 year of age}}{\text{No. of live births in same year}} \times 1000$$

$$\text{Age-specific Death Rate} = \frac{\text{No. of deaths among persons of a given age group in a year}}{\text{Average (midyear) Population in Specified Age Group}} \times 1000$$

Source: Mausner and Kramer, 1985

Growth Rate = Crude Birth Rate minus Crude Death Rate

Source: Nadakavukaren, 1990.

Similar to other lesser developed countries, the major health problems of Ethiopia are communicable diseases and nutritional disorders. These diseases account for 75-80% of the health problems of the country. According to the Department of Epidemiology, Ethiopia:

> Among the most common communicable diseases, those which need attention are shigellosis, amebic dysentery, yellow fever, cerebrospinal meningitis, infectious hepatitis, trypanosomiasis, measles, malaria, bilharziasis, pertussis, poliomyelitis, tetanus, rabies, relapsing fever, typhus, typhoid fever, influenza, leprosy, onchocerciasis, tuberculosis, and sexually transmitted diseases. (1986, p. 13)

Most of the diseases that prevail in the country can be eliminated through the provision of immunization, extensive health education, and proper environmental sanitation (Epidemiology Department, Ethiopia 1986, p. 15).

It is estimated that less than 50% of the entire population has access to health facilities. In spite of the mal-distribution of health care institutions, the difficult terrain, and limited communication networks in the country, and above all, the shortage of health manpower in the existing health facilities, great effort was made to expand the vaccination program to vaccinate as many eligible people (children less than two years of age and women of child-bearing age) as possible. Although many health units are engaged in the delivery of the vaccination service using the different strategies, the effectiveness of the program in reaching eligible children has to be evaluated routinely.

Objectives

The principal objectives of this thesis were:

1. To make preliminary epidemiological interpretation of the intrinsic and extrinsic factors contributing to coverage and participation rates of the vaccination program in Arssi, Ethiopia, in areas where the service was made available.

2. To make statistical inference about the progress of the vaccination program by making comparisons of the results of the vaccination coverage evaluation surveys conducted over three years since its inception.

Sub-objectives

The study was designed to:

1. Assess the ability of the program to reach the children before they celebrate their second birthday;

2. Determine the ability of the program to vaccinate pregnant women in particular and women of child-bearing age in general;

3. Measure the technical capability of health workers in delivering the different antigens at the appropriate age

with the correct dose, route, and proper interval between doses;

4. Examine the commitment of community and governmental organizations in the program;

5. Identify the extent and explanation of drop-out rates based on the responses obtained from the mothers or guardians of the eligible children under study; and

6. Determine if there is significant progress made over the years by comparing the results of the coverage evaluation surveys conducted in 1983 and 1985 with the current survey. Statistical inference is made about the results of the surveys for the three years. Confidence intervals are constructed on the parameters of differences between population proportions in year one and population proportions in year two ($p_1 - p_2$) in order to test the null hypothesis of no difference (H_0: $p_1 = p_2$).

Significance

Epidemiological assessment of diseases to be controlled by immunization consists of the measurement of occurrence of diseases of relative public health importance. The following information is needed to monitor the impact of vaccination programs:

1. Prevalence of the disease;
2. Mortality and morbidity rates;
3. Age-specific attack rates; and
4. Geographical distribution.

The sources of information can be divided into two basic groups:

1. Routine reporting of mortality and morbidity;

2. Population surveys.

In places like Ethiopia, where routine morbidity and mortality reporting is developing, population surveys are taken as either a complement of or as an alternative to evaluating whether specified objectives are met.

Evaluation of the levels of vaccination coverage usage rate helps in:

1. Redefining objectives, if they are inappropriate;

2. Redefining strategies and replanning programs, if they are ineffective or inefficient; and

3. Reconfirming if the current program is satisfactory.

It was the investigator's assumption that an attainable higher level of vaccination usage and coverage rate could be achieved through the combined effort of health personnel, the community, and the government based on the results of the study. Furthermore, it is hoped that the study would provide data for future studies, especially in the assessment of health manpower training, the need for active involvement and full participation of the community and the government to increase the usage rate of the immunization program.

Limitations

The study was conducted as part of the routine coverage evaluation surveys outlined in the 1980 instructional guideline of the Ministry of Health, Ethiopia. The reasons for immunization failure for the years 1983 and 1985 were not available to make comparisons with that of the current study. The results shown are particularly true for Arssi Administrative Region to which the investigator was responsible for the planning, implementing, and evaluating of the vaccination program. The results reflect only the performances of the vaccination program up to the period of evaluation. The scope of the study is limited only to examining the vaccination coverage levels of the program; it is not intended to measure the sero-conversion rate of each antigen.

CHAPTER 2

Literature Review

The prevention of infectious diseases by immunization is one of the most effective branches of preventive medicine. The first effective use of artificial immunization came from the work of Jenner in 1798 when he discovered that milkmaids who had suffered from cowpox were immune to smallpox (Islam 1977).

Deliberate defense against infectious diseases started in the late 18th century with Edward Jenner's discovery of the principle of immunity, so triumphantly demonstrated by the success of Jenner's vaccine against smallpox. Dr. Edward Jenner used the cowpox virus for vaccination against smallpox. This was the first successful development of a method for the protection of human beings against a serious disease which occurred as an epidemic or pandemic. It conferred an active immunity (Barrett 1974).

For almost a century no further advances in the knowledge of immunity followed Jenner's discovery. This is not really surprising since the infectious agents were initially being described, and it was still uncertain what organisms were true causative agents. Pure culture techniques were just being developed, and many uncertainties surrounded the sparse understanding of microorganisms. In addition, smallpox was a very exceptional case. Smallpox was one of the few diseases that was entirely preventable by recovery from some other illness. Cross-immunity of this sort can now be explained in exact chemical terms, but the discovery of the vaccine 175 years ago must have been confusing (Barrett 1974, p. 7).

The next great discoveries in immunity were made by Pasteur. He accidently discovered two different methods of reducing the virulence of pathogenic microbes. Barrett states that Pasteur discovered virus vaccines and attenuation of virulence, which rightly earned him a position as a "father of science" (Barrett 1974, p. 7).

For more than a decade, a quiet public health revolution has been going on throughout the world. With technical direction, coordination, and support from the World Health Organization (WHO), this revolution has brought out a spectacular decline in sickness, death, and disability among children in particular. This was made possible as a result of the inception of the Expanded Program on Immunization (EPI). It was launched by WHO after the eradication of smallpox (Harkishan,1989). Immunization services were virtually nonexistent in many developing countries, except against smallpox and tuberculosis.

Attenuation of pathogens has been the key to the development of vaccines against tuberculosis, yellow fever, poliomyelitis, rabies, measles, mumps, and other infectious diseases. Incidentally, Pasteur coined the term "vaccination" for these immunization procedures in honor of Jenner's initial discoveries with cowpox (Barrett 1974, p. 8).

Despite advances in medical technology and the enormous amount of resources spent on health care services, Bellanti (1990, p. 735), states that it is estimated that greater than 60% of the population of developing countries do not have access to health care services. Poor nutrition, lack of environmental sanitation, crowding, poor personal hygiene, inadequate health education, and no or incomplete immunizations result in the high incidence of such communicable diseases as gastroenteritis, respiratory infections (including tuberculosis), measles, tetanus, poliomyelitis, pertussis (whooping cough), diphtheria, and other bacterial, viral, and parasitic infections.

In the less developed areas of the world, up to 20% of the population is under five years of age, and 40% are below 15 years of age. Mothers and children together make up over 60% of the population in these nations. These groups are especially vulnerable to preventable infectious diseases. The infant mortality rate may be three to 25 times greater than that of the industrialized nations of North America and Europe (Bellanti 1990, p. 735).

The integration of immunization practices into routine health care services has provided caregivers with control over a substantial proportion of the disease and mortality that plagues less developed countries. Immunization represents one of the most cost-effective means of preventing serious infectious diseases.

The extraordinary advances in disease control during the last four decades began with the first systematic introduction of a biologic product into widespread use. As an example, tetanus toxoid was administered routinely to the United States military personnel during World War II (Bellanti 1990, p. 736).

The widespread use of vaccines has resulted in the global eradication of smallpox, the near elimination of poliomyelitis in the developed countries, and the dramatic reduction in tetanus, measles, mumps, and diphtheria. The full potential of vaccine use is displayed by steady progress in the lesser developed countries (Bellanti 1990, p. 736).

Diseases Preventable by Vaccination in the Developing World

Each year, 3 million infants and children will die and another 3 million will become crippled, deaf, blind, or mentally retarded because of the six childhood diseases--pertussis, diphtheria, poliomyelitis, measles, tuberculosis, and tetanus. Bellanti mentions:

> Between 20-35% of all the deaths in children under five years of age are associated with diseases preventable by immunization. In areas of drought, economic chaos, or war, this figure is even higher. The synergistic effect

of diseases preventable by immunization with undernutrition, diarrhea, and respiratory infections, places children under five years of age at a particularly high risk of mortality, further multiplying the potential benefit accrued from immunization (Bellanti 1990, p. 739).

Children in the less developed world often have their defense mechanisms compromised from the start by low birth weight. They are assailed by a series of stresses, including pertussis, measles, weaning, repeated episodes of diarrhea, and malaria. Each event retards the child's growth and development; and, if the interval between events is too short,the child cannot recover and subsequently dies. Immunization services alone can be effective in preventing specific diseases that can precipitate malnutrition, and by permitting the child a longer recovery period between events, can help to break this cycle and contribute to the overall reduction of childhood mortality (Bellanti 1990, p. 739).

The Expanded Program on Immunization has now grown to be an operational program of the member countries of WHO, working with a broad-based network of agencies of the United Nations System, multilateral and bilateral agencies, and non-governmental organizations. The development of improved operation manuals, simple and flexible immunization schedules, and appropriate training materials for the handling and management of the program has made it possible for the expansion of the service in the developing countries. Above all, the will and commitment of governments, political parties, and non-governmental organizations to accept EPI as a high priority have saved considerable lives.

Despite being one of the most powerful and cost-effective means of preventing diseases, immunization remains tragically underutilized. As a consequence, diphtheria, pertussis, tetanus, tuberculosis, measles, and polio remain uncontrolled and continue to take an unacceptable toll in much of the developing world. The WHO estimates that for every 100 children born, 3 will die of measles (the figure rising to 10 or more in malnourished populations), 2 will die of pertussis, 1 will die of neonatal tetanus, and 0.5% of the population will have residual paralysis from poliomyelitis. The primary goal of immunization efforts is to reduce the morbidity, mortality, and disability resulting from the six diseases, mentioned earlier, through immunization (Bellanti 1990, p. 736). According to Henderson:

> Because the EPI diseases strike young, immunizations must reach children early in life to be productive. To achieve a high coverage, and to do this on a continuing basis, requires that whole communities be actively involved. The task is to ensure that every newborn child is identified and brought to the health service promptly, and that return visits are made until all the needed immunizations are complete. (Jan/Feb. 1987, p. 4)

Immunization Practices

In the 1970s, as confidence in the global eradication of smallpox grew, confidence in the potential of effects of infant and childhood immunization grew. Immunization services existed in virtually all countries; the challenge was to expand them in terms of coverage of the susceptible population and of the number of antigens that were being used.

The resolution creating the Expanded Program on Immunization (EPI) was passed by the WHO Assembly in 1977, establishing the goal of providing immunization services for all the children of the world by 1990, giving priority attention to developing countries. EPI was made an essential element within WHO's strategy to achieve health for all by the year 2000 (Allan, Jan/Feb. 1987). Dr. Halfdan Mahler, the then Director of the World Health Organization, stressed the importance of the immunization program by devoting World Health Day 1987 to Immunization. He stated:

> Planet Earth can no longer accept that, in the age of modern technology, children should still die by the millions of diseases which can be prevented by available vaccines. To offer the chance of a lifetime to all the children of the world will call for the informed cooperation of the people, the unwavering commitment of leaders, the devotion of health workers, the loving care and intelligent interest of parents, and the raising of

> necessary funds and materials. Immunization is truly a chance for every child. (Jan/Feb. 1987, p. 3)

Immunization coverage of children has been included among the indicators that WHO uses to monitor the success of that strategy at the national and global level. Since the inception of EPI worldwide in 1980 efforts were made to vaccinate as many eligible children as possible. During the first year the program was launched, 1980, 5% of the world's children were protected against vaccine-preventable diseases by vaccination. In 1988 the number of eligible protected was only 50%, two years away from the global target year of providing vaccinations to all children and women of child-bearing age, 1990. The level of immunization needed to stop disease transmission is approximately 85% of all individuals in a community (Stein 1991).

EPI Target Diseases

Measles

All babies surviving infancy in developing countries are eventually infected with measles, most within their first year of life. According to Bellanti:

> Of the 120 million births in the developing world in 1990, an estimated 100 million will develop measles; 1 in 10,000 will die and 1 in 2000 will have encephalitis which frequently leads to brain damages and mental retardation. Recent information based on surveys in

> African countries stated that 80% of the children will be infected by measles by age five. With the possible exception of malaria in certain areas, measles is thought to be the number one killer of African children. (1990, p. 739)

Complications occur in about 30% of the cases, and include ear infections, diarrhea, blindness, and encephalitis (Henderson, Jan./Feb. 1987, p. 7).

Though surveys have not been conducted in Ethiopia, observation indicates that there is not much difference from the rest of African countries. Measles vaccination is given after the age of nine months. Vaccination against measles is 85-95% effective if properly administered (Epidemiology Department, Ethiopia 1986, p. 53).

Poliomyelitis

Until the 1970s poliomyelitis was not recognized as a major health problem in the developing world. In the more than 100 surveys used since then to detect symmetric flaccid paralysis without sensory change, the rate of residual paralysis has been three per 1000 children with a range of 0-25%. Despite the availability of effective vaccines, some 250,000 new cases of poliomyelitis still occur each year (Bellanti 1990, p. 740).

Using the WHO lameness surveys, rates of poliomyelitis compatible residual paralysis ranging from 1.5/1000 to 8.5/1000 children have been observed. In Ethiopia, from two surveys conducted in some parts of the country, including Arssi, the range has been 2.9/1000 to 13.1/1000 (Epidemiology Department 1986). Oral polio vaccine is widely used and has been proven effective in protecting infants and children.

Pertussis (whooping cough)

Some 51 million children contract pertussis every year; over 600,000 of them die from it (Henderson Jan./Feb. 1987, p. 7).

Pertussis is known to infect 80% of African infants and children. The case fatality rate is expected to be high in Ethiopia as many children remain not immunized. Pertussis vaccine given as DPT (Diphtheria-Pertussis-Tetanus) was administered in three doses at monthly intervals. If properly given the vaccine is 75-85% effective (Epidemiology Department, Ethiopia 1986, p. 54).

Neonatal Tetanus

The incidence of neonatal tetanus has declined dramatically in industrialized countries because of effective immunization programs, improved living standards, and hygienic delivery techniques (Bellanti 1990, p. 741).

The results of surveys carried out in Africa to estimate neonatal tetanus mortality revealed that it ranges from 1.0 to 17.0 neonatal deaths per 1000 live births. In Ethiopia, surveys conducted in 1983 showed 4.2 to 4.3 deaths per 1000 live births. Therefore, based on the survey results, the disease is thought to be serious in Ethiopia (Epidemiology Department, Ethiopia 1986, p. 54).

Tetanus toxoid vaccine is nearly 100% effective when given in the appropriate dosage at the right time and at the correct interval (Henderson Jan./Feb. 1987, p. 7).

Tuberculosis

There are 1.3 million cases of tuberculosis among children less that 15 years of age annually in the developing world, resulting in 450,000 deaths also annually (Bellanti 1990, p. 741). Although tuberculosis is known to be a major health problem in Ethiopia, childhood tuberculosis has not been documented separately so far (Epidemiology Department, Ethiopia 1986, p. 54).

Diphtheria

Diphtheria kills between 10-15% of its victims (Henderson Jan./Feb. 1987, p. 7). The incidence of diphtheria is not well known in Ethiopia as the disease is rarely observed. However, vaccination against the disease is given to children in combination with pertussis and tetanus toxoid vaccines as DPT.

Program Implementation

The Expanded Program On Immunization is a vaccination program aimed at preventing measles, diphtheria, pertussis, poliomyelitis, neonatal tetanus, and childhood tuberculosis. The program was launched in Ethiopia in 1980 supported by WHO and the collaborating international agencies (Primary health Care Review Committee, Ethiopia 1985, p. 38).

According to the Epidemiology Department, Ethiopia:

> The broad objective of EPI is to reduce morbidity, mortality, and disability resulting from vaccine-preventable diseases by immunization to a degree that they are no longer major health problems in the country. (1986, p. 56)

No quantitative objectives were set initially, except for the immunization coverage to be increased by 10% each year after 1980, the date the program commenced. Available data show that the projected target was not possible to achieve (Primary Health Care Review Committee 1985, p. 38).

Target Age Groups

The target groups of EPI were children below two years of age and pregnant women for tetanus toxoid vaccine for the first year the vaccination service was offered. In the years following, the target was set for children under one year. Later, women of child-bearing age were included as targets of the vaccination program (Primary Health Care Review Committee 1985, p. 38).

Program Strategy

The immunization program was an integral part of the general health services and was carried out by health units of various types as part and parcel of the health unit activities. Normally, eligible children and pregnant women were registered through a special survey with the involvement of community organizations prior to starting immunization service in a new site. Dates for vaccinations were usually determined jointly by health workers and community leaders. Individual vaccination cards, prepared in duplicate, were distributed during the house-to-house survey. The duplicates of the individual vaccination cards were kept in the responsible health units rendering the service for their records.

There were three strategies employed in the delivery of the vaccination services:

Static Strategy

The immunizations were performed by the staff of the health units as part of the routine activities within the premises of health facilities. This was mainly done in hospitals, health centers, and health stations. At the very beginning of the program, immunization sessions were held on a weekly basis in static sites. The service was given on a daily basis in most of the static sites at present.

Outreach Strategy

This was an immunization approach in which the staff of a health unit administer vaccines at other sites, outside their health unit, in their assigned geographic areas. With this strategy, vaccination sessions were held on a monthly basis.

Mobile Strategy

This strategy was implemented only for single dose vaccination (BCG and measles) in settlement areas, farmers' villages, and refugee camps, for controlling outbreaks and epidemics of measles.

Immunization Schedule

In developing countries, like Ethiopia, diseases included within EPI strike early in life making it especially important to protect children through immunization as early as possible. A guiding strategic principle of any immunization program is that protection must be achieved prior to the time infants are at high risk of a disease. The WHO/EPI estimates that 25-50% of all new poliomyelitis cases occur in infants from 6 to 12 months of age, with some cases occurring in those as young as three months. Infants are susceptible to pertussis soon after birth, and 50% of all deaths from pertussis occur during the first year of life. The most important measure is that of obtaining protection at as young an age as possible and acknowledging that sero-conversion with some EPI antigens is age-dependent (WHO/EPI 1987).

To provide early protection for the child against infectious diseases preventable by vaccination, the schedules outlined in Table 2 and Table 3 was employed.

Table 2. Childhood Immunization Schedule

Antigen	No. of Doses	Age	Interval
BCG	1	At birth	
OPV	4	At birth, with DPT	28 days
DPT	3	At 6, 10, 14 weeks	28 days
Measles	1	At 9 months	

BCG--Bacille Calmette Guerin

OPV--Oral Polio Vaccine

DPT--Diphtheria-Pertussis-Tetanus

Source: WHO/EPI, 1987.

Table 3. Tetanus Immunization Schedule

Dose	Interval	Percent Protected	Protection
TT1	-	0	0
TT2	4 weeks	80 (60-90)	3 years
TT3	10 weeks	95	5 years
TT4	1 year	99	10 years
TT5	1 year	99	Life long

TT--Tetanus Toxoid

Source: WHO/EPI 1987.

Program Evaluation

Evaluation and monitoring are integral parts of routine program management at all levels of the health service. Programs which cannot be evaluated cannot be managed.

Designing programs so they can be evaluated is a management task. This consists of defining program objectives and activities so they are measurable and evaluating progress with an information system that has been designed along with the other parts of the program rather than considering the latter as an afterthought.

In assessing coverage, one simply seeks to estimate whether coverage in a particular area is satisfactory or not. A maximum coverage figure is obtained by assuming that all doses were actually administered to persons in the appropriate target group and that there were no drop-outs between doses. In places where coverage estimates cannot be derived from routine reports of doses administered or where validation of the accuracy of the routine report is desired sample surveys are used.

Cost

Eligible children and women or any individual who seeks to get any vaccination service in any health facility, regardless of age, socioeconomic status, sex, race, or religion, receive the vaccination free. In some places treatment for other diseases is given freely to children to encourage mothers to bring their children for vaccination. An eligible child who develops side effects after being vaccinated, either due to the vaccination itself or due to anything associated with the vaccination process, gets treated without being charged for service.

Background Information About Project Area, Arssi

As stated previously, Arssi is one of the 16 administrative regions of Ethiopia. The capital city of the region, Assela, is located 175 kilometers southeast of the Nation's capital, Addis Ababa. The estimated population of the region according to the 1988 projection was 1,873,800, with an area of 24,100 square kilometers giving a density of 75 persons per square kilometer. It is the second largest region in population density, and the mean family size is 4.7. The majority of the working force is engaged in agriculture and animal husbandry. The dominating religion of the region is Muslim and Oromogna is a widely spoken dialect.

The health indices and the major health problems mentioned for the entire country hold true for Arssi. There were 2 hospitals, 7 health centers, and 109 health stations in the region in 1988.

Thanks to the literacy campaign that has been conducted for over a decade, more than 50% of the regional population can read and write. The women in the region assume a heavy load of responsibility in addition to taking care of their household. Besides the routine engagement in preparing and cooking food for the large family, taking care of children, washing clothes and cleaning the house and the compound, the woman is also expected to assist her husband in the field in farming and harvesting. On top of the tight and busy day-to-day engagement of the mother in other laborious activities, she is also expected to take her children for health care services.

CHAPTER 3

Methodology

The primary goal of this study was to measure the coverage levels of the vaccination program in Arssi Administrative Region. As mentioned earlier, the aim of the program is to reduce morbidity, mortality, and disability by providing immunization against the EPI target diseases. This commits the health personnel, mass and governmental organizations, and the population at large to provide immunization to all children. Yet, even in some places with the best programs, a few children remain unimmunized.

Random cluster sampling was used to conduct the immunization coverage evaluation survey. It is a simple and inexpensive sampling method to estimate coverage that requires only approximately 210 children be selected, divided among 30 clusters. The sample result has a 95% chance of being within 10 percentage points of the true value and is adequate for most purposes (WHO/EPI 1987).

Sample Population Study

The total population of Arssi Administrative Region in 1988 was 1,873,800. The population was organized into 17 Urban Dwellers' Associations and 1,027 Peasants' Associations (Planning and Programming Bureau, Ethiopia 1988, p. vii). There were 246 EPI sites (97 static and 149 outreach) that covered 47.5% of the region's population. During the survey, 171 EPI sites (67 static and 104 outreach) were included for the selection of the 30 clusters through simple random cluster sampling method. The population of these sites was 691,811 which was 36.9% of the total population of the region (Survey data 1988).

Investigators

To carry out the survey, trained health workers from neighboring regions and the Ministry of Health were recruited. To avoid undesirable data the evaluating team was an independent body, with no active involvement of the health workers from the region in the collection and analysis of information in the evaluaton process.

Eleven teams, composed of two evaluating health workers each, were formed and two to three clusters were shared by each team according to distance and difficulty of the sites selected for evaluation.

Target Age Groups for Evaluation

All children between the ages of 12 to 23 months whose parents had lived in the area for at least six months were considered residents. Birth certificates were used to determine if the child was in the appropriate age range when they were available. Since this was not possible in many cases, the investigators were instructed to try to determine the date of birth through other documents such as vaccination cards, or to relate the date of birth with well-known holidays or Saint's days known by the parents.

Only the vaccination card retained by child and mother was considered acceptable evidence of immunization. The BCG scar was the only vaccination evidence checked to ensure immunization of children. If the card was lost and the mother claimed that either the child or herself was vaccinated, the investigators had to write down the appropriate information, including name and address, and counter check in the health institution where the immunization was given. Individual vaccination cards are always prepared in two copies--one to be kept at the health facility and the other given to the mother.

Survey Procedure

The populations of the different localities (urban and rural) to whom the vaccination service has been made available were listed by location. After summing the cumulative population the sampling interval was calculated as follows:

$$\text{Sampling Interval} = \frac{\text{Cumulative Population}}{\text{30 Clusters}}$$

Once the sampling interval was calculated, a five-digit random number, which was equal to or less than the sampling interval, was selected from random number tables, currency notes, or lottery tickets. The random number helped to locate the first cluster included in the survey by matching it with the cumulative population of the areas listed. The random number was equal to or less than the cumulative population it was going to identify.

To save time, the 30 clusters and the random number were identified by the investigator. The selection of the starting household for the survey was left for each team. This had to be done in the area to be evaluated. The following procedure was recommended to determine the direction to go and to identify the first house to be visited. This was accomplished by assigning a two-digit random number. The first digit would indicate the direction to go from the central location of the cluster where the team located for this purpose (i.e., one North, two East, three South, and four West) and would be in the range of one to four, inclusive. The second digit identifying the starting house for the survey would range from zero to nine inclusive. Therefore, the following procedure was recommended to avoid bias as much as possible: From a random table, currency note, or lottery ticket, whichever was available, two digits were obtained, in this case numbers between 10 and 49; and then proceed as mentioned above. The next household to be included was the one physically nearest to the first house measured from the main entrance. In urban areas there are occasions when it is difficult to determine which is the nearest household to the one first completed. In this case the house on the left was selected.

Seven children, whose ages were between 12-23 months from the date of the interview, had to be identified in each cluster. This was in conformity with the WHO/EPI instructional guideline for coverage evaluation surveys. Therefore, all children whose ages fell between 12 and 23 months were eligible for the survey regardless of their vaccination status.

A total of 210 children and 210 mothers was expected to be evaluated in all of the 30 clusters. However, if the seventh child was found in the household where other children of the selected age range were living, these children had to be included in the survey. So it was possible to have 8, 9 or 10 children in a cluster.

Duration of the Survey

The surveys were supposed to be carried out within a day. However, in some cases if teams were unable to identify the 7 eligible children in a certain cluster within the specified day, they were advised to continue the next morning. If so, teams had to change the age range of the children eligible to be included in the survey.

Questionnaire

The questionnaires used for the study were the standard format developed by WHO/EPI (Appendices A, B, C). The coverage survey was intended to give information about the immunization status of each eligible child. The intent of the survey was outlined as follows:

1. Coverage surveys include all sources of immunization, not only the immunizations given by the health unit.

2. The coverage survey tells the immunization status per child, not just the number of doses given.

3. The coverage survey tells how many of the doses were valid. The survey questionnaire enabled the investigator to gather information from mothers or guardians as to why their children were not able to complete their vaccinations, if they had not.

Data Analysis

Statistical analysis was made on the survey results obtained. Comparison of survey results was done in order to determine whether or not the differences were statistically significant and whether or not the differences in population proportions were scientifically important. The reasons for immunization failure were analyzed based on the responses obtained from the mothers/guardians of eligibles in order to identify the constraints of the vaccination program and to indicate possible solutions.

CHAPTER 4

Results

According to the survey data of 1988, a total of 212 children and the 212 mothers of the children were surveyed in the 30 clusters identified. One-thousand-five-hundred-ninety-four houses were visited in the 30 clusters. This took the 11 teams 73 hours and 20 minutes to complete. The greatest time period taken to interview the seven children and seven mothers in one of the clusters was eight hours and 30 minutes; the smallest amount of time was one hour. The mean time spent to identify eligible children in each cluster was two hours and 27 minutes. The results were calculated and depicted in percentages. Based on the information obtained from the survey, mothers and children were categorized in one of the following groups:

1. Fully immunized--a child was fully immunized if he/she had received three doses of DPT/Polio, one dose of measles vaccine, and a BCG scar was present.

A mother was considered fully immunized if she had taken at least two doses of tetanus toxoid vaccine at an interval of 28 days.

2. Partially immunized--a child was partially immunized if measles vaccine was given before the age of nine months; DPT/Polio vaccinations were given before six weeks of age; interval between successive doses of DPT/Polio was less and 28 days; BCG scar was missing.

3. Not immunized--a child was considered not immunized if he/she had not received any of the antigens and if there was no evidence of BCG scar at the time of the physical check-up (Tables 4-20).

If children and/or mothers were classified as partially immunized or not immunized, the mothers or guardians of the children were asked for reasons why they were not immunized (Tables 23-24). Mothers were encouraged to give their opinion. Community leaders were assigned to accompany each team.

In order to draw conclusions and make decisions on the survey results obtained, statistical calculations were performed. Standard error of proportion, Sp, was calculated on all responses using the following formula:

$$Sp = \sqrt{\frac{pq}{n}}$$

Where: p = proportion of eligible children who were vaccinated

q = 1 - proportion

n = sample size

Confidence intervals at the 95% level were then calculated to determine the significance of the results obtained. The following formula was used to calculate the confidence intervals:

$$CI_{95\%} = p \pm zS_p$$

Where: p = proportion of mothers and children who were vaccinated

z = z distribution

s_p = standard error of proportion

Retention of Vaccination Cards

Mothers or guardians were asked to show individual vaccination cards to determine the vaccination status of mothers and children (Table 4).

Table 4. Number of children and mothers who retained their vaccination cards, 1988

Card	Number	Percentage	S_p	$CI_{95\%}$
Children				
Yes	155	71.1	0.031	(0.650, 0.772)
No	57	26.9	0.030	(0.209, 0.119)
Total	212	100.0		
Mothers				
Yes	109	51.4	0.034	(0.447, 0.581)
No	103	48.6	0.034	(0.419, 0.553)
Total	212	100.0		

Source: Survey data 1988, by investigator

Table 5. Antigen specific vaccination status of children in 1988

Antigen	Number Vacc.	Percent	S_p	$CI_{95\%}$
BBG	198	93.4	0.017	(0.900, 0.967)
Scar Present	169	79.7	0.028	(0.743, 0.851)
Scar Absent	43	20.3	0.028	(0.149, 0.257)
DPT_1	196	92.5	0.018	(0.889, 0.960)
DPT_2	192	90.6	0.020	(0.867, 0.945)
DPT_3	187	88.2	0.022	(0.838, 0.925)
Drop-out rate	9	4.6	0.014	(0.018, 0.074)
$Polio_1$	196	92.5	0.018	(0.889, 0.960)
$Polio_2$	192	90.6	0.020	(0.867, 0.945)
$Polio_3$	187	88.2	0.022	(0.838, 0.925)
Drop-out rate	9	4.6	0.014	(0.018, 0.074)
Measles	165	77.8	0.028	(0.722, 0.834)
Overall drop-out rate	33	16.8	0.026	(0.117, 0.217)

Source: Survey data 1988, by investigator.

Table 6. Number of children fully, partially, and not vaccinated in 1988

Vaccination Status	Number Vacc.	Percent	Sp	CI95%
Fully vaccinated	141	66.5	0.032	(0.601, 0.728)
Partially Vaccinated	57	26.9	0.030	(0.206, 0.326)
Not immunized	14	6.6	0.017	(0.032, 0.199)
Total	212	100.0		

Source: Survey data 1988, by investigator.

Table 7. Tetanus toxoid vaccination for mothers, 1988

Antigen	Number Vacc.	Percent	Sp	CI95%
TT1	137	64.6	0.033	(0.578, 0.707)
TT2	117	55.2	0.034	(0.482, 0.616)
TT3	10	4.7		
Drop-out rate for TT2		14.6	0.024	(0.098, 0.193)

Source: Survey Data 1988.

Survey Results of Previous Years

Similar survey results obtained in 1983 and 1985 by the investigator to evaluate the vaccination program are presented in order to show the relative increase of the usage rate of the service (Table 8 - 13).

Table 8. Vaccination Status of Children, 1985

Antigen	Number Vacc.	Percent	S_p	$CI_{95\%}$
BBG	187	89.0	0.022	(0.848, 0.932)
DPT_1	200	95.0	0.015	(0.860, 0.919)
DPT_2	195	93.0	0.018	(0.895, 0.964)
DPT_3	168	80.0	0.028	(0.746, 0.854)
Drop-out rate	32	16.0	0.025	(0.110, 0.209)
$Polio_1$	197	94.0	0.016	(0.908, 0.992)
$Polio_2$	193	92.0	0.019	(0.883, 0.957)
$Polio_3$	170	81.0	0.027	(0.757, 0.863)
Drop-out rate	27	13.7	0.024	(0.090, 0.183)
Measles	151	72.0	0.031	(0.659, 0.781)

Source: Survey data 1985, by investigator.

Table 9. Number of children who were able to complete their vaccinations in 1985

Vacc. Status	Number Vacc.	Percent	Sp	CI95%
Fully Vacc.	112	53.5	0.034	(0.467, 0.602)
Partially Vacc.	89	42.4	0.034	(0.357, 0.491)
Not Vaccinated	9	4.3	0.014	(0.016, 0.070)

Source: 1985 survey data, by investigator.

Table 10. Vaccination status of mothers with tetanus toxoid vaccine in 1985

Antigen	Number Vacc.	Percent	Sp	CI95%
TT1	54	25.7	0.030	(0.198, 0.316)
TT2	41	19.5	0.027	(0.141, 0.248)
Drop-out rate	13	24.1	0.029	(0.183, 0.299)

Source: 1985 survey data, by investigator.

The first evaluation survey conducted in 1983 revealed that the number of eligible children and mothers who were able to complete their vaccinations was relatively lower than in preceding years (Tables 11 and 13).

Table 11. Antigen specific vaccination status of children in 1983

Antigen	Number	Percent	S_p	$CI_{95\%}$
BCG	182	86.0	0.024	(0.813, 0.907)
DPT_1	182	86.0	0.024	(0.813, 0.907)
DPT_2	165	78.0	0.028	(0.724, 0.836)
DPT_3	138	65.0	0.033	(0.586, 0.714)
Drop-out rate	44	24.2	0.029	(0.184, 0.300)
$Polio_1$	182	86.0	0.024	(0.813, 0.907)
$Polio_2$	165	78.0	0.028	(0.724, 0.836)
$Polio_3$	138	65.0	0.033	(0.586, 0.714)
Drop-out rate	44	24.2	0.029	(0.184, 0.300)
Measles	136	64.0	0.033	(0.575, 0.704)
Overall drop-out rate		25.3	0.030	(0.194, 0.312)

Source: 1983 survey data, by investigator.

Table 12. Vaccination status of children in 1983

Vacc. Status	Number Vacc.	Percent	S_p	$CI_{95\%}$
Fully Vacc.	100	47.0	0.034	(0.403, 0.537)
Partially Vacc.	83	39.0	0.033	(0.324, 0.456)
Not Vaccinated	30	14.0	0.024	(0.093, 0.187)

Source: 1983 survey data, by investigator.

Table 13. Tetanus toxoid vaccination status of mothers in 1983

Antigen	Number Vacc.	Percent	S_p	$CI_{95\%}$
TT_1	42	20.0	0.027	(0.146, 0.254)
TT_2	36	17.0	0.026	(0.119, 0.220)
Drop-out rate	6	14.3	0.024	(0.096, 0.190)

Source: 1983 survey data, by investigator.

<u>Comparison of Survey Data between 1983, 1985, and 1988</u>

To show the true difference of the survey results over the years (Tables 14-22), statistical calculations were made. The standard error of estimate for the difference in population proportions for the years 1983, 1985, and 1988 is denoted by the following statistical formula:

$$p_1 - p_2 = \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}}$$

Where: p_1 = Population proportion for year one

p_2 = Population proportion for year two

q = 1 - proportion

n_1 = sample size for year one

n_2 = sample size for year two

The confidence interval at the 95% level was calculated using the following formula:

$$CI_{95\%} = (p1 - p2) \pm z s_p$$

Where: p1 - p2 = point estimator for the population proportion of the two years

z = z distribution

s_p = standard error of proportion

Note that the negative signs in the tables merely reflect the fact that better results were obtained over the years. As mentioned in Daniel, "the interval could just as well have been constructed around $p_2 - p_1$, in which case the endpoints of the interval would have been the same, but the signs would have been positive" (1991, p. 155). Please also note that two additional children of the same age range were found in the last two houses visited during the evaluation surveys in 1983 and 1988, making the total number of children evaluated 212.

Table 14. The difference in antigen-specific vaccination status of children between 1983 and 1985

Sample size	Antigen	Vaccinated No.	Percent	Point Est. $p_1 - p_2$	S_p	$CI_{95\%}$ *
212(n_1)	BCG	182	86.0	-0.03	0.032	(-0.093, -0.033)
210(n_2)		187	89.0			
212(n_1)	DPT_1	182	86.0	-0.09	0.028	(-0.145, -0.035)
210(n_2)		200	95.0			
212(n_1)	DPT_2	165	78.0	-0.15	0.033	(-0.215, -0.085)
210(n_2)		195	93.0			
212(n_1)	DPT_3	138	65.0	-0.15	0.043	(-0.234, -0.066)
210(n_2)		168	80.0			
212(n_1)	$Polio_1$	182	86.0	-0.08	0.029	(-0.137, -0.023)
210(n_2)		197	94.0			
212(n_1)	$Polio_2$	165	78.0	-0.14	0.034	(-0.207, -0.073)
210(n_2)		193	92.0			
212(n_1)	$Polio_3$	138	65.0	-0.16	0.042	(-0.242, -0.078)
210(n_2)		170	81.0			
212(n_1)	Measles	136	64.0			
210(n_2)		151	72.0	-0.08	0.045	(-0.168, 0.008)

n_1 = sample size for 1983

n_2 = sample size for 1985

p_1 = population proportion for the year 1983

p_2 = population proportion for the year 1985

$p_1 - p_2$ = point estimator of the difference for the two years

* Results for GCG, DPT_1, DPT_2, DPT_3, $Polio_1$, $Polio_2$, $Polio_3$ are statistically significant

Source: Survey results of the respective years.

Table 15. The difference between the vaccination status of children between 1983 and 1985

Vacc. status	Vaccinated No.	Vaccinated Percent	Point Est. $p_1 - p_2$	S_p	CI95% *
Fully Vaccinated	100 112	47.0 (p_1) 53.5 (p_2)	-0.065	0.049	(-0.161, 0.031)
Partially Vaccinated	83 89	39.0 (p_1) 42.4 (p_2)	-0.034	0.048	(-0.128, 0.600)
Not Vaccinated	30 9	14.0 (p_1) 4.3 (p_2)	-0.097	0.028	(0.042, 0.152

p_1 = population proportion for the year 1983

p_2 = population proportion for the year 1985

* Results for Not Vaccinated are statistically significant

Source: Survey data of 1983 and 1985.

Table 16. Differences in tetanus toxoid vaccination of mothers between 1983 and 1985

Antigen	Vaccinated No.	Vaccinated Percent	Point Est. $p_1 - p_2$	S_p	CI95%
TT_1	42 54	20.0 (p_1) 25.7 (p_2)	-0.057	0.041	(-0.137, 0.023)
TT_2	36 41	17.0 (p_1) 19.5 (p_2)	-0.025	0.038	(-0.099, 0.049)

p_1 = population proportion for the year 1983

p_2 = population proportion for the year 1985

Source: Survey data of 1983 and 1985.

Table 17. Differences of vaccination status of children between 1983 and 1988

Vaccination status	Vaccinated No.	Vaccinated Percent	Point Est. $p_1 - p_2$	S_p	CI95% *
Fully Vaccinated	100	47.0 (p_1)			
	141	66.5 (p_2)	-0.195	0.047	(-0.242, -0.103)
Partially Vaccinated	83	39.0 (p_1)			
	57	26.9 (p_2)	0.121	0.045	(0.033, 0.210)
Not Vaccinated	30	14.0 (p_1)			
	14	6.6 (p_2)	0.074	0.029	(0.017, 0.131)

p_1 = population proportion for the year 1983

p_2 = population proportion for the year 1988

* Results are statistically significant

Source: Survey data of 1983 and 1988.

Table 18. The difference of tetanus toxoid vaccination status of mothers between 1983 and 1988

Antigen	Vaccinated No.	Vaccinated Percent	Point Est. $p_1 - p_2$	S_p	CI95% *
TT_1	42	20.0 (p_1)			
	137	64.3 (p_2)	-0.443	0.043	(-0.527, -0.359)
TT_2	36	17.0 (p_1)			
	117	54.9 (p_2)	-0.379	0.043	(-0.463, -0.295)

p_1 = population proportion for the year 1983

p_2 = population proportion for the year 1988

* Results are statistically significant

Source: Survey data of 1983 and 1985.

Table 19. The difference between antigen specific survey results between 1983 and 1988

Sample size	Antigen	Vaccinated No.	Percent	Point Est. p1 - p2	Sp	CI95% *
212(n_1)	BCG	182	86.0			
210(n_2)		198	93.4	-0.074	0.029	(-0.131, -0.172)
212(n_1)	DPT_1	182	86.0			
210(n_2)		196	92.5	-0.065	0.030	(-0.124, -0,006)
212(n_1)	DPT_2	165	78.0			
210(n_2)		192	90.6	-0.126	0.035	(-0.195, -0.057)
212(n_1)	DPT_3	138	65.0			
210(n_2)		187	88.2	-0.232	0.039	(-0.306, -0.157)
212(n_1)	$Polio_1$	182	86.0			
210(n_2)		196	92.5	-0.065	0.030	(-0.124, -0.006)
212(n_1)	$Polio_2$	165	78.0			
210(n_2)		192	90.6	-0.126	0.030	(-0.195, -0.057)
212(n_1)	$Polio_3$	138	65.0			
210(n_2)		187	88.2	-0.232	0.039	(-0.306, -0.157)
212(n_1)	Measles	136	64.0			
210(n_2)		165	77.8	-0.138	0.044	(-0.224, -0.052)

n_1 = sample size for 1983; n_2 = sample size for 1988

p_1 = population proportion for the year 1983

p_2 = population proportion for the year 1988

* Results are statistically significant

Source: Survey results of the respective years.

Table 20. Comparison of vaccination status of children between 1985 and 1988

Vaccination status	Vaccinated No.	Vaccinated Percent	Point Est. $p_1 - p_2$	S_p	$CI_{95\%}$ *
Fully Vaccinated	112	53.5 (p_1)			
	141	66.5 (p_2)	-0.130	0.047	(-0.222, -0.037)
Partially Vaccinated	89	42.0 (p_1)			
	57	26.9 (p_2)	0.155	0.046	(0.065, 0.245)
Not Vaccinated	9	4.3 (p_1)			
	14	6.6 (p_2)	-0.023	0.022	(-0.066, 0.020)

p_1 = population proportion for the year 1985

p_2 = population proportion for the year 1988

* Results for Fully Vaccinated and Partially Vaccinated are statistically significant.

Source: Survey data of 1985 and 1988.

Table 21. Comparison of vaccination status of mothers according to the survey results of 1985 and 1988

Antigen	Vaccinated No.	Vaccinated Percent	Point Est. $p_1 - p_2$	S_p	$CI_{95\%}$ *
TT_1	54	25.7 (p_1)			
	137	64.3 (p_2)	-0.386	0.045	(-0.473, -0.299)
TT_2	41	19.5 (p_1)			
	117	54.9 (p_2)	-0.354	0.044	(-0.440, -0.268)

p_1 = population proportion for the year 1985

p_2 = population proportion for the year 1988

* Results are statistically significant

Source: Survey data of 1985 and 1988.

Table 22. Differences between 1985 and 1988 antigen-specific vaccination results of children

Sample size	Antigen	Vaccinated No.	Percent	Point Est. $p_1 - p_2$	S_p	$CI_{95\%}$ *
212(n_1)	BCG	187	89.0			
210(n_2)		198	93.4	-0.044	0.027	(-0.098, -0.010)
212(n_1)	DPT_1	200	95.0			
210(n_2)		196	92.5	0.025	0.023	(-0.021, 0,071)
212(n_1)	DPT_2	195	93.0			
210(n_2)		192	90.6	0.024	0.027	(-0.028, 0.076)
212(n_1)	DPT_3	168	80.0			
210(n_2)		187	88.2	-0.082	0.035	(-0.151, -0.013)
212(n_1)	$Polio_1$	197	94.0			
210(n_2)		196	92.5	0.015	0.024	(-0.033, 0.063)
212(n_1)	$Polio_2$	193	92.0			
210(n_2)		192	90.6	0.014	0.027	(-0.400, 0.068)
212(n_1)	$Polio_3$	170	81.0			
210(n_2)		187	88.2	-0.072	0.035	(-0.140, -0.004)
212(n_1)	Measles	151	72.0			
210(n_2)		165	77.8	-0.058	0.042	(-0.140, 0.024)

n_1 = sample size for 1985; n_2 = sample size for 1988

p_1 = population proportion for the year 1985

p_2 = population proportion for the year 1988

* Results for BCG, DPT_3, and $Polio_3$ are statistically significant

Reasons for Immunization Failure

When the mothers were interviewed as to why their children or they themselves were not fully vaccinated, the responses were categorized into the following reasons (Tables 23 and 24): (1) lack of information, (2) lack of motivation, (3) obstacles/barriers, or (4) wrong or improper vaccination techniques.

Table 23. Results of reasons for immunization failure, 1988

Reasons	No.	Percent	S_p	$CI_{95\%}$
1. Lack of information				
a) Unaware of need of immunization	9	12.6	0.039	(0.049, 0.203)
b) Unaware of need to return for 2 and 3 dosages	8	11.3	0.037	(0.039, 0.187)
c) Place and/or time of immunization unknown	8	11.3	0.037	(0.039, 0.187)
d) Others	4	5.6	0.027	(0.025, 0.109)
Subtotal lack of information	29	40.8	0.058	(0.294, 0.522)
2. Lack of Motivation				
a) No faith in immunization	1	1,4	0.014	(-0.013, 0.041)
Subtotal lack of motivation	1	1.4	0.014	(-0.013, 0.041)

Table 23 Continued. Results of reasons for immunization failure, 1988

Reasons	No.	Percent	Sp	CI95%
3. Obstacles/barriers				
a) Family problems including illness of mother	5	7.0	0.030	(0.011, 0.129)
b) Time of immunization inconvenient	4	5.6	0.027	(0.025, 0.109)
c) Long waiting time	2	2.8	0.019	(-0.010, 0.066)
Subtotal obstacles/barriers	11	15.5	0.043	(0.071, 0.239)
4. Wrong or improper vaccination techniques				
a) Wrong interval	11	15.5	0.043	(0.071, 0.239)
b) Only BCG scar missing	19	26.8	0.052	(0.165, 0.371)
Subtotal Wrong vaccination technique	30	42.3	0.054	(0.193, 0.406)
Total	71	100.0		

Source: 1988 Survey data.

Ethiopian students currently enrolled at East Tennessee State University, majoring in environmental health, were asked to complete a questionnaire regarding their experience and observation of the vaccination program from the perspective of a health professional actively engaged in the delivery of the service,and as a citizen who was the benefactor of the program (Appendix E). All except one responded that they were given training on EPI,and that they have participated in the delivery of the service at different capacities.

Based on their experiences and observations they cited the following points as the major constraints of EPI, which was by far in conformity with the results of the surveys:

1. Many people in the different parts of Ethiopia do not have ample information about the risks of EPI diseases and the use of the different antigens.

2. Most Ethiopian mothers whose children form abscesses after vaccination do not come back for subsequent vaccinations.

3. Vaccination sessions were mostly interrupted by the cold chain failure in which health facilities were unable to keep vaccines at the required temperature, due to shortage of fuel or spare parts to run refrigerators. Mothers and children return home without getting vaccinations. Parents feel that this situation will happen every time; therefore, they prefer not to go again.

4. Most health workers do not give priority to the vaccination service. Mothers are made to wait for a long time before they and their children are given the inoculations.

CHAPTER 5

Discussion

A guiding strategic principle of any immunization program is that protection must be achieved at an earlier age prior to the time infants are at high risk from a certain disease. This can only be obtained by providing improved quality immunization programs and expanding the service to all eligible children and to all women of child-bearing age. Extensive health education regarding the risk of the diseases preventable by vaccination and the services to be offered are the major components of the activities of health facilities that help to facilitate the success of the vaccination program.

At present, high visibility is being given to immunization coverage levels that are relatively easy to estimate. The WHO/EPI suggests that countries should certainly strive to attain no less than 100% coverage, but it is also fair to give some indication of what level might be judged acceptable, even if falling below the ideal. Coverage levels should not be, at the least, lower than 80% (WHO/EPI, 1987). Even supposing that a level of 80% immunization coverage was sufficient to eliminate the transmission of a given disease in a given geographic area in a given year, it would be unlikely to do so in future years. For such implies that, each year, another 20% of the cohort of newborn would be added to the population of newly susceptible children, and in a short time the number of susceptible children would increase to a level which would sustain transmission. This often produces an explosive epidemic when the disease in question becomes reintroduced into the area.

General Information of the Questionnaires

Questions 1 through 6 permit the recording of information regarding cluster number, date of interview, name of place under survey, range of birth dates to be included in the study, date of birth, and name of child. The individual vaccination card was considered the only reliable source of information to ensure whether an eligible child was vaccinated or not. Mothers or guardians were asked to show if they had a vaccination card provided to them by any health facility.

The main portion of the coverage survey, Questions 7 through 12, allows the recording of all required details for seven to eight children. The number of houses visited to identify the seven children is recorded in the appropriate form (Appendix A).

Information of the vaccination status of mothers with tetanus toxoid are recorded on a separate questionnaire (Appendix B). The questionnaire enables the recording of information regarding tetanus toxoid vaccination of the mother when she was pregnant with the index child. As the full intention of the project was to investigate vaccination usage and coverage rate of Arssi Administrative Region and, based on the findings of the survey, recommend corrective measures to reduce or remove the impact of the problems, the reasons for immunization failure were recorded separately. The questionnaire on immunization failure allows the recording of the possible reasons given by the mothers when the child was found either partially vaccinated or not vaccinated at all (Appendix C).

In examining the survey results in order to determine the intrinsic and extrinsic factors that might have contributed to the usage and participation rate of the vaccination program, it might be appropriate to focus the discussion on the results of certain antigens that could give a clear picture of the entire program. Conclusions from the survey results were made based on whether or not the results were statistically significant and whether or not the results were scientifically important.

The individual vaccination card was the most reliable source of information to determine the vaccination status of mothers and children. It was considered as the best indicator of whether or not mothers/guardians were given the proper education to keep it and show it to health personnel upon request. In the absence of a vaccination card, when a mother claims that her child or herself was vaccinated the investigators had to verify the history of the vaccination by checking the presence of a BCG scar on the child and trying to find the duplicate of the card in the particular health facility where the service was offered. During the 1988 coverage evaluation survey, 71.1% of the children and 51.4% of the mothers showed their vaccination cards to the investigators. The remaining 26.9% of the children and 48.6% of the mothers did not have vaccination cards. They had either lost it or had not received one.

Although the results of the recent survey regarding the proportion of fully vaccinated children and mothers were far less than that of the expected coverage of about 80%, significant improvement was observed in the overall management of the immunization program over the years. According to the survey results of 1988 the proportion of children who received BCG vaccination accounted for 93.4% of those surveyed, with a confidence interval of (0.900, 0.967) at the 95% level. The vaccination against childhood tuberculosis (BCG) is given starting from the first day of life without age screening, and a relatively larger proportion of children get the inoculation. Out of those children who received the antigen only 79.9% were protected against the disease as confirmed by the presence of a BCG scar upon physical check. The confidence interval at the 95% level for the presence of the BCG scar was (0.743, 0.851).

The survey results revealed that one of the major contributing factors for not being fully immunized was the absence of a BCG scar. It has been noticed in the field that the technique of BCG vaccination required the utmost care, patience, skill, and experience. According to practical observations, two extreme situations occur regarding BCG vaccination. On the one hand, a considerable number of children do not develop the proper BCG scar, in which case they are considered as partially vaccinated or else they develop more than a BCG scar or abscess, as a result of which they experience serious pain. This discourages mothers from bringing their children for vaccination. Both extremes are the result of inadequate skill in the delivery of the antigen. The investigator is aware of the fact that there are many health professionals who are technically competent in every aspect. The intent is to show that both situations need due consideration.

Since measles vaccination is given at the age of nine months, a child younger than nine months who is brought to the vaccination site is sent home because of age screening. Mothers are usually told to bring their children when they reach the age of nine months; however, mothers forget the appointment date unless there is intensive follow-up. Thus the attrition rate for measles vaccination is high. In 1988, 77.8% of those surveyed were found to have taken measles vaccination. The calculated confidence interval at the 95% level was (0.722, 0.834). The overall dropout rate as measured by the proportion of children who received BCG vaccination and those who made it through measles vaccination was 16.8%. The confidence interval was (0.117, 0.217) at the 95% level (refer to Table 5). Although there is no established basis for the expected minimum overall dropout rate of vaccination programs, the figures indicate that it is beyond an acceptable limit of attrition rates. It is worthwhile to mention that it is mostly the responsibility of health professionals to remind mothers of the appointment dates for vaccination usually by making house-to-house visits.

The proportion of children who were able to complete their vaccinations was a determining factor of the strength of the vaccination program; 66.5% of the children were fully vaccinated. The confidence interval at the 95% level was (0.601, 0.728). The proportion of children who were partially vaccinated in the same year were 26.9% with a confidence interval of (0.206, 0.326) at the 95% level. The remaining 6.6% were not vaccinated at all. The confidence interval for that proportion was (0.032, 0.199) at the 95% level. Many children who were brought to vaccination sites remained partially vaccinated as opposed to those who were never brought to the vaccination sites. The reasons for immunization failure are addressed later (refer to Table 6).

In places like Arssi, Ethiopia, where endemic childhood diseases such as measles and whooping cough sweep away the lives of many children every year, and where diseases like tuberculosis and poliomyelitis cause debilitating effects, it is a serious concern that only 66.5% of the children to whom the service was made available were able to complete their vaccinations. A large majority of mothers and children in the region do not have access to the vaccination program in particular, and basic health services in general. The strong commitment to expand the service is definitely as essential as increasing the usage and participation rate of the existing service. The reasons for immunization failure, discussed below, gathered from mothers/guardians indicate what measures should be taken.

The proportion of mothers who were vaccinated with the first shot of tetanus toxoid vaccine was 64.6%, with a confidence interval of (0.578, 0.707) at the 95% level. Mothers who returned for the second shot of the antigen accounted for 55.2%, giving a confidence interval of (0.482, 0.616) at the same level. The dropout rate was 14.6% with a confidence interval of (0.098, 0.193) at the 95% level (refer to Table 7).

The usage rate for tetanus toxoid vaccination is usually very low and under-utilized as determined from past experiences. One of the major contributing factors to the low utilization rate was the scheduling of the vaccination sessions in the past. Most health facilities had separate vaccination sessions for mothers and children held on different days. An eligible mother who had brought her child for vaccination on one day had to come back to get her vaccination on another day. This could involve a long walking distance. Many mothers tend to avoid such repeated travel.

Comparison of the survey results for the years 1983, 1985, and 1988 revealed that there was a difference in vaccination performance and usage rate from one year to the other. To determine the progress of the vaccination coverage over the years, conclusions were made based on whether or not the differences were statistically significant and whether or not the differences in population proportions were scientifically important.

An examination of the survey data between 1988, 1985, and 1983 indicated that there was a better return rate for vaccinations in 1988 than in 1985 and 1983. As an example, the proportion of children who received BCG vaccinations was 86.0% in 1983, and 89.0% in 1985. The confidence interval for the difference between the two years at the 95% level was (-0.093, -0.033). The difference in coverage between the two years was statistically significant, because the confidence intervals did not contain the null value of no difference (zero). This leads to the rejection of the null hypothesis of no difference.

On the other hand, the survey results of 1983 and 1985 for measles vaccination and the percentage of children who were fully vaccinated were not statistically significant as denoted by the confidence intervals calculated at the 95% level. In 1983, 64.0% of the children surveyed had taken measles vaccinations, while in 1985, 72.0% were vaccinated. The confidence interval at the 95% level for the difference of the two years was (-0.168, 0.031). The confidence intervals contained the null value of no difference. This may be due to a small sample size. With regard to increase in coverage, the usage rate showed an increase in percentage in 1985 over 1983. The results were scientifically important to the program (refer to Tables 14 and 15).

The difference in tetanus toxoid vaccination could be addressed in the same way. Although comparison of the results of the surveys regarding the vaccination status of mothers showed a slight increase in 1985 from 1983, the vaccination coverage in both years was too low to be appreciated and the difference was virtually minimal. This situation could be attributed to the fact that vaccination with tetanus toxoid was given to pregnant women only. Mothers who had taken the first shot of tetanus toxoid comprised 20% of the mothers surveyed in 1983, and 25.7% of those surveyed in 1985. The confidence interval for the difference in population proportions between the two years at the 95% level was (-0.137, 0.023). Fully vaccinated mothers consisted of 17.0% and 19.5% in 1983 and in 1985 respectively. The confidence interval at the 95% level for the difference between the two years was (-0.099, 0.049) (refer to Table 16). The difference in achievement between the two years as indicated by the confidence intervals was not statistically significant, perhaps again due to small sample size.

Similar inference was made on the difference in vaccination performance between 1983 and 1988 (refer to Tables 17-19). As expected, the usage rate of the vaccination service was significantly higher in 1988 than

1983. The experience developed over the years by health professionals, both at the managerial and field level, and the increased awareness of the public about the vaccination service were the major factors that contributed to the major difference in achievement between the two years. This can be illustrated by the proportion of eligible children who were able to complete their vaccinations. In 1983, 47.0% of the children surveyed were found to have completed their vaccinations successfully. Similarly, 66.5% of the children were able to complete the full course of the antigens in 1988. The confidence interval for the difference in population proportions between the two years at the 95% level was (-0.242, -0.103). Likewise, the proportion of children who were partially vaccinated showed a decrease in 1988 from 1983. In 1983, 39.0% of those surveyed had not completed their vaccinations. This figure dropped to 26.9% in 1988, and the confidence interval was (0.033, 0.210) at the 95% level. The difference in achievement can further be demonstrated by the number of children who were never reached (not vaccinated), 14.0% versus 6.6% in 1983 and 1988, respectively. The confidence interval at the 95% level for the difference between the two years was (0.017, 0.131). As indicated by the confidence intervals, the difference in population proportions between the two years was statistically significant.

A drastic increase in tetanus toxoid vaccination was observed from 1983 to 1985. Mothers who had been given the first shot of the antigen accounted for 20.0% and 64.3% in 1983 and in 1988, respectively. The calculated confidence interval for the difference in population proportions between the two years at the 95% level was (-0.527, -0.359). The proportion of mothers who were fully vaccinated was 17.0% and 54.9% in 1983 and 1988, respectively. The confidence interval at the 95% level for the difference between the two years was (-0.463, -0.295). The results were statistically significant. The major factor for the tremendous change in achievement of higher usage rate was the revision of the vaccination schedule to include all women of child-bearing age as target groups and the availability of the service to mothers along with their children in other maternal and child health care programs.

Similar comparisons for the population proportions between the two years showed a drastic leap in antigen-specifc vaccination performances from 1983 to 1988. Children who received BCG vaccinations consisted of 86.0% and 93.4% in 1983 and 1988, respectively. The difference between the two years in population proportions provided by the confidence interval at the 95% level was (-0.131, -0.172). The usage rate of measles immunizations showed an increase in 1988 over 1983. In 1983, 64.0% of the children were vaccinated with the antigen, while in 1988, 77.8% were able to take the vaccination. The confidence interval for the difference in population proportions between the two years at the 95% level was (-0.224, -0.052). The increase in usage rate as depicted by the above data indicated that the difference between the two years was statistically significant.

The survey results of 1985 and 1988 indicated major differences in the population proportion of children who received vaccinations. These differences indicated that better vaccination coverage was attained in 1988 than in 1985. The proportion of children who were able to complete their vaccinations accounted for 53.5% in 1985 and 66.5% in 1988. The true difference between the two years provided by the confidence interval at the 95% level was (-0.222, -0.037). The percentage of partially vaccinated children dropped from 42.4% in 1985 to 26.9% in 1988. The confidence interval at the 95% level for the difference in population proportions for the two years was (0.065, 0.245). The differences in the proportion of children who were fully vaccinated and partially vaccinated were statistically significant. The proportion of children who were not vaccinated increased slightly from 1985 to 1988, 4.3% versus 6.6%, respectively. The difference between the two years provided by the confidence interval at the 95% level was (-0.066, 0.020). However, as shown above, this increase did not have an impact on the difference of the overall better achievement of vaccination coverage in 1988 than in 1985 (refer to Table 20).

Tetanus toxoid vaccination was a better indicator of the usage rate of the antigen between 1985 and 1988. The proportion of mothers who received the first shot of tetanus toxoid vaccine increased from 25.7% in 1985 to 64.3% in 1988, giving a confidence interval of (-0.473, -0.299) at the 95% level. Mothers who received the second dosage of the antigen consisted of 19.5% and 54.9% in 1985 and in 1988, respectively. The confidence interval for the difference in population proportions between the two years was (-0.440, -0.268) at the 95% level (refer to Table 21). As indicated by the confidence intervals, the differences were statistically significant.

The antigen-specific vaccination performance survey results revealed similar differences in population proportions. The proportion of children who received BCG vaccination accounted for 89.0% and 93.4% in 1985 and 1988, respectively. The calculated confidence interval for the difference in population proportions between the two years was (-0.098, -0.010) at the 95% level. It was also noticed that 72.0% and 77.8% of the children were vaccinated against measles in 1985 and 1988, respectively. The confidence interval for the difference between the two years at the 95% level was (-0.140, 0.024). The differences in usage rate of the service indicate both with regard to statistical significance and scientific importance that better effort was made to improve the delivery of the service and to increase the participation rate of the community.

The major factors that contributed to the improvement of the vaccination program over the years, according to the experience of the investigator, included:

1. Government commitment at the higher level was reinforced by giving high priority to the immunization program, based on the progressive reports of increased achievement. Ample funding was allocated to strengthen and expand EPI.

2. A large portion of the health staff was given on-the-job training throughout the country each year.

3. Health education was provided for the public more intensively than in previous years.

4. Routine and frequent supervision at all levels helped monitor and correct problems.

5. The target group for tetanus toxoid vaccination was extended to cover women of child-bearing age, unlike the previous practice of only immunizing pregnant women.

About half of the reasons why children and mothers did not complete their vaccinations, according to the 1988 survey results, included intrinsic factors such as improper/wrong vaccination techniques, including negligence to check either the age of the vaccinee or the interval between doses. Some of the pertinent reasons for immunization failures given by the mothers in 1988 indicated that the hindrance could have been avoided by extensive training of health personnel and the provision of health education to the public.

According to the survey results on immunization failures in 1988, the mothers of 40.8% of the children who were partially or not-immunized said that they did not have any information about the availability of the vaccination service. One of the mothers said that she did not have faith in the immunization. This might indicate that ample effort was not made to convince her to go to the vaccination site. Five mothers told the interviewers that they were sick and were unable to take their children to the vaccination sites. Four mothers reported that the time the immunization was scheduled to be given was not convenient for their work schedules.

Two mothers said that they were tired of sitting for a long time waiting for health workers. They thought that would happen every time they went there, and they decided not to return to the vaccination site. About 42.3% of the children who were partially vaccinated were brought to the vaccination sites and were given the vaccinations. However, the health workers did not check the interval between doses of DPT/Polio, the minimum of which is stated to be at least 28 days; and there was no BCG scar observed upon check. This could be due to either poor vaccination technique or inoculation of vaccine that had lost its potency, because of failure of the cold chain system (refer to Tables 23 and 24). The cold chain system is a method of keeping vaccines at the standard temperature, starting from the manufacturer up to the point of inoculation. It is one of the most frequently occurring problems, particularly in rural areas where most health facilities do not have electricity to run refrigerators. They have to depend on liquified natural gas or kerosene to operate their refrigerators to keep the potency of the vaccines, since the vaccines have to be kept at a standard temperature to maintain their potency.

The survey results revealed that the major intrinsic and extrinsic factors that were the causes of the problems of the immunization program originated from:

1. Dropouts (withdrawals)
2. Missed opportunities
3. Never-reached people
4. Wrong/improper vaccination technique

Possible causes of dropouts were:

1. Some health personnel did not fully explain to mothers the need to return for additional immunizations, or the date to return.

2. The health education given on EPI diseases becomes one way, and mothers or guardians usually return home without gaining much from the education. This was the major contributing factor for the cause of lack of awareness of widespread social support for immunization.

3. Some health facilities were poorly managed. Women did not return because of a long waiting time.

4. Immunization services were scheduled to be given at fixed times that were inconvenient for mothers.

5. Follow-up visits were not conducted on a continuous basis so as to minimize the attrition rate.

6. Community members or mothers refrained from bringing their children or themselves for vaccination because of fear of side effects or reactions. Abscess formation from both

BCG and DPT vaccinations was the major source of complaint for most mothers.

The possible causes of missed opportunities observed in the field were:

1. Health workers in some health facilities did not screen and immunize, regardless of the reason the woman or child came to the health unit.

2. Some mothers believed immunizations were harmful.

3. Mothers were not immunized in the same vaccination session with their children.

4. People who were "never reached" were those who never used the services offered at the health unit for reasons other than lack of geographic access.

Wrong/improper vaccination techniques included:

1. Most children did not have a BCG scar after being vaccinated with the antigen.

2. Some mothers did not want to take their children back to the vaccination sites because of fear of side reactions.

3. Some children were considered partially vaccinated because the minimum interval between the triple doses of DPT/Polio was not adhered to strictly.

4. Many children were given measles vaccinations before the age of nine months, in which case they were considered partially vaccinated according to the instructional manual of the vaccination program of the country.

CHAPTER 6

Conclusions and Recommendations

In lesser developed countries like Ethiopia, where communicable diseases account for 75-80% of the health problems of the country, emphasis should be placed upon the prevention and control of those diseases. Environmental sanitation, extensive health education, proper nutrition, and immunization are the best tools to tackle such problems.

In view of community involvement in previous health activities at all levels and promoting self-reliance, the Ethiopian government placed great emphasis on community participation at various levels as one of the strategies to implement Primary Health Care programs (PHC), so as to achieve the global goal of "Health for All by the Year 2000." EPI is one of the main components of PHC programs to achieve this goal. For EPI to succeed it requires the combined effort of health workers, the population, and the government.

Recommendations

Based on the findings of the study and on field experiences of the investigator, the following recommendations are forwarded:

1. Health personnel should work more closely with community leaders so as to get those who are eligible to come to health units for vaccination.

2. Involvement of women's, youth's, peasants', and urban dwellers' associations should be increased.

3. Immunization awareness campaigns should be conducted in schools, in meeting places, by mass media, in health facilities, and in other places where audiences can be found periodically.

4. Immunization services should be offered on days and at times that are convenient to mothers.

5. Refresher training for health workers should be carried out at all levels.

7. Mothers and children should be screened at every contact and be given immunization as needed to avoid missed opportunities.

8. Intensive house-to-house follow-up activity should be carried out periodically to reach those who have dropped out and those who have never been reached.

9. Tetanus toxoid vaccination should continue to be given to all women of child-bearing age.

10. The need to involve other governmental agencies and private organizations should be strengthened.

11. Children should be required to present a certificate of vaccination when they apply for admission to schools.

12. Birth and death registration systems should be developed at all levels.

13. Similar studies should be conducted periodically to identify the strengths and weaknesses of the vaccination program.

14. Studies on the impact of vaccinations on EPI diseases could be a good estimate of how successful the vaccination program is in the reduction of the morbidity, mortality, and disability resulting from the EPI diseases. Therefore, disease surveillance should be carried out by all health facilities.

15. If economically and epidemiologically feasible, studies to determine the sero-conversion rate of each antigen level could be a beneficial measure of the entire program.

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APPENDICES

APPENDIX A

EVALUATION FORM INFANT IMMUNIZATION

CLUSTER FORM
INFANT IMMUNIZATION

(1) Cluster number: ________
(2) Date: ________________
(3) Area: ________________

(4) Range of Birth Dates:

From: ____________
Until: ____________

		(5) Name								TOTAL Card
Child number in cluster:		1	2	3	4	5	6	7	8	
(6) Birth date										
(7) Immunization Card	Yes/No									
(8) BCG	Date/+/0									
	Scar: Yes/No									
	Source									
(9) DPT 1	Date/+/0									
	Source									
DPT 2	Date/+/0									
	Source									
DPT 3	Date/+/0									
	Source									
(10) OPV 1	Date/+/0									
	Source									
OPV 2	Date/+/0									
	Source									
OPV 3	Date/+/0									
	Source									
(11) Measles	Date/+/0									
	Source									
(12) Immunization Status	Not									
	Partially									
	Fully									

(13) Tally of households visited: ________________

(14) Name of Interviewer: ________________________

Signature: ________________________________

Key: Date/+/0:

Date – Copy date of immunization from card, if available
\+ – Mother reports immunization was given
0 – Immunization not given

Source
HC-Health Care
HOS-Hospital
OUT-Outreach
PRIV-Private

APPENDIX B

CLUSTER FORM TETANUS TOXOID IMMUNIZATION OF WOMEN

CLUSTER FORM
TETANUS TOXOID IMMUNIZATION OF WOMEN

(1) Cluster number: ______
(2) Date: ______
(3) Area: ______

(4) Range of Birth Dates:

From: ______
Until: ______

		(5) Mother's Name								TOTAL Card
Women in cluster		1	2	3	4	5	6	7	8	
(6) Birth date of child										
(7) Immunization Card (Mother)	Yes/No									
(8) TT 1	Date/+/0									
	Source									
TT 2	Date/+/0									
	Source									
TT 3	Date/+/0									
	Source									
TT 4	Date/+/0									
	Source									
TT 5	Date/+/0									
	Source									

(13) Tally of households visited: ______

(14) Name of Interviewer: ______

Signature: ______

Key: Date/+/0:

Date - Copy date of immunization from card, if available
+ - Mother reports immunization was given
0 - Immunization not given

Source
HC-Health Care
HOS-Hospital
OUT-Outreach
PRIV-Private

APPENDIX C

EVALUATION FORM

REASONS FOR IMMUNIZATION FAILURE

CLUSTER FORM
REASONS FOR IMMUNIZATIONS FAILURE

1. Cluster number: ____________ 4. Range of birthdates: From: ______________
Until: ______________

2. Area: ____________________
3. Date: ____________________

NOTE: ASK ONLY ONE QUESTION: Why was the child not fully immunized?
Mark (X) the single most important reason according to your judgement.

Child number in cluster		1	2	3	4	5	6	7	8	TOT:
5. Immunization Status	Not immunized Partially immunized Fully immunized									
Lack of Information	a. Unaware of need for immunization									
	b. Unaware of need to return for 2 or 3 dose									
	c. Place and/or time of immun. unknown									
	d. Fear of side reactions									
	e. Wrong ideas about contraindications									
	f. Other									
6. Lack of Motivation	g. Postponed until another time									
	h. No faith in immunization									
	i. Rumors									
	j. Other									
Obstacles	k. Place of immuni-zation too far									
	l. Time of immuni-zation inconvenient									
	m. Vaccinator absent									
	n. Vaccine not available									
	o. Mother too busy									
	p. Family problems, including illness of mother									
	q. Child ill-not brought									
	r. Child ill-brought but not given immunization									
	s. Long waiting line									
	t. Other									

APPENDIX D

COMPILATION FORM

INFANT IMMUNIZATION

COMPILATION FORM
INFANT IMMUNIZATION

Area: ____________ Age Group Evaluated: ____________
Date of First Interview: ________ Date of Last Interview: ____________
Number in Survey: ____________

		TOTAL CARD		TOTAL CARD PLUS HISTORY	
		Number	Percentage	Number	Percentage
BCG		____	____	____	____
BCG scar				____	____
Source:	HOS			____	____
	HC			____	____
	Out			____	____
	Priv			____	____
DPT 1		____	____	____	____
DPT 2		____	____	____	____
DPT 3		____	____	____	____
Source:	HOS			____	____
	HC			____	____
	Out			____	____
	Priv			____	____
OPV 1		____	____	____	____
OPV 2		____	____	____	____
OPV 3		____	____	____	____
Source:	HOS			____	____
	HC			____	____
	Out			____	____
	Priv			____	____
Measles		____	____	____	____
Source:	HOS			____	____
	HC			____	____
	Out			____	____
	Priv			____	____
Not Immunized		____	____		
Partially Immunized		____	____		
Fully Immunized		____	____		

Total number of households: ____________
Average number of households
Per cluster: ____________

APPENDIX E

COMPILATION FORM

REASONS FOR IMMUNIZATION FAILURE

COMPILATION FORM
REASONS FOR IMMUNIZATION FAILURE

Area: ______________________ Age Group Evaluated: __________

Date of first interview: ______________ Date of last interview: __________

		TOTAL	PERCENTAGE
	Partially/not immunized	______	
	Lack of Information		
a.	Unaware of need for immunization	______	______
b.	Unaware of need to return for 2nd and 3rd dose	______	______
c.	Place and/or time of immunization unknown	______	______
d.	Fear of side reactions	______	______
e.	Wrong ideas about contraindications	______	______
f.	Other:	______	______
	Subtotal:	______	______
	Lack of Motivation		
g.	Postponed until another time	______	______
h.	No faith in immunization	______	______
i.	Rumors	______	______
j.	Other:	______	______
	Subtotal:	______	______
	Obstacles		
k.	Place of immunization too far to go	______	______
l.	Time of immunization inconvenient	______	______
m.	Vaccinator absent	______	______
n.	Vaccine not available	______	______
o.	Mother too busy	______	______
p.	Family problem, including illness of mother	______	______
q.	Child ill-not brought	______	______
r.	Child ill-brought but not given immunization	______	______
s.	Long waiting time	______	______
t.	Other:	______	______
	Subtotal:	______	______

APPENDIX F

QUESTIONNAIRE FOR ETHIOPIAN STUDENTS

MAJORING IN ENVIRONMENTAL HEALTH

AT EAST TENNESSEE STATE UNIVERSITY

Questionnaire for Ethiopian Students
Majoring in Environmental Health
at East Tennessee State University

1. Name ______________________________

2. Place of assignment before coming to ETSU ______________

____

3. Position ______________________________

4. Have you been trained in EPI: Yes ____ No ____ If yes, at what level: High level Management ______________

Mid-level Management ______________

Low-level Management ______________

5. Have you articipated in EPI acitivity: Yes ____ No ____ If yes, at what level ______________________

____

6. Was immunization offered in the area you lived? ________

____

7. Type of health facility rendering the service:

Hospital __________

Health Center _________

Health Station __________

Other ______________

8. How often is the service offered: daily ____ weekly ____ monthly ____

9. Do people use the service very well: Yes ____ No ____ If no, why not ______________________

10. From your experience what are some of the constraints of EPI? ______________________________

____

____

11. What do you think should be done to increase usage rate of the vaccination service? ______________________________

____

____

____

____

APPENDIX G

LIST OF ETHIOPIAN STUDENTS

LIST OF ETHIOPIAN STUDENTS

TESHOME MENGISTU; Head of Food Sanitation, Department of Environmental Health Services, Ministry of Health, Addis Ababa, Ethiopia.

HULUAGERSH SERTSE; Head, Water Quality Section, Department of Environmental Services, Ministry of Health, Addis Ababa, Ethiopia.

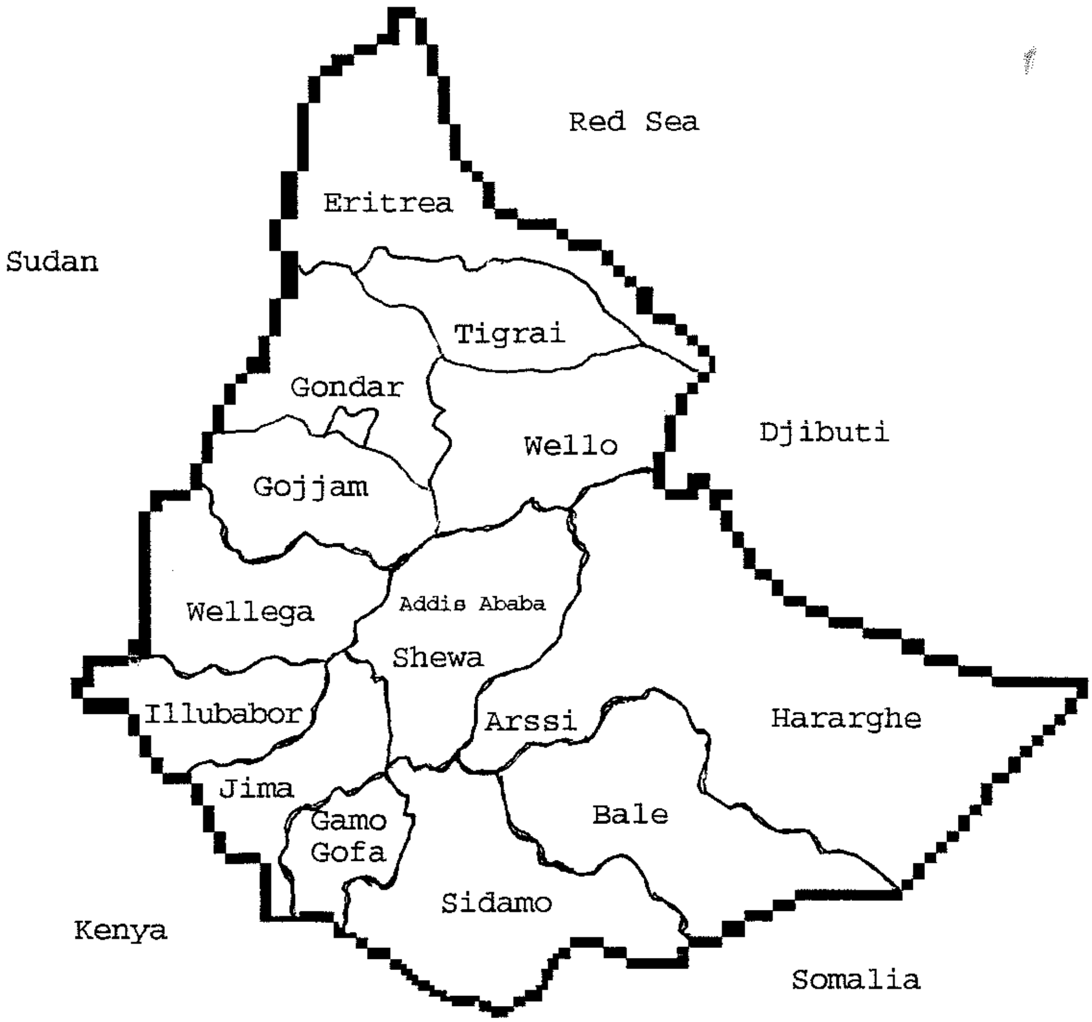
YILMA TEKLESELASSIE; Regional Environmental Health Coordinator, Addis Ababa Health Department, Addis Ababa, Ethiopia.

DUBIWAK GEMEDA; Regional Environmental Health Coordinator, Wollega Regional Health Department, Nekemte, Wollega.

APPENDIX H

MAP OF ETHIOPIA

MAP OF ETHIOPIA



APPENDIX H

POPULATION OF ETHIOPIA BY REGION

POPULATION OF ETHIOPIA BY REGION - 1987

Regions	Population in '000			Area in '000 Km^2	Density	Average No. of Persons Per Household
	Total	Urban	Rural			
Arssi	1808.5	122.5	1686.0	24.1	75.0	4.7
Shewa	8805.3	673.7	8131.6	85.0	103.6	4.5
Hararghe	4527.4	308.6	4218.8	272.3	16.6	4.4
Asseb	98.2	34.9	63.3	27.4	3.6	3.0
Wello	3962.0	254.3	3703.7	82.1	48.3	4.1
Eritrea	2852.9	423.5	2429.4	93.7	30.4	4.5
Tigrai	2624.4	251.6	2372.8	64.9	40.4	4.3
Gojjam	3530.5	242.1	3288.4	61.2	57.9	4.3
Gonder	3178.7	229.6	2949.1	79.6	39.9	4.5
Illubabor	1048.3	57.1	991.2	46.4	22.6	4.2
Keffa	2664.6	139.5	2525.1	56.6	47.1	4.1
Wellega	2693.6	135.5	2558.1	70.5	38.2	4.7
Bale	1095.1	26.0	1069.1	127.1	8.6	4.7
Gamo Gofa	1356.7	58.6	1298.1	40.3	33.7	4.3
Sidamo	4123.4	256.6	3866.8	119.8	34.4	4.4
Addis Ababa	1589.2	1589.2	- -	0.2	7946.0	5.2
TOTAL	45958.8	4803.3	41155.5	1251.2	36.7	4.4

Source: Planning and Programming Bureau, Ethiopia, 1988.

APPENDIX J

COVER LETTER FOR INFORMATION

May 5, 1991

Pan American Health Organization
Expanded Program on Immunization
Washington, D.C.

Dear Sir:

I am a graduate student in the Environmental Health Department at East Tennessee State University. As part of my academic requirements for a Masters degree in Environmental-Epidemiology, I am preparing a thesis entitled "Preliminary Epidemiological Interpretation of the Intrinsic and Extrinsic Factors Contributing to Coverage and Participation Rates of the Vaccination Program in Arssi, Ethiopia.

To help me achieve my goal, I am requesting you to send me written materials related to vaccination coverage evaluation surveys. It would be helpful if you could send me the documents in the stamped, self-addressed envelope. Please let me receive them before April 25, 1991.

Thanking you in advance,

Sincerely yours,

Muchie Kidanu

VITA

Muchie Kidanu

Personal Data:	Marital Status: Married Language: Amharic and English
Education:	Ibinat Elementary School, Ibinat, Ethiopia, Certificate. Addis Zemen Junior Secondary School, Addis Zemen, Ethiopia, Certificate. Gondar Comprehensive Secondary School, Gondar Ethiopia, Certificate. Public Health College and Training Center, Gondar, Ethiopia, Sanitary Science, Diploma. Mid-level Management on Expanded Program on Immunzation, EPI, and Maternal and Child Health Care, NCH, Nazareth, Ethiopia, Certificate. Cold Chain and Logistics Management, Addis Ababa, Ethiopia, Certificate. Control of Tuberculosis, Nazareth, Ethiopia, Certificate. Supervisory Skills on the Control of Diarrheal Diseases, Nazareth, Ethiopia, Certificate. East Tennessee State University, Johnson City, Tennessee, BSEH, May, 1991. East Tennessee State University, Johnson City, Tennessee, MSEH, December, 1991.
Professional Experience:	EPI National Supervisor, Department of Epidemiology, Ministry of health, Ethiopia. Regional Coordinator for the Control of Communicable Diseases, Arssi, Ethiopia. Regional Coordinator for the Smallpox Eradication Program, Arssi, Ethiopia. Surveillance Officer in the "Yellow Fever Vaccination Campaign, Sidamo, Ethiopia. Regional Team Leader for the Smallpox Eradication Program, Gondar, Ethiopia. Surveillance Officer for the Smallpox Eradication Program, Gojjam, Ethiopia. Health Center Sanitarian, Jinka, Health Center, Gamo Gofa, Ethiopia.
Awards:	Certificate, for outstanding participation in the "Global Eradication of Smallpox." Certificate, for active participation in the "Literacy Campaign" to wipe out illiteracy from Ethiopia.