The Costs of EPI

REACH

Resources for Child Health Project

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The Costs of EPI:

Lessons Learned from Cost and Cost-effectiveness Studies of Immunization Programs

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Logan Brenzel, M.S.
Technical Advisor

Resources for Child Health (REACH) Project
John Snow, Inc.
1100 Wilson Blvd., Ninth Floor
Arlington, VA 22209

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LIST OF ACRONYMS

A.I.D.	U.S. Agency for International Development
BCG	Bacillus Calmet-Guerin Vaccine
CE Study	Cost Effectiveness Study
CFA	(Franc) Communauté Financière Africaine
COSAS	Coverage Survey Analysis Software
DPT	Diphtheria-Pertussis-Tetanus Vaccine
DPTP	Diphtheria-Pertussis-Tetanus-Polio Vaccine
EPI	Expanded Programme on Immunization
EPICost	EPI Costing Module developed by WHO
FIC	Fully Immunized Child
GDP	Gross Domestic Product
GNP	Gross National Product
IPV	Injectable Polio Vaccine
MCH	Maternal and Child Health
MOH	Ministry of Health
PAHO	Pan American Health Organization
PHC	Primary Health Care
PPC	Program and Policy Coordination Bureau (A.I.D.)
PVO	Private Voluntary Organization
REACH	Resources for Child Health Project
RUSHA	Rural Unit for Health and Social Affairs, Tamil Nadu, India
TT	Tetanus Toxoid vaccine
UNICEF	United Nations International Children's Fund
WHO	World Health Organization

PREFACE

This document is written primarily for field officers and national EPI (Expanded Program on Immunization) managers to discuss what has been learned from a decade of EPI cost studies. In a time when dwindling resources require that national programs yield greater coverage levels at less cost, cost-effectiveness analysis is an important tool to assist in decision-making about how to allocate scarce resources. However, some confusion remains concerning the underlying assumptions of cost analysis and the benefits of these studies for program planning and management. This document was written to shed light on what is known about the cost of EPI as well as to clarify some of the strengths and weaknesses of the methods in use.

Section I outlines current knowledge about the costs of national child immunization programs. Section II provides information about how to conduct a cost-effectiveness study. Section III discusses future directions for the role of cost and cost-effectiveness evaluations in the EPI as a whole. While the last section is aimed at a more technical audience, the interested reader may find it useful. Additional discussion about cost-effectiveness methodology is found in Appendix C.

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Production of this document was funded by the U.S. Agency for International Development contract no: DPE-5927-C-00-5068-00 through the Resources for Child Health (REACH) Project. The REACH Project (1985-1990) was created to support the U.S. Agency for International Development's multifaceted efforts to improve child survival through reducing preventable childhood deaths in developing countries. The project comprises a worldwide effort by John Snow, Inc. (JSI) and its subcontractors to provide technical support to global child survival efforts. The major technical areas of activity are immunization and health care financing. Between 1985 and 1990 the REACH Project participated in eleven cost-effectiveness studies of EPI in Cameroon (1987); Turkey (1986, 1988); Ecuador (1988); Philippines (1988); RUHSA (1989); North Arcot, India (1989, 1990); Mali (1989); Sudan (1990); and Haiti (1990)

SECTION I:

LESSONS LEARNED FROM SELECTED COST-EFFECTIVENESS STUDIES

A. Rationale for Conducting Studies

The earliest cost-effectiveness studies of immunization programs followed the adoption of two WHO health initiatives: Primary Health Care (PHC) in 1978 and the Expanded Programme on Immunization (EPI) in 1977. The first published EPI cost-effectiveness study (Barnum, et al., 1978) evaluated the incremental costs of adding additional vaccines to the EPI in Indonesia. A subsequent study (Shepard, et al., 1979) examined the use of different immunization strategies in selected areas in Côte d'Ivoire. In 1979, the WHO EPI Costing Guidelines were developed as a training tool for field managers. These guidelines were field tested in the Philippines, Thailand and Indonesia by Creese.

Early studies described the EPI as one of the most cost-beneficial means of reducing childhood mortality since the unit cost of vaccines was lower than the enormous costs of treating disease. Early studies suggested it cost between $5 to $15 to fully immunize a child, and that most governments were contributing 80% of the total program cost. Demonstration of the cost-effectiveness of EPI coincided with increased commitments on the part of donor organizations for financing the start-up and early operating costs of the EPI.

Between 1980 and 1984, six EPI cost-effectiveness studies were conducted. Two studies were conducted by Creese, et al., in Brazil (1984) and Colombia (1987) using the EPI Costing Guidelines as a framework. These studies evaluated national polio immunization campaigns. Three studies by Robertson, et al. (1985) in Malawi, Swaziland and The Gambia compared health facility costs and outcomes for immunization services. A final study by Hartman, et al., (1986) evaluated the national program in Honduras. The methodology used and the objectives of each study differed. Furthermore, studies were conducted on an ad hoc basis, mostly at the request of different donors.

Following a 1984 conference on immunizing the world's children in Bellagio, Italy, the rationale for doing cost and cost-effectiveness studies of EPI changed from documenting the cost-effectiveness of the program for initial donor investment, to documenting its cost-effectiveness for continued donor contributions. The donor community became more interested in knowing the total cost of this global immunization effort to reduce childhood death and disease.

With the advent of acceleration strategies for increasing immunization coverage, a new series of cost and cost-effectiveness studies was undertaken in collaboration with UNICEF, WHO and A.I.D. as part of joint program reviews. The emphasis was on documenting and comparing the costs of intensive immunization campaigns versus routine immunization programs and special outreach efforts. A.I.D.'s Child Survival initiative starting in the mid-1980s provided needed resources for improving and expanding national immunization programs. Yet, during this time there was a general decline in developing countries' economic base due to a worldwide recession.

Government's ability to bear some of the costs of immunization programs lessened while large-scale strategies, such as campaigns, have been initiated and financed by donors. Donor resources often replaced scarce public sector resources, which were reallocated to other government programs and priorities. Greater importance has been placed recently on the role of cost and cost-effectiveness studies to examine the current and future financing of the EPI, and to assess the program's financial sustainability.

As the technical capabilities of national immunization programs became stronger, improved methods of measuring program effectiveness (through 30-cluster sample surveys and computerization of records of immunization activity) allowed cost-effectiveness studies to be integrated into other program evaluation activities. Effectiveness measures became more standardized among countries and cost-effectiveness data could be compared from one setting to another or over time in the same country.

Finally, given the decline in available government resources, more attention has been given to improving the overall management and efficiency of immunization programs. Some of the most recent cost studies have attempted to provide practical managerial recommendations in order to improve efficiency and program effectiveness in controlling disease. For example technological developments, such as new vaccines and syringes, added to or potentially saved immunization program costs. Thus, specific economic evaluations were conducted to assess the impact of new technologies on the cost and cost-effectiveness of EPI.

In conclusion, the initial interest in conducting cost-effectiveness studies of the EPI was to raise sufficient resources to launch the global program. The last decade has seen a proliferation of cost-effectiveness analyses driven by donor organizations' need to justify investments into the program and to explore possible solutions to the problems of recurrent cost financing and sustainability. Primarily, the rationale for conducting many of these studies has come from donor organizations, not from program managers themselves. As a result, study objectives may not coincide with managerial priorities, thereby limiting the usefulness of the cost-effectiveness study results. More attention needs to be paid in future to addressing the ongoing needs of managers by providing them with practical information for routine monitoring of EPI resource use and distribution.

B. What are the Costs of EPI?

A review and analysis of the cost and cost-effectiveness literature was undertaken by the REACH Project[1] in order to draw conclusions about the current state of knowledge and to provide recommendations for future studies. Of 28 studies, only eight (of 11 immunization program strategies) used similar information sources and research methods. Use of 30-cluster sample studies for data on coverage rates of fully immunized children, classification of cost elements, and methods for calculating costs were uniform for the eight studies.

This section highlights the general findings of the REACH review. Given the limited sample size (n=8) of comparable studies, results of this review should be considered suggestive rather than definitive of the range of EPI costs found worldwide. All cost figures are reported in 1987 U.S. dollars for comparison.

1) Total cost and cost per fully immunized child

The total cost of EPI includes personnel, transportation, supplies, vaccines, maintenance, miscellaneous operating costs, equipment, vehicles and buildings costs. Total costs are divided by the number of children fully immunized (at less than one year of age) measured through 30-cluster coverage surveys. Table 1 compares the results from the eight studies for costs per fully immunized child, broken down by type of immunization strategy.

According to these results, the arithmetic average for all eleven estimates was $12.60 per fully immunized child (FIC), with a range from $4.47 in Burkina Faso to $19.48 in Senegal. When the costs of maintaining in-country EPI technical assistance are factored into total cost figures, the average cost per FIC increases to $15.00.

These results somewhat modify previous figures of the average cost per fully immunized child. This review of cost-effectiveness studies demonstrates that the initial range of 1984 WHO estimates between $5 and $15 per child (which would be $5.47 and $16.41, respectively, in 1987 U.S. dollars) is wide enough to capture the range of costs found in immunization programs. <u>However, the current average of $13 per FIC, or $15 per FIC including technical assitstance, lies at the upper end of the range, and future planning of programs or strategies should consider the revised estimate as more indicative of actual program costs.</u>

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[1]Research was conducted under the Immunization Sustainability Study, funded by the Policy and Program Coordination (PPC) Bureau of A.I.D.

TABLE 1

Comparison of Cost-effectiveness Studies of the EPI by Strategy

COUNTRY	STRATEGY	COST 1987 $	NO. FIC	COST/FIC 1987 $
Burkina Faso (1987)[1]	Facility	$26,707	5,977	$4.47
Tanzania (1988)[2]	Facility	$4,571,000	700,000	$6.53
Mauritania (1985)[3]	Facility	$88,698	12,297	$7.21
Philippines (1988)[4]	Facility	$17,036,583	1,233,147	$13.82
The Gambia (1982)[5]	Facility	$442,222	26,791	$16.51
Turkey (1988)[6]	Facility	$15,265,676	803,568	$19.00
Mean (n=6)		$6,241,373	463,630	$11.26
Mauritania (1985)[3]	Campaign	$207,652	25,507	$8.14
Cameroon (1987)[7]	Campaign	$4,905,427	255,000	$19.24
Senegal (1987)[8]	Campaign	$3,678,669	188,864	$19.48
Mean (n=3)		$2,920,311	156,457	$15.62
Burkina Faso (1987)[1]	Mobile	$16,512	2,325	$7.10
Mauritania (1985)[3]	Mobile	$290,313	20,604	$14.09
Mean (n=2)		$158,476	11,465	$10.60

[1]de Champeaux, Antoine, "Evaluation du programme elargi de vaccination, province de la Sissile," OCCGE, 1987.

[2]Ministry of Health, Tanzania, Joint Review Report on EPI in Tanzania, DANIDA Review Team (September 1987).

[3]Brenzel, L., Cost-effectiveness of Alternative Immunization Strategies in the Islamic Republic of Mauritania, UNICEF, 1986.

[4]Turner, Pamela, excerpts from a A.I.D. Project Proposal (PP) for USAID/Manila, 1988.

[5]Robertson, R.L., et al., "Cost-effectiveness of immunization in The Gambia," Journal of Tropical Medicine and Hygiene, 1985, Vol. 88, p.p. 343-351.

[6]Brenzel, L., et al., The Cost-effectiveness of the National Immunization and CDD Program in Turkey, REACH Publication, March 1988.

[7]Brenzel, L., "Cost-effectiveness of Immunization Strategies in the Republic of Cameroon," REACH Publication, August 1987.

[8]Brenzel, L., et al., "Rapid Assessment of Senegal's Acceleration Phase," submitted to UNICEF, November 1987.

2) Evaluation of alternative strategies

In general, the objective of cost-effectiveness analysis is to compare alternative strategies for achieving the same outcome. The method can also be used to determine the best mix of strategies for reaching a target level of outcomes, given a fixed amount of resources. For EPI, a highly cost-effective program is one which maximizes the number of immunized children with the fewest resources. As such, a highly cost-effective strategy is preferable on economic grounds. Several studies included in this review compared fixed facility strategies with mobile teams and immunization campaigns, though not all evaluations of the EPI have been conducted with this purpose.

The variation in EPI strategy costs and level of immunization activity presented in Table 1 is due to the volume of services provided, range of technologies, methods of program implementation, and differences in coverage levels. On average, mobile team strategies are the most cost-effective at $10.60 per FIC, followed by fixed facilities at $11.26 per FIC. However, there was a two-fold difference in the costs associated with the two mobile team strategies, making the calculated arithmetic average of $10 per FIC potentially due to the limited number of studies available. In this comparison, campaigns have the least desirable cost-effectiveness ratio of $15.62. Differences between the most and least cost-effective strategies ($5.00 per child) is small given the wide range of technologies and volume of services delivered. Forty times more children are fully immunized by routine services in fixed facilities than by mobile teams. However, the total annual cost of an EPI will be significantly affected by the average cost per child, particularly in countries with large population sizes.

Table 2 segregates the data by strategy and region. These data reveal an unexpected finding: on average, African programs through fixed facilities are more than twice as cost-effective per FIC ($6.94) than the Asian programs evaluated ($16.41). The African estimates had a wider range of from $4.89 to $19.00 per child. Higher average costs in the Asian studies may be due to larger population sizes and higher immunization coverage levels than the African programs.

Although the number of studies for this analysis is limited, these data suggest a greater degree of uniformity for cost-effectiveness ratios across regions and strategies than perhaps previously believed. The general conclusion one can draw from data in Table 2 is that routine fixed facility services are the most cost-effective strategies, with mobile services being the least cost-effective. Mobile and outreach services lie between facility and campaigns. No cost-effectiveness studies of EPI were found in Latin America which use coverage survey data and similar cost methodology at the time of this review.

An analysis of cost profiles for each strategy will highlight reasons for the differences in their cost-effectiveness.

TABLE 2

Comparison of the Cost Per Fully Immunized Child by Region
(in 1987 U.S. Dollars)

STRATEGY	ALL STUDIES	ASIAN PROGRAMS	AFRICAN PROGRAMS
FACILITY	$11.26 (n=6)	$16.41 (n=2)	$6.94 (n=4)
MOBILE TEAMS	$10.60 (n=2)	-----	$10.60 (n=2)
CAMPAIGNS	$15.62 (n=3)	-----	$15.62 (n=3)
ALL	$12.60 (n=11)	$16.41 (n=2)	$9.58 (n=9)

Source: Table 1.

Cost profiles represent the ratio between the cost of a specific component of the immunization program (e.g., vaccines or transportation) to the total cost of that program. These figures could be used to determine the relative impact of each component on total costs and to identify potential areas where resources could be conserved. Figure 1 illustrates the cost profiles for selected cost-effectiveness studies. These data support the following conclusions:

1. The share per cost component was different for the three principal strategies: fixed facilities, mobile teams, and national campaigns;

2. Salaries and wages are the predominant cost category for all strategies, ranging from 37% for campaigns to 42% for fixed facilities and 45% for mobile teams;

3. Supervision and management categories were the second highest cost element at 20% due to inclusion of transportation and per diem costs in this category;

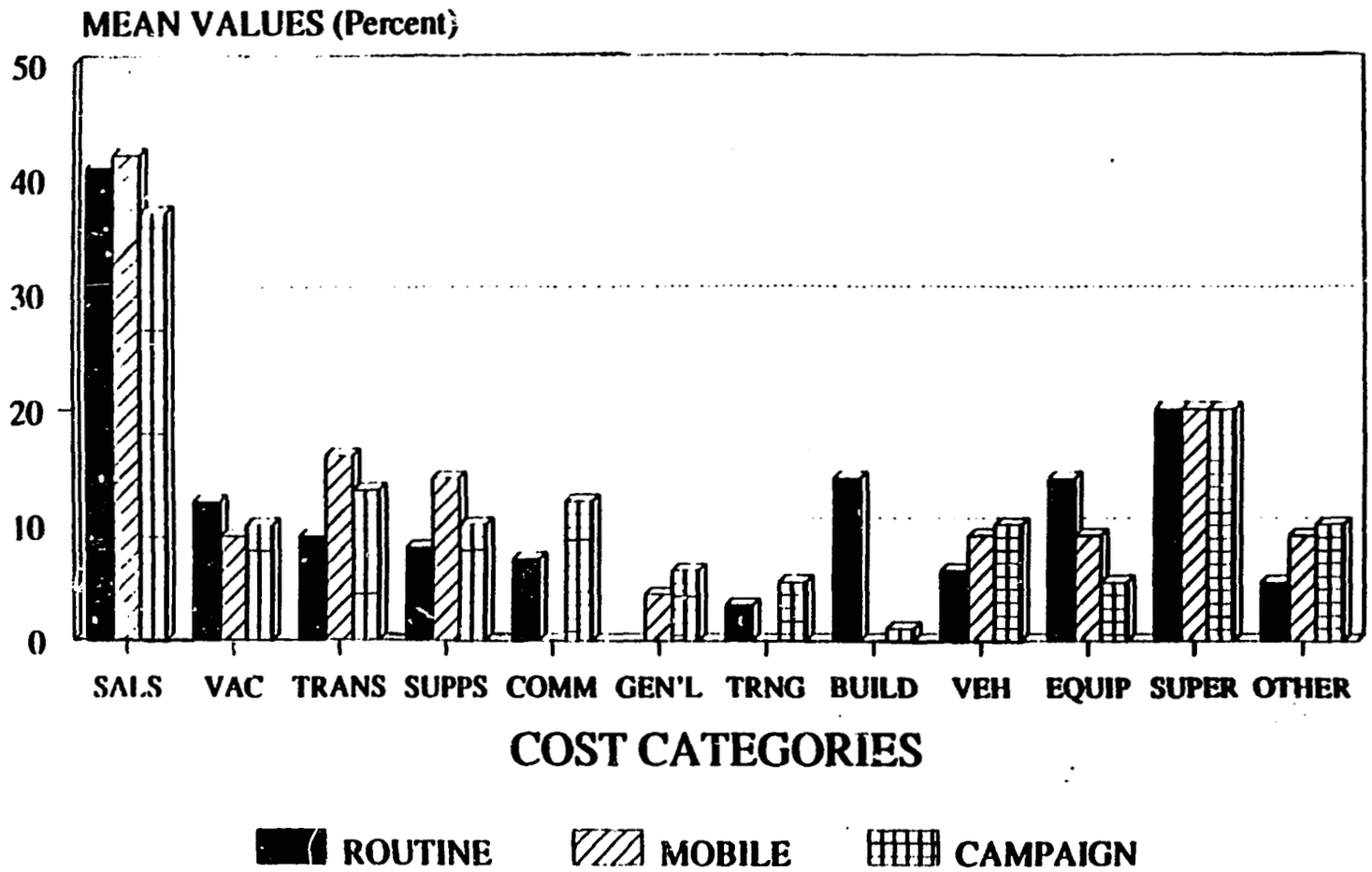
4. The importance of the annualized value of buildings and vehicles, supplies, equipment, transportation, and communications varied according to strategy. Not surprisingly, buildings were most important for fixed facility programs and least important for mobile teams. Communications costs were more important for campaigns than the other two strategies, and transportation was highest for mobile teams;

5. Vaccine costs ranged from nine to twelve percent of total costs. In Senegal, vaccine costs represented 35% of total cost for the campaign and in Burkina Faso, vaccines accounted for 44% of the total cost of the EPI in Sissili Province. Both of these countries were using injectable polio vaccine which has a higher cost-per-dose than oral polio vaccine: $0.69 versus $0.03. In Tanzania, the 42% of total cost for vaccine was attributed to high wastage rates because of the small numbers of children to be immunized in remote facilities. Changes in vaccine technology and associated costs may be more strongly felt in the cost of fixed facilities than for mobile teams and campaigns because of the larger role that vaccine costs play (as a percent of total cost) in fixed facilities.

Figure 1

(Cost Profiles)

PERCENT DISTRIBUTION OF ANNUAL COSTS BY COST CATEGORY AND BY STRATEGY



Sals=salaries and benefits; Vac=vaccine costs; Trans=transportation costs; Supps=supplies costs (syringes, needles); Comm=costs of social mobilization; Gen'l=miscellaneous and overhead costs; Trng=training costs; Build=building costs (annualized); Veh=vehicle costs (annualized); Equip=equipment costs (annualized); Super=supervision and management costs; and Other=other costs.

Major factors which appear to influence the cost of each alternative strategy include:

- the number and type of personnel providing services;
- the type of immunization technology used;
- the level of immunization activity, as higher activity means a greater use of vaccine and syringes; and
- the cost of critical elements for service delivery, such as buildings or vehicles.

Cost-effectiveness ratios may be sensitive to the numbers of children fully immunized. In some cases, facilities or mobile teams which have low immunization activity will have less desirable cost-effectiveness ratios. One method to reduce apparent inefficiencies in service delivery is to improve the number of children reached. This may be done by increasing the demand for immunization services in the population or by making the EPI more accessible to households.

3) Immunization Campaigns

By 1988, worldwide immunization coverage reported for the complete series of DPT and polio vaccines had surpassed the 50 percent level in both developing and developed countries, and regional differences in coverage had decreased considerably. UNICEF was a major force behind acceleration of the EPI as part of the global effort to achieve Universal Childhood Immunization. Since 1984, approximately 60 countries have conducted national campaigns, had periodic accelerations of activity, or intensified their routine activities for childhood immunization.[2] Some countries, like Brazil, offer mass immunization on a routine basis.

The major contributions of accelerated strategies have been:

- enhanced immunization coverage within a short period of time;
- increased social awareness and mobilization of the population for immunization services;
- stronger political commitment to the program; and
- strengthened infrastructure (e.g., equipment and trained personnel) for immunization services.

However, campaigns have been criticized for their high cost and vertical focus. Accelerations may have been launched in some countries at the expense of promoting other health programs. In some countries EPI activity fell back to earlier levels after a mass campaign, raising questions about the sustainability of these types of strategies. The experiences reviewed suggest a greater need for planning and promoting integration of acceleration efforts into overall EPI goals.

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[2]Favin, M. "Acceleration Immunization: An Assessment." Prepared for UNICEF, 1987.

Table 3 presents campaign cost data in 1987 dollars by cost category for three immunization campaigns in Senegal, Cameroon, and Mauritania. Personnel costs are the greatest in Cameroon at $12.92 per FIC, compared with Senegal and Mauritania at $3.66 and $3.28, respectively. One explanation for this difference is that the Cameroon campaign had between 12,000 and 16,000 individuals working at 2,000 vaccination posts. Another source of the difference per FIC is variation in annual wages and benefits earned by health workers in each country, ranging from approximately $200 in Mauritania to $500 in Cameroon. Overall, personnel costs represented 66% of total costs in Cameroon, versus 35% in Mauritania and 18% in Senegal.

Vaccine costs per fully vaccinated child are highest in Senegal, $7.01 as compared to $0.28 in Mauritania and $0.94 in Cameroon. These differences may be explained by two factors. First, injectable polio vaccine was used in Senegal at a unit cost per dose of $0.69. Second, greater absolute numbers of doses of vaccine were administered in Senegal (five million) than in Mauritania (1.7 million). While the total doses given is counted in the cost of the program, the denominator only includes children fully immunized and excludes those children who received some vaccinations but not the complete series. While campaigns immunize and protect children more quickly than routine strategies, these data raise concern whether administering large quantities of costly vaccines during a campaign is justifiable.

Transportation costs per FIC are highest for the Senegal campaign ($3.56) as compared to $1.17 and $1.18 in Cameroon and Mauritania, respectively. Though the dispersion of the population and great distances among vaccination sites would lead to a prediction of higher transportation costs per child in Mauritania, the figures in Senegal may reflect the amount of internal travel used for the training and social mobilization activities, which were distinctive features of that campaign.

TABLE 3
Cost per FIC by Cost Category for Immunization Campaigns
(1987 U.S. $)

COST CATEGORY	SENEGAL[1]		CAMEROON[2]		MAURITANIA[3]	
COUNTRY	COST	COST/FIC	COST	COST/FIC	COST	COST/FIC
Salaries	$934,029	$3.66	$2,440,218	$12.9	$83,712	$3.28
Vaccines	$1,787,521	$7.01	$178,276	$0.94	$7,077	$0.28
Transport	$907,261	$3,56	$220,829	$1.17	$30,046	$1.18
Supplies	$432,159	$1.69	$141,785	$0.75	$46,625	$1.83
Media	$500,771	$1.96	$103,935	$0.55	$10,869	$0.43
General Oper	$191,224	$0.75	$247,824	$1.31	$158	40.01
Cld Chn Main	$11,675	$0.05	—	—	—	—
Training	—	—	$87,901	$0.47	$47,460	$1.86
Food	—	—	$141,740	$0.75	—	—
Buildings	$29,417	$0.12	$49,084	$0.05	$3,116	$0.12
Vehicles	$220,177	$0.86	$121,654	$0.64	—	—
Equipment	$93,837	$0.37	$14,037	$0.07	$12,528	$0.49
Total Cost	$5,108,071	$20.03	$3,705,445	$19.63	$241,592	$9.47
Number Fully Immunized	255,000		188,864		25,507	
Total Population	6,200,000		10,450,000		1,792,890	
Population < 5 yrs	1,200,000		2,121,350		376,507	
Cost per 1 million children < 3 years of age	$4,256,726		$1,746,739		$641,666	

[1] From Brenzel L., et al., "Rapid Assessment of Senegal's Acceleration Phase," UNICEF, 1987.

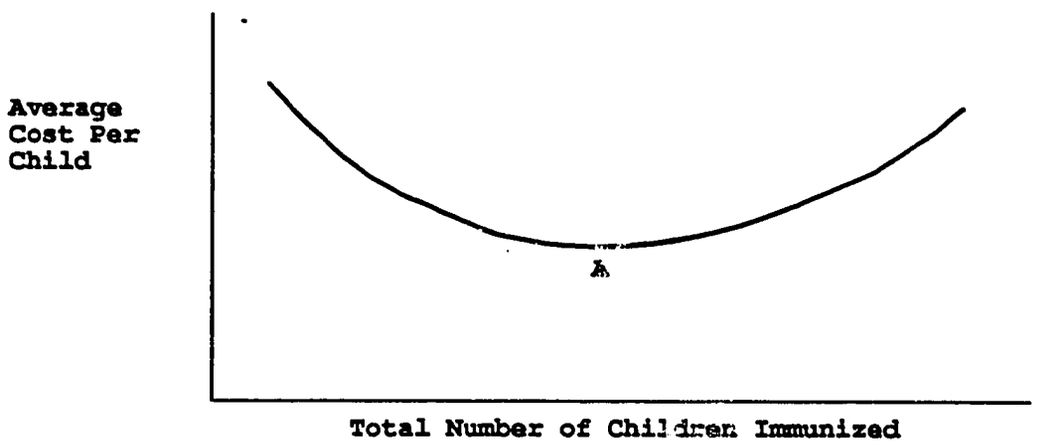
[2] From Brenzel L., et al., "Rapid Assessment: Cameroon's National Vaccination Campaign", UNICEF, 1987.

[3] From Brenzel, L., "Cost-effectiveness Analysis of Immunization Strategies in the Islamic Republic of Mauritania," UNICEF, 1986.

4) **Relationship of cost to coverage level**

Economic theory suggests that the average cost per unit of output changes as the total level of output increases. Initially, average cost should be high because large capital and equipment costs (such as a vehicle or building) are spread over small numbers of output. As output increases, average costs decline to the most efficient level (Point A in Figure 2). Past this point, additional investments in capital and equipment are required and average cost increases. Figure 2 illustrates these general principles. However, since no empirical evidence exists on changes in average cost as coverage increases, the shape of the curve is hypothetical.

Figure 2
Average Cost Curve for Hypothetical Immunization Program



Figures 3 and 4 illustrate the relationship between total strategy cost and coverage levels. Figure 3 compares the total cost of immunization campaigns in Ecuador, Senegal, Mauritania, and Cameroon with coverage levels of fully immunized children (after the campaign). This figure shows that average cost per child declines with increasing coverage levels (up to 63%) suggesting some economies of scale. However, it may be that each of these campaigns lies on a different average cost curve and therefore cannot be compared on the same graph.

Figure 4 compares total outcomes with total cost of routine strategies and suggests that the greater the number of children immunized for a particular country program, the higher the total program cost. This relationship is what is expected from economic theory. While it is impossible to draw conclusions from this limited number of data points about immunization programs in different countries, this pattern may describe how program costs are influenced by additional investments in infrastructure and fixed costs at higher levels of coverage.

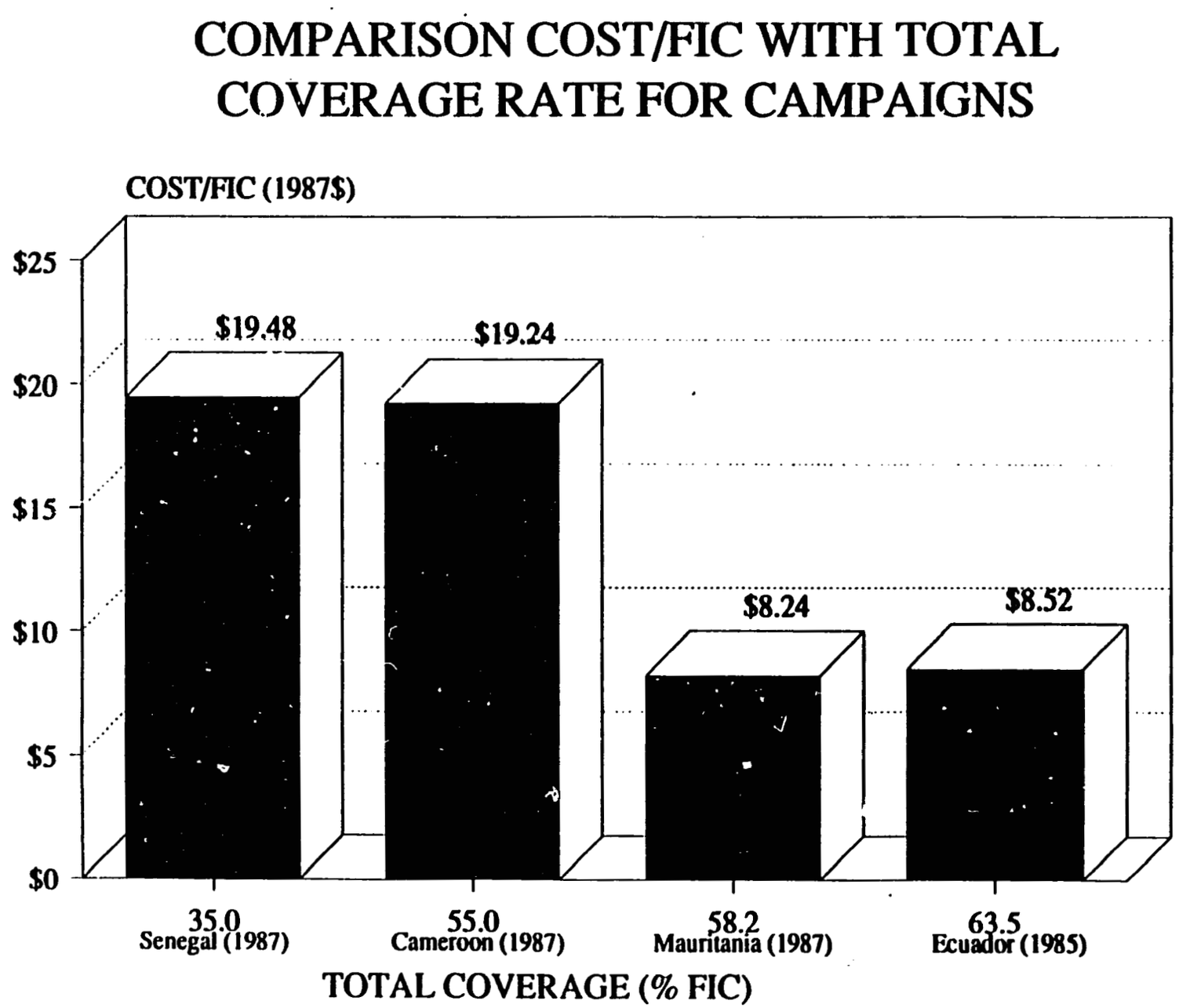
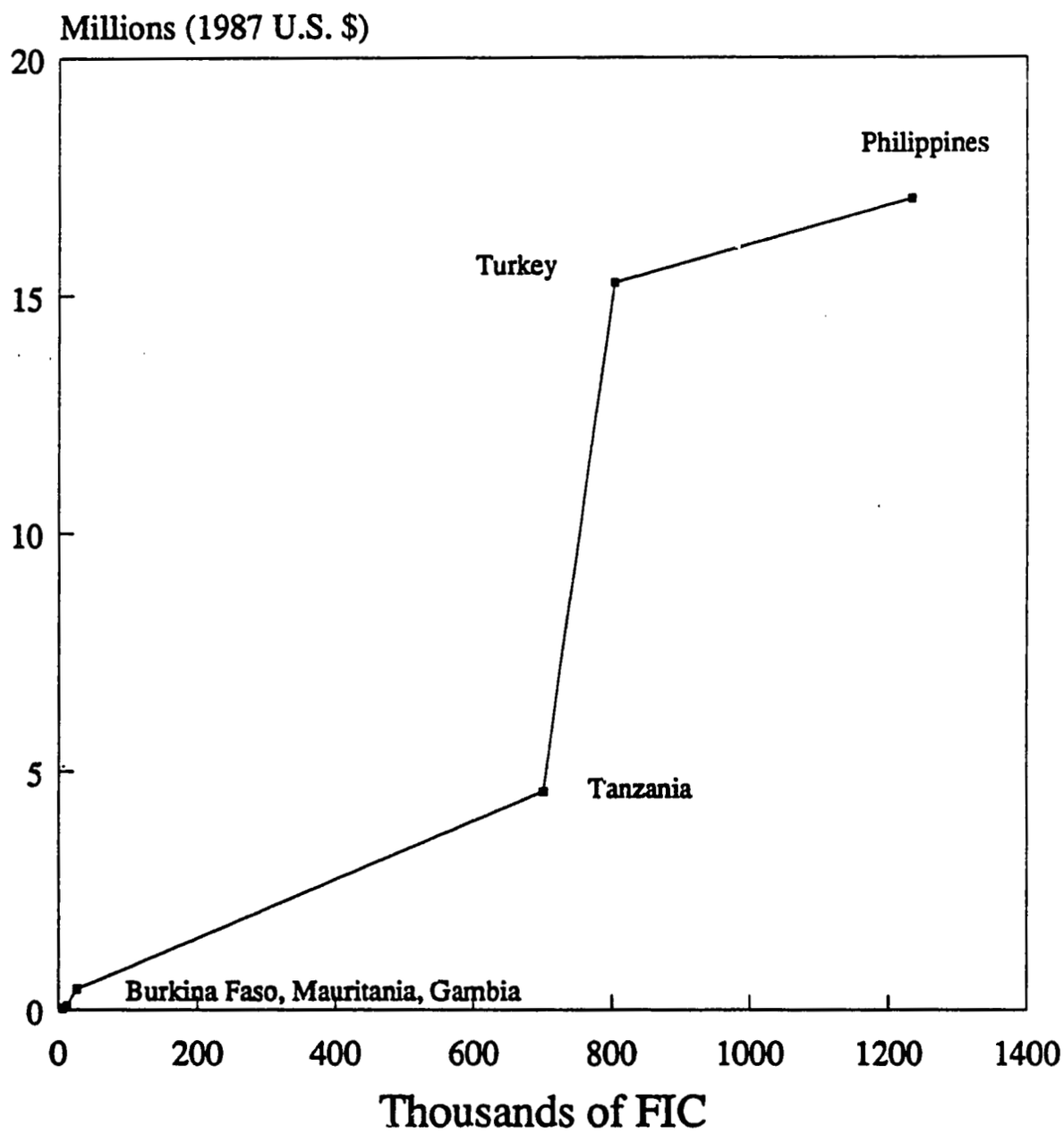


Figure 3
Comparison of Cost/FIC with Total Coverage Rate for Campaigns

Figure 4

NUMBER FIC VS. COST:
FIXED FACILITY STRATEGIES



SOURCE: Brenzel, L. April 1989

5) New technologies

One consideration for the future of the EPI is the impact of new technologies on total cost and cost per FIC. Few studies have addressed the incremental costs of adding new vaccines to an existing program. Table 4 presents data on the cost per fully immunized child for programs which use either oral polio vaccine (OPV) or a combination of DPT and injectable polio vaccine (DPTP). The results are largely inconclusive although strategies using OPV appear to have higher average costs than those using DPTP. Other factors, such as size of population, may also have affected average costs. Mobile team costs are lower for programs using DPTP vaccine (Burkina Faso) than programs using OPV (Mauritania). On the other hand, the campaign in Senegal (DPTP) was the least cost-effective of all campaigns reviewed in the study. Campaign and routine program costs for one district in India are lower with DPTP than costs found in other countries. The inconclusiveness of the data suggests that more investigations as to the cost implications of new vaccines and technologies should be conducted.

TABLE 4

Comparison of Cost-effectiveness Studies of the EPI using OPV or DPTP

STRATEGY	COST PER FULLY IMMUNIZED CHILD
Mass Campaigns	
RUHSA, India (DPTP)[1]	$4.85 (1988)
Ecuador (OPV)[2]	$8.52 (1987)
Mauritania (OPV)[3]	$9.47 (1987)
Cameroon (OPV)[4]	$18.93 (1987)
Senegal (DPTP)[5]	$20.03 (1987)
Mobile Teams	
Burkina Faso (DPTP)[6]	$7.10 (1987)
Mauritania (OPV)[4]	$18.35 (1987)
Routine (Fixed Facilities)	
Burkina Faso ((DPTP))[6]	$5.89 (1987)
Tanzania (OPV)[7]	$6.53 (1987)
Senegal (DPTP)[2]	$8.00 (1987, estimate)
Philippines (OPV)[8]	$13.82 (1987)
The Gambia (OPV)[9]	$16.51 (1987)
Turkey (OPV)[10]	$19.00 (1987)

(1) Brenzel, L., et al., "Cost-effectiveness of the Immunization Programme in the Rural Unit for Health and Social Affairs," REACH Publication, revised February 1990.

(2) Shepard, D.S., et al., "The Cost-effectiveness of Immunization Strategies in Ecuador," REACH Publication, August 1988.

(3) Brenzel, L., "Cost-effectiveness of Alternative Immunization Strategies in the Islamic Republic of Mauritania," UNICEF Publication, May 1987.

(4) Brenzel, L., "Cost-effectiveness of Immunization Strategies in the Republic of Cameroon," REACH Publication, August 1987.

(5) Brenzel, L., et al., "Rapid Assessment of Senegal's Acceleration Phase," submitted to UNICEF, REACH Publication, November 1987.

(6) de Champeaux, A., "Evaluation du Programme Elargi de Vaccination, Province de la Sissili," OCCGE, Unite de Vaccinologie, Centre Muraz, Burkina Faso, November 1987.

(7) Fielden, Rachel, "Joint Review Report on EPI in Tanzania," Ministry of Health/Tanzania - DANIDA Review Team, September 1987, selected appendices.

(8) Turner, Pamela, excerpts from a cost evaluation of the national EPI in the Philippines, REACH 1987.

(9) Robertson, R., et. al., "Cost-effectiveness of Immunization in The Gambia," Journal of Tropical Medicine and Hygiene, 1985, Vol.88, pp.343-351.

(10) Brenzel, L., et al., "Cost Analysis of the National Immunization and CDD Programs in the Republic of Turkey," REACH Publication, March 1988.

6) Financing of the EPI

One outcome of a cost analysis is an evaluation of financing trends among national governments, international donor agencies and private voluntary organizations. Table 5 demonstrates the proportion of total strategy costs financed by national governments and donor resources. For immunizations provided through fixed facilities, governments are financing 57% of total national EPI costs on average. There is considerable variation among the countries, however. In Turkey and The Philippines, the government is responsible for more than 80% of total EPI costs; in Burkina Faso and Tanzania, the government funds less than 40% of total. Fewer government resources are devoted to the financing of campaigns (44% of total cost on average), although there is a wide range in government financial commitment. The Ministry of Health in Cameroon subsidized 87% of the cost of the national campaign, whereas the government contributed only 15% of campaign financing in the Republic of Mauritania.

These data suggest that national governments are financing fewer EPI costs than estimated previously: in 1984 it was believed that governments financed nearly 80% of total EPI costs. Financing patterns may reflect the relative dominance of donor organization priorities and level of resources, rather than a lack of commitment on the part of national governments. The availability of donor resources may lead to a redirection of government monies away from EPI toward other health programs (curative services, for example).

TABLE 5

Source of Financing for the EPI (percentages)

COUNTRY	Ministry of Health	Donor Organizations
Routine Strategies		
Turkey	96.5%	3.5%
Philippines	84.0%	16.0%
Mauritania	41.0%	59.0%
Tanzania	35.0%	65.0%
Burkina Faso	27.0%	73.0%
Average	56.7%	43.3%
Campaigns		
Cameroon	87.0%	13.0%
Senegal	29.0%	71.0%
Mauritania	15.0%	85.0%
Average	43.7%	56.3%
Mobile Team		
Mauritania	31.0%	69.0%

Source: Brenzel, L., "The Cost of EPI: A Review of Cost and Cost-effectiveness Studies (1979-1987)," REACH Publication, Revised April 1989.

Table 6 divides total EPI costs by source of financing and cost category. This table clearly illustrates several trends.

1. Countries which have a higher GNP per capita (Turkey and Cameroon) are financing greater shares of individual cost components than countries that have lower GNP per capita (Mauritania and Burkina Faso).

2. In wealthier countries, the costs of salaries, communication, general expenditures, and buildings tend to be financed by government resources rather than by donors. These costs do not usually represent additional outlays for immunization programs but are part of the public health system or public broadcasting networks. Donors finance salaries, to a large extent, in Burkina Faso and Mauritania.

3. The costs of vaccines, training, supplies, vehicles and equipment are paid for primarily by donor organizations (with the exception of Cameroon). These components of EPI (excluding training) usually require foreign exchange. Although some countries (those based on the French CFA, for example) have relatively better access to foreign exchange, the public health sector in most countries competes poorly with other sectors for limited foreign exchange.

4. Costs for transportation and vaccine are financed jointly by governments and donors (with the exception of Mauritania and Senegal), perhaps representing the first EPI components to be subsumed under government budgets after initial donor financing.

These data suggest that the financial sustainability of country programs may depend on how well the public health sector is able to finance foreign exchange-requiring components in the future. It appears that economically well-off countries are able to finance the costs of the EPI to a greater extent and that resolution of the issue of program financial sustainability may depend on general economic development. The results also suggest that donor financing is necessary for implementation of the EPI in the foreseeable future.

TABLE 6

Total EPI Cost by Source of Financing and Cost Category

Category	Turkey		Burkina Faso		Senegal		Cameroon		Mauritania(1)		Mauritania(2)		Mauritania(3)	
	Gov.	Donor	Gov.	Donor	Gov.	Donor	Gov.	Donor	Gov.	Donor	Gov.	Donor	Gov.	Donor
Salaries	100%	0%	8%	92%	75%	25%	98%	2%	29%	71%	48%	52%	79%	11%
Vaccines	40%	60%	41%	59%	1%	99%	62%	38%	0%	100%	0%	100%	0%	100%
Transport	87%	13%	0%	100%	7%	93%	49%	51%	1%	99%	36%	64%	54%	46%
Training	72%	28%	0%	100%	0%	100%	0%	100%	15%	85%	0%	100%	0%	100%
Communic.	98%	2%	na	na	100%	0%	86%	14%	19%	81%	na	na	na	na
Supplies	3%	97%	0%	100%	0%	100%	18%	82%	0%	100%	4%	96%	4%	96%
General /Other	95%	5%	na	na	14%	26%	98%	2%	0%	100%	53%	47%	100%	0%
Vehicles	99%	1%	na	na	11%	89%	75%	25%	na	na	0%	100%	0%	100%
Equipment	82%	18%	na	na	0%	100%	75%	25%	0%	100%	0%	100%	0%	100%
Buildings	100%	0%	na	na	100%	0%	100%	0%	100%	0%	na	na	99%	1%

Source: Brenzel, L., "The Cost of EPI: A Review of Cost and Cost-effectiveness Studies (1987-1989)," REACH Publication, revised April 1989.

7) Use of study results

One of the weaknesses of cost-effectiveness studies is that their results and recommendations have not been put into practice in most instances. The results can be used to make choices about which strategy to pursue or which technologies to use. They can also be used to help make program management decisions, such as how often supervision can be performed, how frequently immunization services are provided, and how resources could be redistributed to increase program outcomes.

The recommendations (and program response) of selected cost-effectiveness studies are summarized below:

Mauritania: (1986)

The study recommended that mobile team routing patterns be changed to reduce costs.

The study recommended that outreach services from urban MCH centers be conducted to serve the urban slum dwellers, a growing population group.

These two recommendations were incorporated into the operations of the EPI in that country. MCH center services were strengthened as well, as these were found to be the most cost-effective of the three strategies evaluated.

Senegal: (1987)

The cost-effectiveness study and campaign evaluation document recommended that Senegal switch from using the injectable polio vaccine to the oral vaccine in order to reduce the cost of the program.

The cost-effectiveness study recommended that vehicles and equipment which are less costly to operate and more appropriate to the geography and climate of Senegal be purchased.

The Senegal EPI still uses IPV in four out of ten regions. Unfortunately, mopeds continue to be in disrepair and the kerosene refrigerators have not been replaced.

Turkey: (1988)

The cost-effectiveness study recommended that the immunization program be given a separate line item in the primary health care budget in order to ensure continuous availability of public health resources.

The study recommended that the MOH explore ways in which revenues generated at health facilities can be used for the national immunization program.

To date, no action has taken place on these recommendations.

RUHSA Study: (1989)

The cost-effectiveness study recommended that the India program alter the frequency and operations of both the routine immunization program at fixed facilities and the mass immunization program offered once a month. The study recommended that all vaccines, not just DPTP and TT be offered at every immunization session, and that sessions should be reduced to once per month, with campaigns taking place once in every three or four months.

Although no changes in the operations of the program have been made at the present time, discussions about reducing the frequency of immunization sessions, in order to increase the number of eligible children and women at each session, have taken place.

Sudan: (1989)

The study made several recommendations for the operations of the mobile teams and health facilities:

1. Urban mobile teams should not provide services in areas which are already covered by health facilities.

2. The routing patterns of mobile teams should be altered to maximize the number of children and women immunized at each session by selecting villages of more than 500 population.

3. An inventory should be made of health facilities which have working refrigeration to determine the potential of incorporating them into the immunization program.

4. EPI management should review policies concerning the number of individuals on each mobile team, per diem payments and staff support.

5. The EPI and UNICEF should develop a financial management system for the program which involves double-entry accounting and more frequent reconciliation of advances made to the regional level.

6. The effectiveness of social mobilization activities based on radio and television broadcasts should be thoroughly evaluated to determine which should be continued and which cancelled to conserve resources.

7. The training program should be evaluated to assess whether the resources spent to train individuals are bringing benefits to the program as measured by more children immunized.

Many of these recommendations were supported by the program review and included in a report to EPI management. It is too early to know what progress has been made so far in the field.

The results of cost-effectiveness studies may be perceived as threatening to EPI management and staff because study findings may reveal the program to be operating ineffectively and inefficiently. If the goals and objectives of cost-effectiveness studies are determined in collaboration with the EPI manager and Ministry of Health, and if recommedations are formulated in a practical and concrete way, the study results will have a greater probability of being considered and implimented by the EPI.

8) Major conclusions

The major findings of this review are:

* The average cost (1987 US dollars) per FIC has been revised upwards to $15.00, although this figure is not far from estimates made for the 1984 Bellagio Conference. The cost per fully immunized child varies only slightly according to the particular strategy or region under consideration. Mobile team strategies are the most cost-effective at $10.60 per FIC. Routine services through fixed facilities follow at cost per FIC on average $11.26. Immunization campaigns have the highest cost per FIC at $15.62.

* The contributions of national governments to immunization programs is lower than expected. For fixed facilities, the proportion of government contribution is greatest at 57% of total; this proportion diminishes to 31% for mobile teams. The study found that countries with lower GNP per capita make less of a contribution to the EPI from government resources.

* Government contributions to the EPI tend to be in the form of salaries for health workers, building depreciation costs and, in some instances, vaccine and transport costs. However, EPI costs which require foreign exchange, such as syringes, cold chain equipment, and vehicles, are being borne by international organizations and outside donor agencies.

* The cost of $15 per child and the continued need for foreign exchange may make the EPI difficult to sustain financially for national governments, particularly in countries with a GNP per capita of $300 or less. The implementation of the EPI cannot occur without the continued high commitment of international donor organizations. Securing national government resources for preventive programs will require some combination of reallocation of resources from curative to preventive programs or to the health sector from other sectors, improved efficiency of service delivery, or financing of immunization by individuals.

* Although average cost appears to decline with increasing coverage levels, there is limited empirical evidence to support the projection that efforts to reach very high coverage levels will result in an increasing average cost. Studies, particularly longitudinal studies, need to be undertaken which examine the interaction of higher coverage levels and program costs.

* Evidence suggests that study results are not always used for planning and managing EPI. More discussion needs to take place to determine why cost-effectiveness analysis is not as useful as it could be and what concrete steps can be taken to improve the utility of studies.

SECTION II:

CONDUCTING A COST-EFFECTIVENESS STUDY

A. Study Design

REACH has learned many lessons in implementing eleven field studies on the costs and cost-effectiveness of immunization programs. Some of the practical aspects of study design, data collection and analysis are discussed below.

1) Developing a study protocol

The results of cost-effectiveness studies are more likely to be put into practice when national program managers and staff are committed to undertake a study and have generated a demand for the results within the program. However, donor organizations sometimes initiate studies to justify contributions or examine how governments are using donor resources. When the impetus is from the outside, the cost-effectiveness study objectives should be developed to maximize the direct benefit to the EPI and provide the program manager with as much practical and relevant information as possible. Discussions between the Ministry of Health, Ministry of Finance, EPI, and donor organizations are essential to generate specific objectives and support for the study. Thus, a study protocol must include a clear description of the rationale for undertaking the cost-effectiveness study and the main objectives. A clear rationale explains why the study is important and what policy or management questions the study will address.

The study protocol should also describe how the results of the study will be put to use. This is an essential component of the protocol because it identifies the users of the study results. Table 7 provides some examples of policy and program decisions and how cost-effectiveness analysis can address them.

TABLE 7

Examples of Policy and Management Decisions for Cost-effectiveness Analysis

QUESTION/PROBLEM	COST-EFFECTIVENESS SOLUTION
Should the EPI consider purchasing solar refrigeration?	Evaluate the long term costs and benefits of conventional versus solar refrigeration.
Could a country introduce injectable polio vaccine?	Evaluate and compare oral and injectable polio vaccines in terms of costs and of effectiveness in reducing cases.
Can an EPI afford to expand to a new target population or region of a country?	Compare the incremental costs of expansion with incremental gains in coverage and protection.
What is the best mix of strategies to achieve the highest immunization coverage with a fixed budget.	Compare alternative strategies and select the most cost-effective.

2) The study team

Cost-effectiveness studies are best conducted as collaborative efforts with team members from the EPI, donor organizations, and the Ministries of Health, Finance and Planning. The most productive study team represents a well-rounded group of professionals who have previous experience in field research, data collection and data analysis methods for health programs. EPI staff, who have an intimate knowledge of program operations, are indispensable as team members. These individuals will be able to describe the type and number of resources being used to deliver services as well as help formulate practical recommendations for the EPI. EPI managers, finance and administrative personnel, program epidemiologists and statisticians also would benefit from learning new evaluation methods.

In the past, cost studies were undertaken by consultants recommended by donor organizations. As counterparts, EPI staff were given the role of data collectors, but were not involved in either data analysis or formulation of recommendations. As a result, strategies of how to conduct a study were not transferred, recommendations were not as relevant as they could have been several results were not implemented because of lack of follow-up.

Several constraints have sometimes prevented full participation of EPI staff and other counterparts in cost-effectiveness studies. These include the short time available to complete the study and analysis, the inability of study team members to work full-time on a study in addition to their routine EPI responsibilities, the novelty of economic terms, and the difficulty with computer or data analysis. Wherever possible, the cost-effectiveness study can be a training exercise in research data analysis, as well as an opportunity for EPI staff to review record-keeping practices and supervise the program in the field during data collection.

To permit training and provide adequate time for data collection, cost-effectiveness studies may require up to four or six weeks to complete (one week orientation, two weeks data collection, one or two weeks for data analysis, and the remaining time for interpretation and writing). Studies can be completed within a much shorter time period depending upon the scale of the study, amount and quality of data collected prior to start of the study, and the number of study objectives. Wherever possible, adequate time needs to be given to collecting the best data possible and to strengthening analysis skills within the EPI so that additional studies can be conducted without the assistance of consultants or donor organizations.

B. Data Collection

Cost and cost-effectiveness studies are conducted using secondary sources of information from donor organizations and government records, or from surveys of health facilities and other immunization delivery sites. Most often, a study will combine information from records and surveys. This section outlines some useful procedures for studies using these two approaches.

1) Data from records

Information on the prices of equipment, supplies, interest rates, salaries and wages of health workers, among other types of data, need to be collected. Prior to data collection, it is best to develop a list of all of the data requirements, the sources of these data and the individuals who will be responsible for collecting the data. An example of such a data list is included at the end of this section.

The key to any good study is the quality of the data. Therefore, the greatest effort should be spent to collect good information and to validate this information through alternate sources. The study team needs to review data requirements before the collection phase begins, to orient all participants and to anticipate possible problems, such as what to do if there are missing or conflicting pieces of data. For missing information, a proxy measure can be used. If the number of kilometers traveled by a mobile team is unavailable, a composite measure of the number of trips per month multiplied by approximate distances can be created. With conflicting data, such as different numbers of doses administered by the same facility, there are two possible courses of action. First, a third source of information can be sought to verify one of the original sources; or, a "rule" is made by the group about which data source to use (e.g., records at central level are preferred over regional or district level). This rule must be followed throughout the study to be consistent.

2) Data from surveys

One approach to evaluating the cost and cost-effectiveness of the EPI is to sample sites where immunizations are provided (e.g., hospitals, health centers, mobile teams, and vaccination posts) and to compare their results. A survey approach of health facilities was recommended in the WHO EPI Costing Guidelines (WHO/GEN/79/5) to know better how inputs into the program correspond with immunization activity and health outcomes.

Surveys provide the manager with practical information about the EPI, such as the types and quantities of personnel and equipment used at different sites. Facilities which use fewer inputs (have lower costs) but give the greatest number of doses, can be investigated further to determine what factors contribute to their overall cost-effectiveness. Likewise, facilities which use more than the average amount of resources and have low immunization coverage can be identified through this approach and possible corrective measures taken. Surveys have been conducted in several REACH cost-effectiveness studies, including Turkey, India and Sudan. The benefits of these surveys are:

- Variations in patterns of service delivery can be identified so that programmatic recommendations can be made;
- Patterns of resource allocation can be studied and their implications highlighted;
- Differences in productivity of health workers among delivery sites can be used as performance indicators; and,
- Technical and economic efficiencies in service delivery can be identified, and "model" facilities or mobile teams used as standards for the EPI in the future.

These advantages can lead to practical recommendations which are more likely to be adopted by the EPI. On the other hand, surveys are complex and time consuming. The study team will need to determine whether the additional benefits of surveys are worth the extra effort required.

C. Cost Surveys

The following section provides some guidelines for cost surveys.

1) Selection of the sample for study

Selection of facilities and immunization sites for cost surveys is important for generalizing results to the national program. Few guidelines in sample selection are available for cost studies. Whenever possible, a random sample of facilities is preferred to a convenience or representative sample. Random samples will include the range of operations, the combinations of personnel and equipment, as well as the range of immunization activity found in a country. Results from random samples can be generalized for the program as a whole, and facilities with high or low coverage and cost can be thought of as similar to other facilities with these same characteristics.

By contrast, results from representative samples are difficult to generalize to the program as a whole. An example of a representative sample is a group of facilities which functions unusually well or poorly. Another type of sample to avoid if possible is a convenience sample, such as those which include facilities located near EPI headquarters or within easy reach of the survey team. A convenience sample may include facilities and teams which have unique characteristics and do not reflect the "average" cost of the program. Thus, the results of these studies typically cannot be generalized for the whole EPI.

The sample size needed for a cost-effectiveness study will vary depending upon the kinds of programmatic or policy question being addressed and the types of factors which appear to influence total program cost and cost-effectiveness. The following examples illustrate how a sample can be selected to measure the impact on cost of different variables.

1) If the study is concerned with differences among health facilities or between strategies, then a stratified random sample of delivery sites should be selected. If a test of significance among the facility types is of interest to the program, then a minimum of 50 facilities of each type should be selected randomly. However, time or money constraints to surveying 50 facilities may result in selection of a fewer number, thereby increasing the standard error of the cost estimates.

2) If the study is designed to determine differences in total cost by urban or rural location, then a stratified, random sample strategy would apply.

3) If facilities are owned and operated by different organizations (such as the government or private, voluntary organizations) and the study wishes to evaluate which is most cost-effective, then a stratified, random sample should be selected for these facilities.

4) If the study focuses on the impact of alternative staffing patterns or alternative technologies, then a representative sample of facilities or delivery sites exhibiting different operational patterns can provide useful information.

The general rule to follow in calculating sample size for a random sample is that each additional variable examined in the study (such as the effects of location, type of facility, population size, ownership of facility, and personnel types) doubles the initial sample size required to make valid statistical analyses. However, the logistics of conducting a large sample survey needs to be considered. When a realistic sample size is smaller than the calculated sample size, the results will have a larger amount of presumed error. There is a tradeoff between the tolerable level of error in the results and the ability to sample enough facilities.

Cost-effectiveness studies need to be linked with coverage surveys to match the resources used to provide services within a given time period directly to gains in coverage and health outcomes. Two approaches have been used in REACH Project-associated studies.

- Select health facilities and conduct coverage surveys in the catchment area of facilities; or
- Match clusters selected for coverage surveys with delivery sites.

In the first scenario, facilities can be selected on a random basis. In the second case, clusters selected randomly for the coverage survey may not always correspond to delivery sites. Alternate facilities will need to be selected to replace those which do not match coverage survey clusters.

2) Design of survey forms

Cost studies using the survey format can collect data using standardized questionnaires. Table 8 provides a list of steps for designing a cost questionnaire. The REACH Project has used standardized questionnaires in three country studies: Turkey, Sudan and India. An example of a facility questionnaire is found in Appendix E.

The best method for designing questionnaires is to first collect examples of the types of record books used by the EPI in the field (on supplies and vaccine stock, number of doses administered and number of children immunized). The questionnaire format should "copy" the way in which data are recorded in these registers to make data collection as easy as possible. Also, it is best that questions be as specific to EPI operations as possible. To formulate good questions, in-depth observations at health facilities and practice interviews with health workers will help. The comprehension of the respondent about what is being asked, and the rapport between the interviewer and respondent will affect how easily the questions will be answered. It may be necessary to ask additional questions not included on the questionnaire to get a useful response.

The most difficult questions to answer are those regarding the amount of time spent on immunization activities, the amount of supplies used and the distance traveled for immunization activities. A short time period between the event and the interview (usually one month, or within the last week) improves the quality of data collected and is easier to remember for the respondent. Data collected through interviews should be validated, either by direct observation or through a secondary source. If immunization activity levels fluctuate over the year, then a longer time frame for the interview will reduce the amount of error in the estimates.

Questions about the amount of time spent on immunization activities by individuals at the delivery site are best asked of each health worker in private. There is a tendency for a group to arrive at an answer which may be different from the actual time spent on immunization by each person. In cases where all participants in the program are not present during the interview, a second option would be to interview the most knowledgeable person about the other workers. This person is most likely to be the public health nurse or medical officer.

The form should be designed to be as simple as possible. If the data analysis will be done by computer, design of the survey form can facilitate data entry. Think about how the data can most easily be entered and calculated in the computer, and then design the form based on the layouts of the computer spreadsheets.

3) Pretesting of survey forms

The steps which are suggested here for pretesting are those which have been successfully utilized in the field for cost-effectiveness studies. Pretesting of questionnaires is an essential step in survey research. It is more practical to pretest in facilities which are within easy reach. Also, pretesting can be part of the training of interviewers. Once the pretest interview is completed, the study team assembles as a group and evaluates the interview process on the basis of the following points:

1. how well the questions were understood;
2. what types of additional questions were used to elicit responses;
3. how clearly the interviewer conducted the interview;
4. how often the interview process was interrupted or delayed and why;
5. how long it took to answer each question; and,
6. the rapport between the interviewer and respondent: did the respondent feel intimidated or comfortable with the interview?

The survey questions and format need to be reviewed and revised as well. Pretests are then conducted on each revised questionnaire until no further changes are necessary. In some REACH Project studies, questionnaires went through as many as five pretests.

4) Training

Training programs need to include a thorough review of the rationale and purpose of the cost-effectiveness study as well as a review of the survey form(s). To become proficient, team members can practice interviewing one another through role-playing exercises, where team members provide each other with difficult interviewing situations to test their abilities. When all members are comfortable and familiar enough with the survey form, pretesting and data collection can begin. Training needs to be an on-going process, where each interviewer receives feedback after data collection. This feedback will help reinforce good methods of data collection and interviews and will identify common problems which can be addressed as a group.

5) Beginning the survey

Before beginning data collection, it is essential that a written introduction which describes the purpose of the study, the types of data required to complete the questionnaires and the approximate length of the interview be developed and distributed to appropriate regional, district or provincial managers. This introduction will prepare the respondents for the interview process as well as alleviate any possible misconceptions about the purpose of the study.

A survey schedule with names, locations and persons responsible for interviews will facilitate data collection. Prior to conducting each survey, the interviewer can explain as clearly as possible the purpose of the study to try to develop a rapport with each health worker. Each study team member needs a set of ball point pens, a calculator (preferably solar-powered), a clipboard and a folder for preserving the survey forms once completed. A supervisor should review each completed form in the field to ensure that questions are appropriately answered and that all responses are legible.

6) Analysis

Methods for calculating individual costs have been developed by WHO (EPI Costing Guidelines and EPICost) and REACH (ANE Bureau Guidance for Costing Health Service Delivery Projects). These manuals are reviewed in Appendix B. It is not the intention of this document to provide recommendations and guidelines as to how to calculate costs, though there is one important issue which will be discussed here. The EPI usually is implemented in health facilities and, as such, shares resources (human and material) with other programs. It is recommended that allocation of shared costs to the EPI be done on the basis of reasonable estimates of the proportion of use for the EPI. Assumptions about proportion of use need to be validated through observation or other secondary sources. A good cost-effectiveness study is one which demonstrates the appropriateness of initial assumptions made through a sensitivity analysis, and all cost-effectiveness studies should include such an analysis. A sensitivity analysis changes assumptions (for example, increases the proportion of use of a vehicle from 20% to 50%) to see what affect that change has on the cost-effectiveness of that strategy.

Analysis of cost data can take the following forms:

1) total cost by each cost category;

2) percent of cost by cost category;

3) calculation of average cost per facility;

4) calculation of average cost per dose and cost per fully immunized child;

5) calculation of average cost and cost-effectiveness by facility type, by location of facility, by population size served by facility, by ownership of facility (depending upon how and why the sample was selected); and,

6) calculation of doses per full-time health worker per month, and other productivity measures.

Program costs and cost-effectiveness can be calculated either manually or using a computer program. Survey data is better processed using a computer, although studies based on secondary information can be analyzed with a pocket calculator. Although many software packages exist, most REACH Project- associated cost-effectiveness survey data has been analyzed using Lotus 1-2-3 software. Each cost element has a distinct worksheet and computer file. Lotus software was selected because it is easy to learn and is almost universally available.

7) Presentation of results

Upon completion of the analysis (or even preliminary results), discussions between the EPI, MOH and other team members need to be arranged. The focus of these discussions should be the practical application of the results to operational issues and problems identified by the EPI.

8) Report writing

Cost-effectiveness study reports are often confusing and complicated. Every effort needs to be made to simplify the presentation of results to a few summary tables, and to explain as clearly as possible what the results mean in practical terms. Where possible, an implementation plan of recommendations drawn from the cost-effectiveness study should be developed.

Reports and results need to be disseminated to various levels in the EPI in order to provide feedback. This is particularly important if district and facility-level workers were part of a field survey.

TABLE 8

STEPS IN DESIGNING COST-EFFECTIVENESS
STUDY SURVEY FORMS

STEP 1: Discuss with EPI managers and donor representatives the operations of the program, including the strengths and weaknesses at different levels of the health system.

STEP 2: Visit health facilities and interview health workers who administer vaccines.

STEP 3: At the health facility or other delivery site, make a list of the following types of information:

A. all of the activities of the immunization program: supervision, management, maintenance of stock, cold store, training, administering vaccine, etc.;

B. the types of personnel involved in the immunization program;

C. the types of equipment (specify brand names and model types), supplies, furniture, and vehicles used for the immunization program;

D. monthly patterns of service delivery, whether vaccines are given on a specified day of the month or of the week, or whether given on request;

E. monthly patterns of replenishment of vaccine and supplies stock and by whom;

F. monthly patterns of supervision and by whom;

G. monthly patterns or strategies for motivating the population and who does this activity;

H. monthly consumption levels of fuel, electricity, butane, water, vaccine and supplies (syringes, needles, etc.);

I. monthly vaccine doses given, wastage rates and stock on hand;

J. immunization coverage levels;

K. monthly budget (if any) for EPI.

STEP 4: Review current reporting forms used by the EPI to monitor immunization activity, fuel consumptions, budgets, etc.

STEP 5: Review earlier survey forms used by the EPI to evaluate performance, such as forms used for Knowledge, Attitudes, and Practices surveys.

TABLE 8 cont'd

STEPS IN DESIGNING COST-EFFECTIVENESS STUDY SURVEY FORMS	
STEP 6:	Design a draft of the survey form(s).
STEP 7:	Review the draft form with the study team, the EPI manager, donor representatives, other interested parties (MOH personnel).
STEP 8:	Revise the draft form based on initial comments and feedback from reviewers.
STEP 9:	Select the sample of facilities and delivery sites.
STEP 10:	Pre-test the survey form in a facility or delivery site not included in the sample.
STEP 11:	Revise the survey form based on the pre-test.
STEP 12:	Pre-test the third version of the form in a delivery site also not included in the sample.
STEP 13:	Revise the form (version four). If the second pre-test resulted in major revisions of the form, conduct a third test of this revised form. If the revisions were minor, skip to step number 14.
STEP 14:	Translate the form(s), if necessary.
STEP 15:	Translate the form back into its original language and identify and correct the differences.
STEP 16:	Reproduce the form(s).
STEP 17:	Develop a list of probe questions for eliciting survey responses.
STEP 18:	Conduct training on survey procedures with all members of the study team.

TABLE 9

LIST OF DATA REQUIREMENTS

DATA TYPE	LEVEL	COLLECTION METHOD
COST		
1. Salaries		
- Salary scales: admin	MOH	records, interview
- Salary scales: workers	MOH	records, interview
- Quantity, types personnel	facility	questionnaire
- Personnel benefits	MOH	records, interview
- Proportion of time	facility	study per interview
	MOH	interview
2. Vaccines		
- Total doses administered	facility	records
- Unit cost/dose	donor, MOH	records
- Vaccine wastage	facility	special study
3. Transportation/storage vaccine		
- Freight	MOH	records
- Customs	MOH	records
- Internal transport kms driven	facility	questionnaire
	MOH	questionnaire
	unit fuel price	questionnaire
- Purchase of ice	facility	questionnaire
4. Supplies		
- No. of syringes	facility	questionnaire
- No. of needles	facility	questionnaire
- Unit price syringes	MOH	records
- Unit price needles	MOH	records
- Quantity other	facility	questionnaire
- Unit price other	MOH	records
- Quantity registres	facility	questionnaire
- Price registres	MOH	records
- Quantity cards	facility	questionnaire
- Price cards	MOH	records
5. Training		
- No. trained	MOH, donor organization	records
- No. trainers	MOH, donor organization	records
- Salary trainers, trained	MOH, donor organization	records

TABLE 9 cont'd

LIST OF DATA REQUIREMENTS

DATA TYPE	LEVEL	COLLECTION METHOD
- Duration training	MOH, donor organization	records
- Travel: kms	MOH, donor organization	records
- Travel: per diem	MOH, donor organization	records
- Quantity booklets	MOH, donor organization	records
- Price booklets	MOH, donor organizaiton	records
6. Social Awareness		
- Quantity personnel	MOH, donor organization	records
- Salary personnel	MOH, donor organization	records
- Quantity posters	MOH, donor organization	records
- Unit price posters	MOH, donor organization	records
- Quantity radio, TV	MOH, donor organization	records
- Unit price radio, TV	MOH, donor organization	records
7. Maintenance/Operation		
- Cold chain	MOH	records
- Vehicles	MOH	records
- Sterilizers	MOH	records
- Other equipment	MOH	records
8. General Administration	MOH	records
9. Equipment Annualization		
- Quantity CC equipment	MOH	records
- Useful life	MOH	records
- Interest rate	Ministry of Finance	records
- Unit price CC equip	donor organization	records
- Proportion for EPI/polio	health staff	interviews
- Quantity sterilizers	MOH	records
- Useful life	MOH	records
- Interest rate	Ministry of Finance	records
- Unit price sterilizer	donor organization	records
- Proportion for EPI/polio	health staff	interviews

TABLE 9 cont'd

LIST OF DATA REQUIREMENTS

DATA TYPE	LEVEL	COLLECTION METHOD
10. Vehicle Annualization		
- Quantity vehicles	MOH	records
- Useful life	MOH	records
- Interest rate	Ministry of Finance	records
- Unit price vehicle	donor organization	records
- Proportion for EPI/polio	health staff	interviews
- Quantity other trans	MOH	records
- Useful life	MOH	records
- Interest rate	Ministry of Finance	records
- Unit price other trans	donor organization	records
- Proportion for EPI/polio	health staff	interviews
11. Building Annualization		
- Useful life	facility	records
- Interest rate	Ministry of Finance	records
- Unit price construction	donor organization	records
- Proportion for EPI/polio	health staff	interviews
EFFECTIVENESS		
1. Total doses administered	facility	questionnaire
2. Total coverage	facility	coverage survey
3. Cases	facility	survey

SECTION III:

SOME ADDITIONAL ISSUES FOR COST-EFFECTIVENESS OF EPI

This chapter presents some thoughts on future directions for the use of cost-effectiveness analysis for the EPI. As the turn of the century draws near and as new global efforts are being launched, such as those aimed at eradication of polio and virtual elimination of measles and neonatal tetanus mortality, there is a need for further reflection about the role of cost and cost-effectiveness evaluations of immunization programs. Specifically,

- Research priorities for cost and cost-effectiveness evaluation of EPI need to consider the priorities of program managers and national governments rather than only the priorities of donor agencies.

- Data collection and analysis methods which are accessible and understandable to EPI managers and staff need to be developed so that studies can be integrated into routine program management and evaluation.

- Once methods are improved, more effort needs to be made to ensure that the results from cost-effectiveness studies are useful for program managers.

- A team approach to data collection and analysis needs to be adopted in the implementation of studies.

- The relationship between the results of these studies and the broader issues of program sustainability needs to be further defined. Financial sustainability of the program can also become a topic addressed by these studies.

There is growing recognition that current knowledge in costing and cost-effectiveness of immunization strategies needs to be reviewed and new lessons drawn from past experiences. Economic and financial evaluations of immunization programs have been the subject of three international symposiums sponsored by REACH and the Centre International de l'Enfance in Paris, France. These meetings have provided a forum for researchers, policy makers, international donors and program managers to discuss the strengths and weaknesses of evaluation methods, the goals and objectives of future studies and the role of cost and cost-effectiveness evaluations in program management and financial planning for immunization programs.

A. Key Remaining Questions

There appear to be two possible directions for cost-effectiveness analysis of EPI in the future. First, cost and cost-effectiveness analysis could become part of routine EPI operations as another tool, like coverage surveys, for management and planning. EPICost, a computerized spreadsheet designed by WHO to facilitate cost analysis, is one example of this approach (see Appendix B). Or, cost and cost-effectiveness analysis could be conducted on a more selective basis with the aim of investigating larger economic questions about the program. The first option emphasizes individual country capacity to conduct economic studies for planning and management and would result in development of manuals, training modules, computer software and other aids to help EPI staff integrate these analyses into the EPI. The second option focuses on cost and cost-effectiveness analysis as a research tool for informing global policy. Importantly, these micro and macro approaches are mutually compatible and both directions should be pursued.

There remain several priority areas for research which can guide the future development of immunization programs and policies. Given recent WHO priorities on eradication, elimination and control of EPI-target diseases, and concerns about financial sustainability of immunization programs, the next generation of cost and cost-effectiveness studies needs to focus on providing answers to some of the following questions.

1. What will it cost in future years to maintain and/or expand current coverage levels, and how will costs change with increasing levels of immunization coverage?

2. What would be the cost implications of integrating EPI services with other primary health care services?

3. What will it cost to eradicate specific diseases (e.g., poliomyelitis)?

4. Will countries be able to afford national immunizations programs and, if so, at what level of coverage?

5. What are the cost implications of new technologies (e.g., new and improved vaccines, cold chain equipment and injection equipment)?

B. Approaches to Answering these Questions

Each of these issues requires a somewhat different method and manner of classifying and analyzing cost information. Studies can incorporate some of the following elements in order to improve our understanding.

1) Repeated or longitudinal design

All of the previous cost-effectiveness studies have been "one-time" analyses of a cross-section of facilities. The lack of information regarding service delivery over time has constrained our knowledge of how total program cost varies with increasing or decreasing coverage levels.

Economies of scale exist in the production of a good or service when the average cost of production declines as the quantity produced increases. Diseconomies of scale exist when average cost rises as the quantity of goods produced increases. A common hypothesis of economic theory is that the average cost curve is U-shaped: average costs are higher at both high and low levels of output. In between, there is an optimal level of output that corresponds to the minimum average cost. Data from previous studies are insufficient to estimate the average cost curve, primarily because they do not evaluate changes in outputs or outcomes relative to changes in cost. Future cost and cost-effectiveness studies can incorporate a longitudinal design to examine this issue.

2) Direct linkage with coverage survey data collection methods

Much of the criticism of earlier cost-effectiveness studies stems from the poor quality of denominator data on outcomes. With the advent of newer and better technologies for measuring coverage rates of infants fully immunized (i.e., COSAS) future cost studies can be conducted in tandem with coverage surveys.

3) Larger sample size

Some of the studies reviewed in this document used a sample of health facilities as the basis for analysis and comparison. However, these studies have not had a sample size sufficient to cover the wide range of variation in service delivery or large enough to have statistically significant results. Some studies in the future could collect data from a larger sample of facilities or mobile teams in order to determine clearly which factors affect the cost of delivering services and the cost-effectiveness of EPI. Once these factors are identified, management decisions can focus on making these aspects of the program more cost efficient.

4) Measurement of program effectiveness

Because the goal of the EPI is to immunize all children less than one year of age with six antigens in order to reduce disease morbidity and mortality, the best measure of program effectiveness at the present time is the number of children fully immunized less than one year of age. However, using the number of fully immunized infants ignores the use of resources to immunize children partially, with one or two doses of DPT or polio, for example. Little attention has been paid to developing a method for estimating accurately the cost-effectiveness of one EPI component, such as the cost of delivering measles or tetanus toxoid immunizations. More effort needs to be made in developing methods for evaluating the cost-effectiveness of partial immunization.

5) Studies to evaluate PHC costs

Most of the variability in cost-effectiveness study findings can be attributed to differences in allocating shared costs among priority health programs. Many priority child survival programs use the same health personnel, vehicles and equipment. Estimating the cost of one program separate from others may result in an over- or under-estimation of the true cost. This problem may be relieved if EPI studies were conducted as part of larger efforts to understand total primary health care costs.

6) Social costs

EPI activities may impose costs on other components of the health care system (negative externality) or confer benefits other than the intended objectives (positive externality). One negative externality of EPI might be the interruption of other primary health care services during a national immunization campaign. Positive externalities might include improved technical capabilities, motivation of health staff, increased awareness or knowledge about immunization on the part of the public or improvement in surveillance. Few studies of EPI have included the "costs" of positive or negative externalities because, in practice, they may be difficult to identify and measure. More attention needs to be paid to estimating these costs.

In addition, the cost of non-immunization to families and the "cost" to the family of seeking services are areas which deserve greater attention.

7) **Make greater use of economic indicators**

Most cost-effectiveness studies have not placed the study results within the larger socio-economic context. This makes cost-effectiveness ratios difficult to interpret, because there is no yardstick to say whether one cost-effectiveness ratio is better or worse than another. An emphasis on relating total EPI cost and cost-per-fully immunized child with proportion of GDP or GNP and level of health expenditures in a country will help managers interpret findings with regard to sustainability and future financing of the program.

This section has provided some suggestions about the future role of cost and cost-effectiveness analysis for the EPI. Cost and cost-effectiveness analysis are useful tools for planning and management. The last decade of studies has provided a wealth of information. Additional efforts need to be paid to making study results more practical for the EPI, and more focused towards operational and financial management aspects of the program.

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APPENDICES

Appendix A: Glossary of Terms

Appendix B: Review and Description of Manuals and Guidelines

Appendix C: The Role of Cost and Cost-effectiveness Studies in the EPI

Appendix D: Summaries of Selected REACH Project Cost-effectiveness Studies of the EPI

Appendix E: Sample Questionnaire for a Cost-effectiveness Study

APPENDIX A

Terms Frequently Used in Cost and Cost-effectiveness Analysis

Budget: A yearly account which estimates how much money goes in and comes out of the national government. This budget may or may not be equivalent to the amount of money spent at the end of the year.

Cost: A cost refers to the value of resources used to deliver immunization services. In this document, the terms cost, full cost, resource cost, and full resource cost are synonymous.

Cost-effectiveness: A technique which calculates the outcomes (effectiveness) of a program in comparison to its costs. The ratio between the total cost and effectiveness of a program is the cost-effectiveness ratio. This analysis can be used to make decisions between alternative strategies to achieve the same level of outcome.

Cost Category: A name given to classify a wide variety of program inputs into similar groups (e.g., personnel, transportation, media, and equipment).

Cost Profile: A ratio of the value of each cost category (e.g., personnel) to the total cost of an EPI. This analysis results in a series of proportions which are unique for each immunization strategy or program. Cost profiles can be compared among strategies and programs to identify useful differences between them.

Cost, Fixed: Fixed costs refer to those which are required for providing a service but which do not vary in quantity as the volume of services delivered changes. For an immunization program, a vehicle is required for supervision and outreach services, but the cost of the vehicle does not change with each additional child immunized.

Cost, Incremental: The incremental cost is the cost of adding a new product or service into an already existing system. Incremental cost analysis can be used to determine the additional costs of a periodic campaign to a routine, fixed facility immunization strategy.

Cost, Investment: Investment costs (or capital costs) are the value of resources which last over more than the given time period of analysis (usually one year) and which contribute to the infrastructure of the program. For example, initial training, building and vehicle costs represent investment costs for immunization programs.

Cost, Marginal: The marginal cost is the additional cost to provide one additional immunization in a program. Evaluation and comparison of marginal costs between strategies can show which one will require fewer resources to implement. A marginal cost analysis could be used to determine how much more an EPI would cost at higher coverage levels.

Cost, Opportunity: An opportunity cost is a measure of the economic value lost to society as a whole by using resources to undertake one activity rather than another. For instance, investing in four-wheel drive vehicles could represent the opportunity cost of capital, as the money used to purchase the vehicles could have been put into a bank to earn interest or used for purchase of another investment.

Cost, Recurrent: Recurrent costs (operating costs) are equal to the value of resources used within a given time period (e.g., each month, each day) to provide immunization services. For instance, personnel costs occur every day of an immunization program and are therefore a recurrent cost of that program.

Cost, Total: The total cost of an EPI is equal to the sum of the value of all resources used. Total costs can be divided into investment costs and recurrent costs. Fixed cost plus variable cost equal total cost.

Cost, Variable: Variable costs equal the value of resources used each time an immunization is given. The cost of vaccines is a variable cost because each child receives a vaccine and incurs a cost for the EPI.

Economies of Scale: This term compares the average cost to provide a service with increasing levels of outcomes. If fewer inputs are required to produce one more immunized child than before, there are economies of scale. If the same level of inputs are required to immunize one more child than before, there are constant returns to scale. If additional resources are required to immunize an additional child, there are diseconomies of scale. Economies of scale can be represented by a U-shaped curve. For immunization programs, it is generally thought that it will cost more and more on average to reach the last 10 to 20 percent of the population, so there will be diseconomies of scale. This theoretical concept has yet to be proven for EPI.

Expenditure: Money which is actually spent from a budget. Expenditures can be different than costs. For example, a cost analysis will include the value of donated media broadcast time, even though these figures do not represent actual expenditures.

Externalities: This term describes the benefits (positive) or disadvantages (negative) of an immunization program which are unforeseen and have a "cost" to society. An example of a positive externality is retraining of health workers during a campaign. A negative externality is when a program prevents the delivery of other preventive health programs because the strategy requires the full attention of administrative and health staff.

Financial Analysis: An evaluation of who is paying for immunizations and how much money is being spent.

Financing: How something is paid for. When individual patients give donations to health centers, they are financing some part of the delivery of services.

Fully Immunized Child: In these studies, a fully immunized child refers to a child who has received at least one dose of BCG vaccine, one dose of measles vaccine, three doses of oral polio vaccine, and three doses of DPT vaccine. Children which have received most but not all of the doses mentioned above are not considered fully immunized.

Resource: The inputs which are used to deliver immunization services. Resources consist of labor, materials, and money.

Sensitivity Analysis: An analysis which changes the key assumptions made in a cost-effectiveness study to test whether different assumptions result in large variations in the cost-effectiveness ratio. If large differences occur, then the cost study is said to be "sensitive" to changes in assumptions.

APPENDIX B

Review and Description of Manuals and Guidelines

World Health Organization (WHO)

WHO published its influential EPI Costing Guidelines in 1979 (WHO/EPI/79/5). These were developed in order to facilitate cost analysis as well as to improve the consistency of cost and cost-effectiveness information. The guidelines provide general rules about cost calculations and the allocation of joint costs among immunizations and other services provided in health facilities. Costs are classified as either capital or recurrent costs. Capital costs include those of buildings, vehicles, equipment (cold chain), and other associated costs including spare parts. Recurrent costs include salaries and benefits, transport, vaccines, training and miscellaneous costs.

The method recommends allocating personnel costs by the proportion of time spent per health worker to administer vaccinations. Vaccine costs are constructed from the number of vials of vaccine used in the health facility multiplied by the unit price per vial. Transport costs are based on the numbers of kilometers driven for the EPI. Other costs are to be reconstructed based on facility records. Capital costs are allocated to the program based on their initial purchase price or replacement value. This figure is multiplied by a proportion of use for the program (presumably determined through interviews) and divided by a present worth-of-annuity factor that is based on the useful life of the capital asset and the current official interest rate (discount rate) in the country.

The EPI costing guidelines were field-tested in Thailand, the Philippines and Indonesia and used to evaluate alternative strategies in Colombia and Brazil. The guidelines were developed as a training tool and were strongly oriented toward managerial applications.

In 1988, WHO developed a standardized computer cost analysis program (EPICost) for program managers to improve the efficiency and effectiveness of the EPI. Based on Lotus 1-2-3, this spreadsheet allows the researcher to enter data into pre-designed cells which will facilitate calculation of program costs. This spreadsheet is currently available from WHO in English and French.

WHO will soon release a set of guidelines and a training manual for cost analysis of primary health care. These guidelines examine financial and economic cost analysis, as well as cost-effectiveness analysis and cost monitoring.

Pan American Health Organization (PAHO)

In order to plan the financing of EPI activities according to program objectives, an Interagency Coordinating Committee (ICC) was formed in each country in Latin America. A matrix for programming and tracking EPI resources at the country level was developed in 1987 in order to monitor five-year budgets for the EPI and polio eradication efforts. This budget matrix includes recurrent and capital costs for the following categories: biologicals, cold chain,

training, social communications, operational costs, supervision, epidemiological surveillance, and research and evaluation. For each, an expected output and time frame is determined. At the country level, the MOH/EPI meets with ICC agencies to negotiate and determine the budget, a "Plan of Action" for each category, and the source of financing - whether national or external (by agency).

United States Agency for International Development

A.I.D.'s Asia/Near East (ANE) Bureau has sponsored the development of a standardized costing framework and methodology for planning, monitoring and evaluating A.I.D. health projects. The ANE Bureau Guidance for Costing Health Service Delivery Projects was produced by the REACH Project and has been distributed widely to USAID offices overses to enhance uniformity in costing aspects of economic analysis for health and family projects, including EPI.

The manual encourages USAID Missions to use the standardized forms to help monitor project costs against projected budget over the life of projects. Indirectly, The Guidance can be used as a basis for project monitoring and in discussions about the long-term financing and sustainability of health projects.

The document is organized into several sections, including a detailed section on the costing framework adopted for data analysis, and information about where and how to collect cost information. A series of tables has been programmed on a Lotus 1-2-3 spreadsheet to facilitate cost analysis. The spreadsheet tables can be adapted to any type of health or family planning project.

Resources for Child Health (REACH) Project

A REACH Manual for Estimating the Incremental Costs of Alternative Strategies for the Control of Neonatal Tetanus was developed in 1988 for a series of WHO workshops in Africa on control of neonatal tetanus. The costing framework includes the minimum cost categories for a cost analysis and an easy, step-by-step description of how to make the calculations.

APPENDIX C

The Role of Cost and Cost-effectiveness Studies in the EPI

A. The Expanded Programme on Immunization (EPI)

The Expanded Programme on Immunization (EPI) is a global program directed and monitored by the World Health Organization which aims to reduce childhood and infant mortality and morbidity from six target diseases: diphtheria, pertussis, tetanus, polio, measles and tuberculosis.

By achieving high immunization coverage rates, the incidence of disease can be reduced and child survival improved. Each country's EPI selects specific strategies, vaccines and approaches to providing services for the target population of women and children. The principal immunization strategies include:

- Services provided through fixed facilities: Immunizations can be provided by facility staff (trained health workers, auxiliary staff, public health nurses and physicians) on a scheduled day of the month or week, or on demand from patients;

- Services provided by mobile teams: Using a vehicle, teams of trained immunization and health workers visit a prescribed route of villages or communities on a scheduled basis;

- Immunization campaigns: Immunizations are given on predetermined days throughout the country, region, or health area, usually with the assistance of volunteers. Campaigns may use the existing health infrastructure to deliver services or may create temporary posts for vaccination.

Other strategies, such as pulse immunization, where outreach workers canvass communities and immunize all eligible children on a periodic basis, and channeling, where outreach workers identify communities which have low immunization coverage and target immunization activities in those areas for a period of time, have also been used.

Immunization services are supervised by EPI staff as well as by regional, district or community level physicians and public health officials. National EPIs monitor immunization activity and coverage of the target population on a routine basis. Other components of a country EPI include training of health workers in immunization techniques and schedules, surveillance of disease, administration and management of the program at all levels of the health system, procurement of vaccines and supplies, logistics and transportation of equipment and supplies, and program evaluation.

The target population for most countries is children less than one year of age. The goal of the EPI is to fully immunize children against the six target diseases before their first birthday. However, some programs have target populations which include older children: those as old as two or sometimes five years of age. Most countries offer tetanus toxoid vaccination to pregnant women, although WHO now recommends immunization for all women of childbearing age to help prevent mortality from neonatal tetanus.

In addition, there is some variation among EPIs in terms of the types of vaccines which are provided, the age at which they are given and the numbers of required doses to become fully protected. A typical EPI provides one dose of BCG (Bacillus Calmet-Guerin vaccine which protects against primary tuberculosis infection), three doses each of oral polio vaccine and DPT (diphtheria-pertussis-tetanus vaccine), and one dose of measles vaccine. In some countries, a dose of oral polio vaccine is recommended at birth, and measles vaccine may be given more than once.

Additional vaccines, such as yellow fever, meningitis, and hepatitis B are provided in some programs. Injectable polio vaccine, acellular pertussis vaccine and a measles vaccine which can be given to infants younger than nine months (Edmunston-Zagreb vaccine) are also being used in some country EPIs.

Therefore, each country has a specific approach for implementing an immunization program, requiring a different set of technologies and resulting in different levels of immunization coverage and protection against disease.

B. Why are cost and cost-effectiveness studies important?

Studies on the cost of immunization programs are important for future budgeting, program design and management, given that per capita national resources for primary health care are decreasing in many countries as population size increases. The total amount of resources available for primary health care (including immunization) must be spread over larger numbers of children, affecting the ability of the health system to provide necessary services of quality. The findings of cost and cost-effectiveness studies can be used to choose among alternative strategies and to strive toward a more effective and efficient program. The objective is higher immunization coverage at lower cost.

Understanding the costs of an immunization program can be an important element in developing a budget and planning the financing of the EPI with the government and outside donor organizations. Financial planning is one mechanism which can be used to sustain activities and benefits of an immunization program. Sustainability has two principal aspects: financial and programmatic. Programmatic sustainability involves those activities which:

1) ensure continuing political commitment to health goals;

2) foster continued demand for immunization and other health services;

3) maintain a cadre of health workers dedicated to preventing, controlling and eradicating disease; and,

4) strengthen the managerial capacity of government institutions in the country.

Financial sustainability refers to the continued mobilization of resources, in order that the EPI will be able to achieve its objectives and have an impact on the health of children in the long run. Planning the financing of primary health care activities, such as immunization, requires an analysis of the cost of providing quality services to the target population. The total cost of EPI can be compared with resources currently available in order to foresee and plan for gaps in financing.

In most countries, donor organizations finance half or more of total immunization program costs. Thus, the issue of the financial sustainability becomes critical when donor funding stops. Cost and cost-effectiveness studies provide information on the total resource requirements of a particular strategy or program. This information is essential for discussing and planning the future financing of EPI. Therefore, cost studies provide the basis from which to address financial sustainability of EPI.

C. What are cost and cost-effectiveness studies?

In the health sector, cost studies are undertaken in order to learn the total amount of resources being used for a particular program or project. Most often, the term cost refers to the value of all resources used to provide a given set of services within a specific period of time, usually one year. Resources include the money which is spent on program operations, equipment and supplies used (such as refrigerators and syringes), and the value of the time spent by health workers, managers, and volunteers. The amount of money spent for an EPI is a financial cost; whereas, the value of all resources used is an economic cost. These terms are sometimes used interchangeably but actually have different meanings. A financial cost analysis is useful to monitor how money was spent. An economic cost analysis helps determine how to allocate all resources best to achieve a maximum outcome.

Cost studies may also value the time spent by a family to receive services, including the time people spend traveling and waiting and the time lost from work. These "costs" are used to estimate the total expense required from society for an EPI even though these costs do not represent actual budgetary categories for EPI managers.

For national immunization programs, cost studies examine the cost of providing services by the government, donor agencies or private groups. The first step in conducting a cost study is to identify and classify ALL of the resources which are being used for an immunization program. The quantity of resources used and their value (price) are the basis for cost calculations. Some of the methodological variation in previous cost studies has come from an incomplete identification of resources. Manuals and guides have been developed which recommend methods for calculating and classifying cost information for immunization programs. Appendix B describes and reviews these manuals and guidelines.

Cost studies generally divide inputs into recurrent (or on-going) and capital (or one-time) costs. Recurrent costs are those which occur on a frequent basis, such as the monthly consumption of fuel. Essential recurrent cost categories for immunization programs include:

- Personnel: all health workers, managers, cold chain technicians, storekeepers, technical experts, accountants, drivers, clerks and other staff who are involved in immunization activities;
- Vaccines;
- Supplies: yearly consumption of syringes, needles, cotton, vaccination cards, stationery, and other items;
- Transportation: shipping, freight, customs duties, fuel, fares and tickets purchased during the year;
- Training of health workers or program administrators;
- Maintenance costs (buildings, vehicles or equipment, including cold chain equipment);
- Supervision, management, surveillance and evaluation costs; and,
- Other miscellaneous costs.

Capital equipment which is purchased or used for the EPI, such as vehicles, cold chain equipment and buildings, last longer than one year of the program. Because a typical cost analysis evaluates program costs for a period of a year, an adjustment must be made to make recurrent and capital costs comparable on an annual basis. This calculation is known as the annualization of capital investments and is the value of the equipment used up during the year in the delivery of health services.

Once both the recurrent and capital costs have been identified, they are organized into a framework which facilitates analysis and calculation of total program cost. Cost studies may specify the total resources donated by specific sources. These sources may include the national and regional government, donor organizations, non-governmental organizations, and the community.

Cost-effectiveness analysis is a tool for comparing alternative strategies for achieving the same outcome, such as universal coverage. Cost-effectiveness analysis for the EPI divides total program costs by the number of children immunized.

Cost-effectiveness analysis can be used to determine which alternative strategy will:

- o achieve a given set of outcomes, such as high coverage rates, at the lowest average cost; and,
- o maximize the outcome at a pre-established level of resources.

One of the weakest aspects of cost-effectiveness studies of EPI is measuring program effectiveness. The number of fully immunized children less than one year of age has been used as an indicator of the effectiveness of immunization services. Other measures of program effectiveness are 1) the number of doses administered within a year, 2) the number of cases of disease prevented, and 3) the number of deaths prevented.

Each effectiveness indicator measures some aspect of the program. For example, the number of doses administered provides an indication of the level of contact with the population. However, reported figures from health centers and other health facilities may not always be accurate representations of EPI performance because of incentives or pressure to reach coverage targets.

Because EPI requires repeated vaccinations for full protection against polio, diphtheria, pertussis and tetanus, the number of fully immunized children (those receiving all doses) is considered to be one of the best measures of the ability of the EPI to provide sustained and complete protection to a population over a period of time. It is well documented, however, that the number of fully immunized children is less than those receiving measles vaccine or the third dose of DPT. The number of fully immunized children under-represents the full activity of a program by omitting children from the calculation who were partially immunized within the year.

The most reliable estimates of children fully immunized come from coverage surveys using the 30-cluster sample technique. The WHO software COSAS (Coverage Survey Analysis Software) can be used to analyze the results of the cluster survey. This software provides additional information on program effectiveness such as the age interval between doses, the number of children correctly immunized (based on schedules and doses), and the percent of missed immunization opportunities.

The measurement of cost per dose and cost per fully vaccinated child does not translate the benefits of immunization into values that reflect the impact of the program on disease or death. For this reason, studies have used assumptions on disease incidence, case fatality and vaccine efficacy to attempt to calculate the cost per case averted, cost per death averted, and cost per years of life added.

The major drawback of using deaths or cases prevented as the definition of program effectiveness for cost-effectiveness studies is that these indicators are rarely measured at the point at which cost-effectiveness studies are made. They are calculations based on a series of assumptions which may or may not accurately reflect disease transmission in a particular population. Thus, most calculations of the impact of immunizations on disease incidence or mortality rates are illustrative rather than accurate.

Comparison of immunization strategies can be based on their cost-effectiveness ratios. Ratios which are smallest represent strategies which require fewer resources to immunize children; conversely, cost-effectiveness ratios which are high correspond to strategies which require more resources to immunize children. For example, if the annual cost of a fixed facility strategy is $10,000 and the annual cost of a mobile team strategy is $200,000, the fixed facility strategy is less expensive to operate. On the other hand, if the fixed facility strategy fully immunizes 1,000 children per year and the mobile team strategy fully immunizes 100,000 children per year, the mobile team strategy is the most cost-effective at $2 per child ($200,000/100,000 children). The fixed facility strategy is less cost-effective at $10 per child ($10,000/91,000 children). One of the limitations of cost-effectiveness analysis is that it is difficult to judge whether $10 per child is good or bad.

Cost-effectiveness ratios can be classified on the basis of outcomes and costs into the following matrix:

		COSTS	
		HIGH	LOW
COVERAGE	HIGH	A Ranking of ratio depends upon absolute values	B Typically most cost-effective
	LOW	C Typically least cost-effective	D Ranking of ratio depends upon absolute values

Case B will represent the most cost-effective strategy, as it has a low cost and high level of coverage. Case C will represent the least cost-effective strategy, as it has a high cost and low level of coverage. Strategies A and D are mid-way between B and C in terms of their cost-effectiveness ratios.

D. Uses of cost and cost-effectiveness studies

From an historical perspective, there have been two principal reasons for undertaking cost and cost-effectiveness studies of immunization programs: 1) to assess the total resource requirements of a program or of a set of alternative strategies in order to make a decision about which approach tfuture; and 2) to determine the current patterns of financing of the program in order to prepare for future financing needs. Table 10 describes some of the uses of cost and cost-effectiveness information.

Evaluation

Most cost and cost-effectiveness studies have been conducted as one-time evaluations of programs. These studies have described the type and quantity, as well as the distribution of resources being used. They have been helpful in justifying continued donor support of the EPI and documenting the extent of government and private sector financing.

Planning

The results from cost and cost-effectiveness studies can be used to advocate more effectively for resources from the central government to finance national immunization programs. These studies can also be used to estimate annual financial requirements and to predict future needs for capital equipment. Cost studies can form the basis for planning the financing of national immunization programs, particularly if the program anticipates expanding the target population or enlarging the scope of the program.

Management

A cost analysis can be used to initiate an on-going system of monitoring EPI resources. Continuous evaluation of program costs can assist the program manager to identify where resources are being spent and how fast they are being used relative to program goals and objectives over a specified time period. Continuous monitoring of costs can also help identify when and where the delivery of immunization services are more or less efficient than average. For example, if monitoring takes place at the facility level, the manager can see which facilities can serve as models of service delivery because they use less resources to provide more immunizations, and which facilities need strengthening in order to make them more efficient. At the national level, if additional expenditures on supervision and training do not result in greater immunization coverage, the manager can undertake further investigations to discover the cause of this discrepancy.

At the micro-level, variation in design and delivery of immunization strategies makes cost and cost-effectiveness studies useful for program management. These studies can compare strategy costs and outcomes in order to identify the approach which uses the least amount of resources to achieve maximum coverage. Program managers can use this information to change program strategies, alter the emphasis of a country program from one strategy to another, or introduce a new strategy based on findings on another region. Cost analysis also can be helpful in examining the impact of alternative immunization technologies, such as new vaccines, different types of cold chain equipment and vehicles, and alternative types of health personnel on the total cost of the program.

E. Limitations of cost-effectiveness analysis

Although cost and cost-effectiveness studies are useful for planning, evaluation and program management, it is important to recognize the limitations of these studies. One criticism of cost-effectiveness analysis is that decisions in the health sector should not be based solely on economic criteria. Ethical, technical, administrative and logistical considerations often have more of an influence on the final choice of a strategy or approach chosen to achieve a goal.

Second, a study may compare the cost-effectiveness of strategies which are not realistically viable alternatives. For example, a mobile team strategy may be less cost-effective than immunization services in fixed facilities, but since these two strategies serve different target populations (nomadic versus urban), cost-effectiveness analysis does not provide the major information needed for programmatic decision-making. Still, it is imperative to take a closer look at the economic and financial implications of health programs (including immunization programs and strategies) so that resources can be mobilized and used more wisely.

Third, most studies examine the cost of providing immunization services at one point in time, while there are other factors which influence the demand for vaccination services. Factors such as travel and waiting time, as well as loss of earnings due to time spent seeking care need to be considered as part of the full cost (whether in monetary or economic terms) of an immunization program.

Four, estimates of the cost per fully immunized child divide the total cost of the EPI by only that fraction of children who have received their full complement of doses through the program within the study period. This method overlooks the contribution of the EPI to the partial protection of children against the six target diseases, and therefore, underestimates effectiveness.

Five, the quality of data collected for cost and cost-effectiveness studies is sometimes only as good as the data reported to the government health system. It is almost impossible at the present time to estimate the degree of error inherent in cost-effectiveness ratios. The best studies provide a range of estimates by altering key assumptions to see the impact of these changes on total cost and cost-effectiveness of the EPI.

Finally, although there is a role for cost and cost-effectiveness studies in planning, managing and evaluating an EPI, the results of these studies have been under-utilized. There is insufficient discussion about how results can be used in the field and why recommendations have not been adopted. The lack of practical application of study results may be due to the way in which study objectives are defined and the overall level of involvement of EPI staff in the study. More explanation of study results between evaluators and program managers may improve their utility for program management and planning. There is no clear-cut explanation of how to use cost information for program management. Study results need to be formulated into practical and operational terms.

TABLE 10: USES AND OBJECTIVES OF COST AND COST-EFFECTIVENESS STUDIES OF EPI

PURPOSE	OBJECTIVE	TYPE OF ANALYSIS	CLIENT
Planning	1. To choose among alternative strategies	CE Study	Donor MOH Manager
	2. To plan future financing of the program	Cost Study	Donor MOH Manager
	3. To determine future costs of expanding the program	Cost Study	Donor MOH Manager
	4. To lobby more effectively from donors or ministries of health	CE Study Cost Study	MCH Manager Donor
Management	1. To describe the type, quantity and distribution of resources for a program	Cost Study	Manager Donor
	2. To estimate annual resource requirements	Cost Study	Manager Donor
	3. To monitor expenditures and resource use over time	Cost Study	Manager
	4. To improve management and efficiency	Cost Study	Manager
Evaluation	1. To determine the least costly strategy for achieving desired health objectives	CE Study	Donor MOH Manager
	2. To assess methods to maximize health gains given a level of resources	CE Study	Donor MOH Manager

APPENDIX D

Summaries of Selected REACH Cost-Effectiveness Studies of the EPI

REPUBLIC OF CAMEROON

EPI in Cameroon

EPI in Cameroon began in 1975 with a mobile team based in Yaounde. By 1986, vaccinations were given one morning per month at 500 fixed centers (30% of which were operated by private groups), by regional mobile teams that immunized 5-10 days per month, and through outreach from fixed facilities aimed to reduce the backlog of older children who were not completely immunized. An estimated 30% of children under five were fully immunized.

In November and December 1986 and January 1987, the Government of Cameroon implemented a major national vaccination campaign. Significant political commitment, financial resources, and voluntary spirit were integral to the campaign's success in giving some 4 million doses of vaccine and raising coverage levels by 12%.

The Cost-Effectiveness Study

REACH conducted a cost study in April and May 1987 in conjunction with a UNICEF rapid assessment of the campaign. Costs were calculated for routine EPI services as well as for the campaign. Campaign costs were estimated in two ways: 1) through an examination of total expenditures by sources; and 2) through an estimation of the full resource costs by source. Data on full resource costs of routine services were not available, thus limiting the comparisons that could be made.

Findings and Recommendations

Since data on routine services were collected from government sources only, they excluded contributions to the EPI from donor organizations. Based on 1986 data, the cost of immunizations through fixed centers and mobile teams amounted to $178,050.[3] The government also spent $89,000 on small regional campaigns during 1985 and 1986.

Cash expenditures for the campaign totalled $1,639,218, 45% of which the government contributed. The recurrent costs of the campaign, which include the costs of salaries, vaccines, transportation, supplies, media, training, and general operating costs, accounted for 88% of total cash outlays. Vaccines accounted for nearly 60% of the total cost, and transportation 15% (primarily due to the high cost of air freight of vaccines and supplies).

[3] These figures reflect actual reported costs, not those in 1987 dollars.

The economic cost of the campaign (including the value of donated time and materials), was approximately $3.7 million. Government resources accounted for $3.2 million of the total. A number of resources used, however, were not costed because of a lack of information, the number of tenuous assumptions that would have had to be made to calculate figures, or because cost information would not be released by the government. Contributions by the Ministry of Health, other elements of the national government, and local indigenous organizations covered approximately 87% of total economic costs. Personnel accounted for the single largest component (66%), with general operating (7%), transportation (6%), and vaccines (5%) also noted. The large personnel cost is due to the enormous public voluntary effort for the campaign.

Cost-effectiveness analysis was performed to assess the relative costs of the campaign (both expenditure and full resource costs) against the achievements of the campaign. The effectiveness of the campaign can be measured in terms of number of doses and number of children fully vaccinated during the National Vaccination Days.

The expenditure cost per dose and per fully immunized child was almost four times greater in the campaign than in routine services. For routine services, the cost per dose was $0.11 and the cost per fully vaccinated child was $2.19 (government expenditures only). For the campaign, the cost per dose was $0.40, with $0.18 allocated to the government. The cost per fully vaccinated child was $8.33 for all donor and government expenditures, and $3.73 per fully vaccinated child just for government expenditures. When full resource costs are considered, the cost-effectiveness for the government of the mass campaign diminishes from $3.73 to $15.86 per fully immunized child (versus $2.19 for routine EPI services).

Although the average campaign cost to the government per FIC was more than one and a half times the cost of routine services, the campaign completely vaccinated twice as many children. One advantage of the campaign approach is that it provided many children with the opportunity to complete the required number of doses of all EPI vaccines. On the other hand, the resources of the campaign were allocated mostly to older children who were not the main target group of EPI.

A sensitivity analysis showing the effect of altering major assumptions resulted in no significant change in the original magnitude of the cost-effectiveness ratios. In fact, changing several of the assumptions resulted in decreased cost-effectiveness for the campaign.

The study also examined the campaign economic costs in terms of major program elements. The major cost categories were procurement of vaccines (61% of total expenditures), development and maintenance of the cold chain (13%), and vaccine delivery (11%). The low resource and expenditures figures for supervision (2%) and cold chain development reflect the underfunding of these activities. This conclusion is supported by the fact that no supervision system exists for routine services, and that the cold chain needs to be upgraded at both the regional and central levels.

A comparison of costs in Cameroon and those in other immunization campaigns showed that in general the Cameroon figures were higher, more than twice as high as in the Mauritania campaign.

In conclusion, the Cameroon campaign resulted in twice as many vaccinations given to children in 1986 as did the routine services but cost more than twice as much. Benefits of the campaign included reaching children who had not finished their series and who would probably have gone unvaccinated into adulthood. In addition, the campaign also may have reduced the time period between the first and last doses of vaccines, thereby improving effective protection.

On the other hand, the campaign required significant resources which were taken away from other important primary health care activities, and which placed a large financial burden on the government. The amount of effort invested in the campaign was found not to have been followed up by the government or by any other donor. This may be because the campaign depleted so many of the country's resources for immunization activities.

To improve the cost-effectiveness of future campaigns, this study suggests that attention be paid to continued promotion of the benefits of immunization in order to increase the numbers of children who come into contact with campaign services. More time should be allowed for planning the campaign, ordering supplies, and distributing them to vaccination sites, which would reduce the cost of air shipments at the last minute. Equipment should be ordered which can continually be used by routine services in order to reduce the cost of this item for the campaign.

This study showed that on economic grounds the campaign was not as cost-effective as routine services and that resources needed for the routine EPI and other preventive programs had been used to finance the campaign. Although the decision to have a campaign is never made solely on economic grounds, but involves political, social, and organizational interests, what can be concluded from this study is that the economic aspects of mass vaccination efforts should be considered more thoroughly. It is only by considering the financial burden of campaigns on routine activities that the future sustainability of immunization programs can be adequately addressed.

***** For further information, see Brenzel L., "Cost-Effectiveness of Immunization Strategies in the Republic of Cameroon." Arlington, VA: REACH, August 1987.

HAITI

EPI in Haiti

In 1985, the government of Haiti's EPI began to develop new strategies to improve low immunization coverage. These strategies included urban immunization days, immunization days in rural communities, and reaching more remote areas on horseback in order to immunize. In addition, a channeling strategy was used to help identify children who had not been vaccinated in communities with low coverage levels.

Reported coverage levels for children less than one year of age in 1987 were as follows: DPT - 29.6%, polio - 29.5%, BCG - 46.3%, and measles - 23.9%. Dropout rates between DPT 1 and DPT 3 were as high as 60% in some communities.

Because coverage remained low despite the new acceleration efforts, in 1988 the government decided to hold national vaccination days. These took place on September 11, October 23, and December 4. Over 4,000 vaccination posts were established, largely outside of the routine health system in community buildings, churches, and schools. Community volunteers supplemented the health personnel to staff the posts. The army, radio and television stations, and the schools also provided important support in logistics and social mobilization.

The Cost-Effectiveness Study

A costing study was designed to compare the national immunization campaign with previous strategies (including routine services). It was expected that the results would be useful to the government, the EPI, and the donor community in determining which strategy conferred the greatest benefit for the least cost. By examining the historical costs and benefits of the various strategies used, the cost study was intended to shed light on the best path to follow in the future. Since the EPI is funded by international agencies, the study would also examine the requirements for continued external funding.

The cost study was undertaken by the Ministry of Public Health, with technical assistance from the REACH Project. In measuring the cost and cost effectiveness of the alternative immunization strategies, the study sought to answer some of the following questions:

1. What was the total cost of the campaign in comparison with other vaccination strategies (routine services, horse teams, community vaccination days, and urban vaccination days)?

2. What is the cost per dose for each strategy and what is the cost per completely vaccinated child?

3. How do costs for individual cost categories vary among strategies?

4. Regardless of strategy, which EPI activities (supervision, training, etc.) require a greater proportion of total resources?

5. For the campaign, what was the proportion of resources provided by the government, NGOs, UNICEF, WHO, and USAID?

Findings and Recommendations

The National Vaccination Days cost $4.2 million in 1988, with recurrent costs of personnel, social mobilization, vaccine, transport and supervision accounting for 94% of the total cost. Personnel was the highest cost category at 40% of total cost, followed by social mobilization (32.7%) which was a strong characteristic of the campaign. The cost per dose was $1.64, for a total of approximately 2.5 million doses given.

In contrast, routine services through fixed facilities cost $719,630, nearly one-sixth that of the campaign. However, a third the number of doses was given in fixed facilities compared to the campaign for the year. The annual value of buildings was the greatest cost category at 29%, followed by personnel (28%), vehicles (7%) and cold chain equipment (7%). The cost per dose was $0.89.

The two other strategies included in this analysis: horse teams and community rally posts showed interesting results and came in between those of the campaign and fixed facilities. The horse teams cost only $173,000 for the year, but provided a minimal number of doses of 159,000. The cost per dose was $1.36. Personnel costs accounted for 78% of the total cost followed by transport (7%).

Rally posts were the least expensive strategy ($164,233). Personnel costs represented 55% of total cost, followed by vaccines (9%). The cost per dose was $0.95.

The study concluded that rally posts were the most cost-effective strategy in relation to fixed facilities and should be encouraged as a method of immunization in Haiti. In addition, the study recommended that improving the cost-effectiveness of the horse teams would be a priority in the coming year.

**** For further information see Dr. Maryse Narcisse, "Analyse du Cout, Cout Efficacite des Strategies du Programme Enlargi de Vaccination en Haiti," Bureau de Coordination du Programme Enlargi de Vaccination, Ministere de la Sante Publique et de la Population, 1990.

RURAL UNIT FOR HEALTH AND SOCIAL AFFAIRS (RUHSA)

NORTH ARCOT DISTRICT, TAMIL NADU, INDIA

Polio Immunization in RUHSA

The Government of India adopted the WHO recommended 3-dose schedule for Oral Polio Vaccine (OPV) in 1979. Although this vaccination schedule had shown a field efficacy of nearly 100% in the United States of America, reported cases of poliomyelitis did not decline in India between 1979 and 1987. In OPV studies using seroconversion as a surrogate for vaccine efficacy in India, 3-dose OPV failure rates between 20% and 25% were observed[4]. The potential for an alternative to OPV is currently being studied in North Arcot District in India. Seroconversion studies have shown that nearly 100% of children seroconverted to two doses of Killed Polio Vaccine administered at an interval of eight weeks.

The Cost-effectiveness Study

A cost-effectiveness study was conducted by the Christian Medical College of Vellore and the REACH Project to examine in detail the costs and outcomes resulting from immunization activities conducted by Christian Medical College's (CMC) Rural Unit for Health and Social Affairs (RUHSA) Programme in K.V. Kuppam Block. RUHSA is an integrated, multi-disciplinary, rural health and development programme started by CMC Hospital in 1977. The goal of the program is to improve the social welfare of the community through training its students in health and development activities. The RUHSA project covers the K.V. Kuppam block which has a population of about 100,000. For organizational purposes, a block is divided into 18 Peripheral Service Units (PSU) with one Central Service Unit (CSU) - a 30 bed hospital - located at the RUHSA headquarters.

This evaluation of the RUHSA Programme was a pilot study for a more extensive cost-effectiveness study of the North Arcot District Polio Control Programme and served as a training exercise in field research and analysis of resource use and outcomes. The study focused on assessing the costs associated with the introduction of diphtheria, pertussis, tetanus, and polio (DPTP) injectable vaccine, and compared the relative cost-effectiveness of routine versus mass immunization delivery strategies.

Data were collected in April, 1989, and included primary data collected from a sample of facilities, in the mobile strategy, and the outpatient department of the main hospital, as well as secondary data collected from RUHSA Headquarters.

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[4]John, T.J. "Poliomyelitis in India: Prospects and Problems of Control." Rev Inf Dis, Vol. 6, No. 2, pp. 438-441, 1984.

The basic costing methodology followed WHO's EPI Costing Guidelines as well as the USAID ANE Bureau Guidance for Costing Health Service Delivery Projects, modified slightly because of the availability of data and limitations posed by the study's three-week time period. For example, information about proportion of time spent on an activity was collected by survey rather than direct observation. Several questionnaires were developed to collect cost and outcome data at different levels of the system. To capture information regarding immunization delivery by the routine strategy, PSU and CSU questionnaires were developed and pre-tested. In addition, a separate questionnaire was made for the mass immunization program.

The costs for each strategy incurred during planning, implementation, and operation were divided into recurrent and capital costs. Recurrent costs included health education and transport, personnel, supervision and supplies. Capital costs included purchases of buildings, vehicles, and cold-chain equipment.

Effectiveness was measured by three sets of indicators for the seven-month period between October 1, 1988 and April 30, 1989: total number of DPTP doses; the number of fully immunized children less than one year and less than two years of age; the number fully immunized against polio, and the number receiving two doses of DPTP.

A sensitivity analysis was performed to determine whether changes in critical assumptions made during the study affect the average cost or cost-effectiveness ratios.

Findings and Recommendations

The study team found that level of outcome significantly affects average cost and cost effectiveness regardless of immunization delivery strategy. Mobile team services had higher average cost and cost-effectiveness ratios than either routine immunization services at the hospital or the mass immunization program. Differences in cost are primarily attributable to the mobile delivery's higher personnel costs - an average of 40.6% of the total program cost versus 22.3% for routine hospital services and 10.9% for the mass program. Additionally, a child had a lower probability of becoming fully immunized with mobile services than with the other delivery options because measles vaccine is usually available only through the main hospital or on mass immunization days.

The study also found a wide range of average cost and cost-effectiveness ratios among different facilities. This suggests that some PSUs were more successful at immunizing their populations than others. Average cost for a dose of vaccine ranged from $1.16 to $9.25. The average cost per fully immunized child varied from $11.04 to $158.61. The major factor influencing a facility's respective cost and cost-effectiveness ratios was the amount of time spent by personnel on immunization relative to total outcome.

Although the RUHSA Programme's average cost per fully immunized child is comparable with the international average, ($14.50 versus an international average of $15) sensitivity analysis indicates that efficiencies in service delivery could be achieved by improving the performance of PSU immunization services and reducing the frequency of mass immunization programs.

The study team recommended the following operational changes and proposed several options for improving the use of resources for immunization in the RUHSA area.

1. Monthly mass immunization rounds and weekly immunization services offered at a facility appear to be redundant and do not represent an optional allocation of immunization resources. While the mass strategy aims to cover the hard-to-reach population and the mobile clinic provides immunization on a routine basis to the facility area, neither strategy seems able to maximize the number of children immunized given the resources available. To ameliorate the situation, any of the following options could be undertaken.

   A. Include all vaccines (measles, DPTP, BCG and TT) in the routine strategy: This option would improve this strategy's ability to fully immunize children earlier, removing this group of eligibles from the beneficiaries list, and allowing the mass campaign to concentrate only on the hard-to-reach population. The sensitivity analysis showed that if the facility strategy could provide as many doses as the campaign, the cost-effectiveness ratio would be twice as good.

   B. Reduce the frequency of both the mobile clinic and the mass campaign: With coverage about 80% on average and declining birth rates, there is a low probability that there are sufficient numbers of children and mothers to hold immunization sessions at the facility each week, or to hold a mass program each month. On average, three doses of any vaccine are administered per week which does not appear to justify the cost of vaccine vials, personnel time and transport costs.

      It was recommended that the facilities change to a monthly immunization session, whereby the officer in-charge could draw up a beneficiaries list and the health and development workers could inform mothers and children of the date. A more concentrated effort would then be placed on completing the full course of immunizations for the children who come normally for vaccination (i.e., providing measles vaccine). On the same day, the mobile team can visit households of children and mothers who did not come for the appropriate immunizations (either because they resist immunization, are unaware of the timing, or had other conflicting activities).

   C. Focused measles campaigns or rounds: One rationale for the continuous mass program was low measles coverage and higher rates of disease in 1988. The team recommends that in October, November and December (pre-measles season), the option recommended in (B) concentrate more heavily on measles than in previous months.

2. RUHSA should plan to evaluate the cost-effectiveness of any new strategies compared to the study year's results. In addition, the cost per case prevented should be calculated.

3. Better records should be kept on the total number of doses administered during a mass program, with a separate reporting format for the officer in-charge to complete immediately following an mass immunization round.

***** For further information, see Brenzel L., et al., "Cost-Effectiveness of the Immunization Programme in the Rural Unit for Health and Social Affairs," Arlington, VA: REACH (for USAID), May, 1989.

THE REPUBLIC OF MAURITANIA

EPI in Mauritania

The Islamic Republic of Mauritania established its EPI program in 1977. By 1984, the government was providing immunizations through:

- 31 maternal and child health centers (PMIs) that offered a range of preventive services in urban and periurban areas; and
- 10 mobile teams devoted exclusively to immunizations.

Despite these programs, coverage remained low as a result of the difficult terrain, dispersion of the population, and the persistence of logistical and other problems. A 1984 coverage survey found that less than 20% of children 12 to 35 months old were completely immunized against basic EPI diseases. In November and December 1985, the government instituted mass campaigns (Journees Nationales de Vaccination--JNVs) in 28 urban sites. Besides providing immunizations, the campaigns were used to distribute Vitamin A and food supplements, and to introduce a standard immunization and child health record.

The Cost-Effectiveness Study

A cost-effectiveness study was commissioned by UNICEF to evaluate in detail the national vaccination campaign and to compare campaign costs and benefits to those conferred by other immunization strategies in operation in Mauritania. Costs and benefits were compared for the PMIs and mobile teams for 1985 with those of the mass campaigns of November 1985 - January 1986.

Data were collected in May and June 1986, primarily in Nouakchott, and included published and unpublished documents, and information from interviews with staff from a variety of government and donor organizations.

The principal funders of immunization included the government of Mauritania, UNICEF, and A.I.D. The cost of contributions made by other private voluntary, nongovernmental, and international organizations (such as WHO, Medecins San Frontieres, The Peace Corps, and World Vision), were included only for the JNVs because of the limited time available for data collection.

The basic methodology followed WHO's EPI Costing Guidelines, modified slightly because of the availability and quality of data. A survey was conducted in health facilities to estimate the proportion of fixed center MCH activities that were attributable to immunization alone.

The costs for each strategy included direct and indirect expenses incurred during planning, implementation, and operation, and were divided into recurrent costs and capital investments. Recurrent costs included those for personnel, transport, training, supervision, supplies, vaccines, and media. Capital investments included purchases of buildings, vehicles, cold chain equipment, and medical equipment.

Although every effort was made to identify all costs, the analysis was not able to include two significant economic variables: opportunity costs (e.g., costs to families to have their children immunized, including travel costs, time lost from work); and potential savings to the health sector from preventing infectious disease cases, and to society from lives and potential labor saved.

Effectiveness was measured by the number of completely vaccinated children under one and under five. Since the different strategies aimed to immunize different populations, target populations had to be estimated based on available statistics.

A sensitivity analysis was performed for both cost and effectiveness factors in order to test the reliability of the initial assumptions, and to identify ways in which the efficiency of vaccination programs could be improved. The most interesting scenario involved improvements in the efficiency of the mobile teams.

Findings and Recommendations

Between 1984 and 1986, full coverage of children between 0 and 36 months increased from 20% to 55%. The costs per completely immunized child were found to be $6.83 for fixed centers, $8.97 for JNVs, and $17.37 for mobile teams. These costs are comparable to those found in other vaccination programs throughout the world.

The mobile teams were the least cost-effective method, due in large part to high recurrent costs. The teams were important, however, because they were the only means of reaching a dispersed, mobile, rural population. This requires very high cold chain and vehicle costs (the useful life of a vehicle was two years instead of the predicted 10). Low female literacy and other factors increased the difficulty of the task.

The JNVs made a major contribution to improving overall coverage, particularly in urban areas, but were less cost-effective than the routine services they were designed to complement. The relatively high cost per fully immunized child for the JNVs can be attributed to a significant degree to the planning, preparation, and training required. The campaign was a learning process for all involved, and future campaigns should benefit from the experience.

The relatively low cost of delivering vaccinations through the PMIs was related to the degree of integration of health services. On the other hand, the high cost per fully immunized child for the mobile teams could reflect the focused nature of that strategy.

Based on various sensitivity analyses and on discussions with government officials, the evaluation gave several recommendations:

1. The cost-effectiveness of PMIs could be improved through a greater coverage of the urban population, particularly through outreach services. There is also a need for continued media promotion of the benefits of vaccination both to convince people to initiate immunizations and to decrease dropouts.

2. The cost-effectiveness of mobile teams could be improved by maximizing the effectiveness of the teams through better vehicle maintenance and repair, and more efficient routing patterns. The mobile teams should strive to decrease the average interval between the first and last dose

of EPI vaccines (240 days), partly through longer stays in villages and more effort to locate all newborns. Integrating basic curative and preventive services (such as oral rehydration therapy and Vitamin A) was also recommended.

3. The campaign approach could also be improved through better promotion, more concerted efforts to reach children under one year of age, and concentrated attention to reducing dropouts.

The EPI was successful in reducing a large backlog of unimmunized children through the three strategies. From the analysis, it was difficult to predict whether vaccinating the remaining hard-to-reach population would be more or less costly, because:

- The remote rural populations required the use of mobile teams, the most costly strategy;
- Improving several inefficiencies in current programs would lower costs;
- Recurrent costs were likely to decrease once EPI could focus on the newborn population rather than both newborns and older children.

Given the particular context of implementing EPI in Mauritania, it is probable that delivering immunizations through a mixture of strategies is the most cost-effective approach. Although the JNVs contributed significantly to the increase in coverage, attention should not be taken away from the two routine strategies which should continue to play key roles in raising coverage levels, particularly among newborns.

This was one of the first studies to compare the three principal vaccination strategies used throughout the world: routine services provided by fixed centers, routine services provided by mobile teams, and mass campaigns. The results were of interest particularly in the Sahelian countries, all of which shared similar difficulties: dispersed population, limited health infrastructure in rural areas, and a significant toll from infectious childhood diseases.

***** For further information, see Brenzel L., "Cost-Effectiveness Analysis of Immunization Strategies in the Islamic Republic of Mauritania," Arlington, VA: REACH (for UNICEF), July 7, 1986.

THE REPUBLIC OF SENEGAL

EPI in Senegal

Although Senegal made a commitment to universal childhood immunization at the 1985 Bellagio Conference, by the summer of 1986 less than 20% of children age 0 to 5 were completely vaccinated. On September 5, 1986, during a visit of the UNICEF Executive Director, the President of Senegal announced his commitment to achieve a target of completely vaccinating 75% of children 0-23 months of age by April 7, 1987, World Health Day.

Senegal's 1987 immunization campaign prospered through the mobilization of extraordinary governmental, donor, and private sector resources. Within the government, a major reorientation of resources took place, as ministries donated resources for transportation during social mobilization efforts, and health facilities used their semi-annual budgets for supervision and transportation expenses.

A July 1987 national coverage survey found 35% of children between 12 and 23 months completely vaccinated, a 15% increase due to the acceleration. The campaign increased full coverage by a factor of three in rural areas, 1.5 in urban areas, and 1.2 in the Dakar region.

The Cost-Effectiveness Study

With the twin goals of learning lessons from the Senegal experience and drawing insights into ways that the government could preserve the impressive coverage gains, UNICEF undertook a rapid assessment of the Senegal acceleration in June and July 1987. As part of this study, REACH conducted a detailed analysis of the cost components of the campaign and a cost-effectiveness analysis of different immunization strategies in Senegal.

The full cost evaluation was complex because of the change in EPI strategy from a predominantly mobile team to a fixed center approach. Investments in material resources before the acceleration phase (November 15, 1986 to April 15, 1987) prepared the way for a fixed facility strategy following the campaign. Because these investments made the campaign possible, they were counted toward the total full cost.

All resource costs, including the cost of personnel time and media time devoted to the campaign, were included in the full cost evaluation. However, it was not possible to estimate many of the social mobilization costs at the local level nor the opportunity cost to the rest of the national health activities of focusing on immunization.

Findings and Recommendations

During the acceleration period, over one million doses of vaccine were administered to children less than two years old, at a cost per dose of $1.24. This cost is higher than that in other UNICEF-supported campaigns, but it does not include doses administered to older children, which would lower the per-dose cost.

The study found that the cost per fully vaccinated child ranged from $19 to $27, figures that are slightly higher than those reported from other campaigns in West Africa. The cost per death averted was calculated to be $1,400. It was estimated that from November 1986 to July 1987, EPI prevented approximately 140,000 cases of measles, pertussis, and tetanus.

The cost of the campaign was $3.5 million, and the government incurred additional expenditures of $60,800. Approximately 93% of the total was for recurrent costs, such as supplies, salary and transportation.

Vaccine costs accounted for the largest proportion of total costs (35%), followed by salary and transportation costs (18% each). Media costs associated with production and transmission of radio, television, and print media accounted for 10% of the total. Salary costs were mostly attributable to the magnitude and intensity of planning and implementing the campaign. Most transportation costs were due to per diems for training sessions and air freight costs for shipments of cold chain and vaccination equipment and of vehicles.

The full costs of acceleration were also separated into the key functional components of EPI. Procurement of vaccines accounted for the most resources (37%). Social mobilization and vaccine delivery were also significant (23% and 22%, respectively). Over 80% of all costs were attributable to three major activities: buying vaccine, mobilizing the population, and administering vaccines. Training and cold chain maintenance were among the lowest cost categories.

Of the total cash expenditures of approximately $3.5 million, vaccines accounted for the greatest portion (30%), with transportation (26%) and vehicle purchases (16%) following. The MOH spent $50,000 on fuel, and other ministries spent $10,800 on transportation. The major differences between expenditures and full costs ($1.5 million) are for the imputed value of salaries, communications, overhead costs, and buildings, and the full resource use of vehicles and equipment.

The acceleration phase represented a departure from the previous mobile team strategy that had been financed significantly by the French. The annual operating cost for the mobile teams in 1987 was an estimated $455,000, or one-eighth the cost of the acceleration. Salaries were the highest component of the teams' costs (32%).

These cost analyses called into question the financial sustainability of EPI in Senegal. The acceleration itself and the fixed facility strategy it introduced were found to be unnecessarily expensive and dangerously dependent on donor financing. Because the acceleration phase was used to launch an immunization strategy through fixed facilities rather than relying solely on mobile teams, Senegal's 650 health centers were equipped with cold chain equipment, vaccination supplies, vehicles for outreach activities, and vaccines. UNICEF made almost all of these purchases.

Several design features of the acceleration and follow-up strategy are very expensive to sustain:

- The use of an expensive ($0.69 per dose) diphtheria-pertussis-tetanus-polio (DPTP) vaccine, which resulted in a 20% increase in the cost of the acceleration phase over a hypothetical case using DPT and OPV ($0.03 each per dose). Vaccines were purchased almost exclusively by donors.

- The type of cold chain equipment purchased for health posts required butane gas for operation, at a monthly cost of $36 per unit. Kerosene or butane are now essential for the cold chain to function and thus must be financed on a continual basis.

- The types of mopeds purchased for the acceleration had run into disrepair four months later. The annual repair cost for these mopeds is estimated at $100, another expensive recurrent cost, but a necessary one for high coverage levels to continue.

In total, the average recurrent cost per health center was calculated at $3,900. Using separate DPT and OPV vaccines would save $3,000 per center. If the population were asked to pay 50 CFA per vaccination card per child, the expected revenue each year would be around $80 per center, or between 2% and 3% of necessary funds. Prior to the acceleration, the population was required to pay for vaccination services as part of the price for a consultation in a health facility (25 or 50 CFA), but during the campaign the President decreed that vaccinations would be provided free-of-charge to the entire population, and this policy remained in effect.

***** For further information, see Brenzel L., "Rapid Assessment of Senegal's Acceleration Phase." Arlington, VA: REACH, November 1987.

REPUBLIC OF SUDAN

The EPI in Sudan

The Expanded Program of Immunization started in 1977 in Sudan, following the adoption of primary health care. The EPI is decentralized to the regional level, where a Regional Operations Officer supervises five to six district-level activities. At the district level, the District Operations Officer is responsible for overseeing all activities of health facilities and mobile teams. Immunization coverage was low in Sudan in 1985. At that time, the government and UNICEF launched an acceleration of activities, including social mobilization, retraining, and equipping of mobile teams and facilities. An ongoing computerized monitoring system was established at headquarters level. Coverage of children less than one year of age increased to over 70% of the first dose of DPT and polio. However, coverage levels for fully immunized children still remained low in some regions (Kordofan 24.11%) and Darfur (23%) due to climatic, geographic and logistic reasons.

The Cost-Effectiveness Study

This study of the cost-effectiveness of the Expanded Programme of Immunization (EPI) represents the most extensive data collection and analysis effort undertaken so far in order to provide the EPI, UNICEF and other providers and supporters of the program in Sudan with practical information about how to use EPI resources more efficiently and effectively in the future. The cost-effectiveness study had two primary objectives: 1) to evaluate the costs and outcomes of alternative immunization strategies through mobile teams and fixed facilities; and 2) to assess the total cost of the program at different levels of the health system. The study was conducted in four northern regions of Sudan.

The methodology developed for the study was founded on providing the EPI with the most practical and relevant results in order that financial and economic information about the program could be used for better planning and management in the future. The study team developed a series of questionnaires specifically for mobile teams, health facilities, district operations officers and regional operations officers. The questionnaires were designed to collect information on:

1) the number and types of personnel working at a particular level;

2) the number and types of equipment used in the last year for EPI and how much of the equipment was not working at the time of interview;

3) the number of supplies (syringes, needles, Road to Health Cards, cotton and other expendable resources) used for the EPI;

4) the number of kilometers travelled for different immunization activities, such as outreach, publicity, meetings, and replacement of stock;

5) information on the price and quantity of fuel, oil, and lubricants used in the past year for the program;

6) the number of doses of vaccine administered to children less than one and less than five years of age by antigen;

7) the catchment population versus the number of fully immunized children;

8) the number of training courses and the number and type of people trained;

9) the amount of local radio and television time for EPI publicity;

10) the size and age of buildings.

Questionnaires were pretested in the National Capital Region with the help of the Regional Operations Officer and the District Operations Officer from Khartoum District. The reference period on the number of doses, supplies, and fuel used was shortened to the previous month (February 1989) because of the inadequacy of record-keeping and problems of recall during the pretest. Because of the shortage of syringes in some areas during the month of February, this reference period may have underestimated the total number of doses administered by the region or district. However, complementary data were collected from central EPI headquarters to make adjustments to annual figures based on monthly reference period. When possible in the field, a month previous to February was used for reference if February activity was considered abnormally low.

The methods used for calculation of costs are those developed earlier by Creese, WHO (1979) and revised by REACH (1988) and WHO (1988). These methods have been used in other recent cost-effectiveness studies of the EPI. The study team included experienced researchers familiar with the methods and techniques for cost analysis as well as individuals familiar with EPI operations in the field.

Findings and Recommendations

The EPI in the Republic of Sudan costs approximately $10 million, including all resources (human, material and financial) used in 1988. The average cost per dose was $1.89 and the cost per fully immunized child (FIC) was $30. Wide variations were found between regions and districts in terms of their annual operating costs and cost per child, suggesting that there is room for improving the overall efficiency and effectiveness of the EPI at these levels. In addition, the study found that mobile team services were more effective at providing immunizations but, on average, they were at least twice as expensive to operate than health facility strategies. It was recommended that the EPI examine more closely policies concerning immunizations at health facilities in order to strengthen this strategy. It was not recommended that one strategy be selected over another on economic grounds as they are designed to serve different population groups.

The cost-effectiveness study team made specific recommendations for each region included in the study and these are available in the individual region reports. Several themes emerged from these regional reports which are described below. These conclusions focus on improving the effectiveness of alternative strategies within the Sudan and on reducing the cost of operating the EPI at different levels.

Mobile Teams

1) The mobile team strategy should be evaluated as to how resources could be conserved either by: 1) reducing the number and types of personnel; 2) becoming more stringent about when per diem and staff support is offered to immunization workers; 3) tracking the number of kilometers used for immunization or for other activities; or 4) preserving and extending the useful life of vehicles through proper driving and maintenance.

2) The total cost of the program could be reduced if other health services were provided by mobile team staff, without reducing their level of activity for immunizations.

3) A policy should be developed on the minimum size of villages to be visited by mobile teams as the first step towards improving efficiency in operations. Smaller villages could be added as the program evolves. A team with four vaccinators travelling far distances to immunize a few children does not represent a reasonable use of the monthly rounds. Making rounds every two to three months in order to have a sufficient number of immunizable children would help make using mobile teams a cost-effective choice.

Health Facilities

1) Health facility services are being under-utilized and represents an untapped resource for EPI.

2) Duplication of immunization services between fixed facilities and mobile teams in urban areas may be contributing to the high cost of the program. A policy should be developed which discourages use of teams in towns even for vaccine drops. Alternative sources of transportation in urban areas, such as donkeys, taxis, and buses should be used instead.

Financing and Financial Management

1) The EPI in Sudan will be required to rely on continued outside donor assistance in order to fund the cost of the program in the near future.

2) Local funding at the district level appears to be an unreliable source of financing for the program.

3) Resources for district and regional operations tend to remain at the regional level and could be used more effectively if some petty cash funds were made available at district level.

4) The financial management system for EPI needs to be strengthened.

General

1) The cost-effectiveness study data show a range in operations and resource use among districts sampled. Within each region, districts should be identified which are using resources in the most effective way; these districts should be used as a standard for service delivery within each region.

2) Record-keeping on number of doses administered and supplies and vaccine used need to be strengthened at all levels.

3) Vaccine wastage was found to be high, and negatively affecting the total cost of the program. Efforts should be made to reduce wastage where possible, given that greater wastage rates are expected at increasing levels of coverage.

4) The cost of the social mobilization program is sufficiently large to warrant further investigation as to the effectiveness of the strategies being used to generate continued demand for immunization services on the part of the population.

***** For further information, see Brenzel L., et al., "Report on the Cost-effectiveness of the Expanded Program in the Rural Unit for Health and Social Affairs," REACH Publication, revised February 1990.

REPUBLIC OF TURKEY

EPI in Turkey

Based on a fixed facility strategy prior to 1985, the EPI in Turkey had achieved an estimated 25% full coverage of children under five years of age. The government made a major commitment to childhood immunization in 1985 during the national immunization campaign, and this commitment has remained until the present time. The initial campaign stimulated a massive social mobilization of governmental leaders on all levels, health workers, mass media, the religious hierarchy, school teachers, and private voluntary groups.

The national EPI is currently operating on a routine basis in a variety of health facilities, including health centers, health houses, Ministry of Health/Family Planning centers, and hospitals. Based on the results of a 1988 coverage survey, 57% of all children between 12 and 23 months were completely immunized (over 800,000 children).

Although primary health care, including EPI, is financed primarily by the government of Turkey, local gubernatorial budgets, the Health Foundation (which administers voluntary donations given at health facilities), and the population at large supplement the resource pool for primary health care services.

The Cost-Effectiveness Study

This study was undertaken as part of a joint Turkey/WHO/UNICEF/USAID Comprehensive Review of the Expanded Program on Immunization (and of the Program for the Control of Diarrheal Diseases) that took place in March 1988. The purpose was to examine current funding and costs in order to determine resource needs for the future. Of particular interest was the financial sustainability of EPI, because of the substantial donor assistance that was required to undertake the national immunization campaign in 1985 and then to strengthen the routine system.

The study included two types of analyses: a policy-level evaluation of national program costs and general cost-effectiveness, and an operational or "micro-analysis" of the factors that influence the cost of delivering immunizations in health facilities.

This was actually the second cost-effectiveness study of EPI in Turkey. In 1986, Dr. Alan Fairbank of REACH estimated the cost per dose in the 1985-1986 campaign to be $1.08.

The study adapted the standard, WHO-recommended methodology (Creese, 1979). The results included total expenditures for EPI for each organization or ministry which made monetary contributions. In addition, the analysis measured the full resource cost of the immunization program, including the opportunity cost of personnel time, donated media broadcasting time, depreciation cost of cold chain equipment and vehicles, and cost of vaccine administered to children. Results were presented in terms of recurrent and investment costs as well as variable and fixed costs for the program.

Data were collected in January and February 1988 in Ankara and Istanbul from a range of documentary and personal sources. Direct allocation of expenditures and costs were made for most of the cost categories; however, because EPI is integrated into other PHC services, there were substantial shared or joint costs that had to be allocated. Salary costs, for example, were allocated on the basis of the proportion of time spent by health workers on EPI, estimated at 15% of total time.

Findings and Recommendations

The national study found the cost per fully vaccinated child to be $17.08, somewhat higher than that for other routine systems in the world but within the range of cost-effectiveness figures. While total expenditures for EPI were approximately $2 million, total resource costs (including donated labor, equipment, vehicles, and media time) were nearly $14 million. Recurrent costs were 83% of the total, with salaries and benefits (65%), media (10%), and cold chain equipment depreciation (8%) the leading cost categories.

The national EPI was found to be well on its way to becoming a financially sustainable program within the Ministry of Health and Social Assistance (MOHSA). Nearly all of the full costs (97%) and most of the expenditures (70%) were being financed by the government. These promising findings indicate the extent to which EPI is now integrated into MOHSA and to which costs should be sustainable with national funding.

There remains reason for vigilance, however, because of the trend of decreasing budget allocations to MOHSA from the central government. Also of concern is the finding that donors such as UNICEF still provided significant financing for expenditures requiring foreign exchange -- vaccines (40% of expenditures), vaccination supplies, and cold chain equipment. Adequate financing for importing vaccines and syringes must be assured until Turkey develops the capacity to produce these items domestically. Training costs are also being borne primarily by donor organizations. It was recommended that attention be paid to developing affordable alternative training strategies, the funding for which the government could take over.

The study also recommended that EPI expenditures and full costs be monitored on a routine basis through a computerized management information system. Such a system would allow managers to predict shortfalls in adequate financing and to plan for improvements in such areas as sentinel surveillance systems and routine training.

The results of a survey of 16 health facilities suggest that the number and types of personnel involved in administering vaccinations and the monthly number of kilometers traveled to replenish stock or to buy necessary supplies had a measurable effect on the cost structure of the facilities.

The average cost per dose ranged from $8.15 to $0.24 among the sample facilities, showing a wide variation in cost and immunization activity. The average cost per dose in village health centers ($6.46) was 19 times that in city health centers ($0.34). These data suggest that it is more costly to deliver services to rural populations. However, when total immunization activity is adjusted for the catchment area population of each facility, city health centers had the lowest "index of activity." These data may be the result of high coverage in cities, high competition among types of health care providers, or low immunizaiton activity.

The variation in cost per dose among health facilities was not merely a function of the level of immunization activity at the health centers. Inefficiencies in the distribution of vaccines and needed supplies and in the provision of services (i.e., offering immunizations every day of the week and having several staff members provide the services) may be some reasons for this variation.

It was suggested that additional studies be undertaken to evaluate the amount of resources being generated in health facilities in a wider sample of provinces and to estimate the potential of these resources to finance priority PHC programs such as EPI, and that the government provide health facilities with guidance about how facility-generated resources should be spent. For example, proportions of expenditures could be recommended, such as that more than 50% of facility expenditures should be for direct patient-related services.

A final recommendation was to conduct a feasibility study of the cost of upgrading the national quality control laboratory and the future recurrent cost burden on the MOHSA. It was suggested that discussions with the World Bank should take place concerning these studies.

***** For further information, see Logan Brenzel, Nimet Cobangolu, and Nese Yemenicioglu, "Cost Analysis of the National Immunization and Control of Diarrheal Disease Programs in the Republic of Turkey." Arlington, VA: REACH, April 1988.

NATIONAL IMMUNIZATION CAMPAIGN IN THE REPUBLIC OF TURKEY

EPI in Turkey

Prior to 1985, the EPI in Turkey had achieved only modest success. This was due to a number of factors, including understaffing at the national level, ill-defined program responsibilities at the local level, use of local vaccine of uncertain quality or expensive imported vaccine, and only partially developed cold chain and monitoring systems. A baseline survey in August 1985 found that 30% of children had received three doses of OPV and DPT by their first birthday, and only 20% of these had received measles vaccine.

This situation changed sharply in 1985, when the government committed itself to organizing a national immunization campaign with the twin goals of paving the way for a permanent system of high immunization coverage and energizing the country's health delivery system.

The Cost-Effectiveness Study

In April 1986, UNICEF conducted a rapid assessment of the recently completed immunization campaign. A REACH staff member performed cost analyses as part of this assessment. The team's findings were in general very positive. In less than six months a noteworthy planning and logistical feat had been accomplished. The nation's entire cold chain was redesigned and re-equipped, thousands of health workers were given re-orientation and training, 41 million doses of vaccine were procured internationally and distributed to hundreds of sites throughout the country, and a remarkable variety of support from all sectors was organized and mobilized with assistance from the Prime Minister, the President, all 67 provincial governors, and over 300,000 school teachers, imams, mukhtars, and volunteers.

The campaign achieved its targets, delivering over 27 million doses of vaccines during its three rounds of ten days each. For each vaccine, pre-campaign coverage at least doubled, particularly among children under one. The assessment team estimated that the campaign prevented 1.2 million cases of measles, 873,000 cases of pertussis, and 9,000 cases of polio, as well as 22,500 deaths from these diseases.

The team also found that the campaign boosted health workers' morale. A country wide cold chain was installed, and the country's training capacity was strengthened. Considerable technical upgrading of personnel took place, and health education of the public raised awareness and understanding of immunization in particular and prevention in general.

Findings and Recommendations

The considerable achievements of the campaign, reported to be 27.4 million doses given, were accomplished at a very low "incremental" cost and a relatively low full economic cost. "New" budgetary outlays were estimated by the Ministry of Health and Social Assistance (MOHSA) to have amounted to no more than $1.6 million, largely accomplished by a transfer of previously obligated funds from other departments of the Ministry. This included an

estimated $890,000 for gasoline, $250,000 for travel expenses, and $404,000 for cold chain equipment. By far the vast majority of resources expended on the campaign were in-kind donations and the use of existing personnel and facilities of the MOHSA and other government and private agencies.

The full economic costs were, of course, considerably more than the "incremental" fiscal outlays required by the campaign. They were estimated to have been at least $29.7 million or $1.08 per dose given. The majority of these estimated costs, however, are monetary valuations of the in-kind donations and of the supporting costs of using personnel and facilities already dedicated to health services. The cost analysis thus included values for many contributions that cannot be costed accurately.

Turkey's campaign benefited greatly from past investments in human resources and physical infrastructure in the health sector. An extensive network of health centers, clinics, and health houses were in place throughout the country, and a large pool of trained health personnel -- led by physicians doing compulsory rural service -- were available for mobilization without the commitment of additional fiscal resources. Existing health personnel were sufficient to administer all immunizations.

It is noteworthy that the additional fiscal resources needed from the government were modest in comparison to the total volume of resources which were mobilized through the President's generation of political and social commitment to the effort. As noted above, the MOHSA estimated that extra fiscal monies consumed by the campaign came to $1.6 million or 5.2% of the total. Some portions of this were capital expenditures (i.e., cold chain equipment) and others were estimates of services donated by other ministries. An additional $17 million worth of resources were made available from personnel and facilities financed in the MOHSA's regular budget. The value of services and facilities donated by non-health ministries was estimated to be almost half that much -- $8.2 million or 27.5% of the total economic costs of the campaign.

The level of donor subsidy was also low relative to the magnitude of the campaign's accomplishments. The total volume of vaccines, syringes, needles, cold chain equipment, and technical assistance consumed by the campaign amounted to $2.2 million, or only 7.4% of the total economic costs. Besides this assistance, the only major foreign exchange requirements (met mostly by the Turkish government itself) were for fuel consumed during the campaign.

The pervasive importance and impact of the groundswell of national social commitment to the campaign was both remarkable and incalculable. While some unknown measure of output was foregone, something of substantial value was also created -- and both the health sector and all of society would continue to benefit from the effort in the future. Among the many benefits that accrued as a result of the campaign, but which are "external" to the immediate benefits of vaccinating children, are:

- increased awareness of the importance and methods of better child health care;

- greater political commitment to preventive and public health issues, particularly in terms of child survival; and

- higher morale among health personnel from a sense of accomplishment through cooperative effort.

Campaign costs can be considered investments in these "external" benefits, even though they cannot be quantified.

In conclusion, campaign costs, particularly the monetary costs, were affordable to Turkey and not overly dependent on donor assistance. The low costs can be attributed to several important factors:

- Turkey's large population and relatively large unimmunized target group meant that the campaign approach could take advantage of economies of scale. High fixed costs (mainly for mass media and telecommunications) could be spread over many vaccinations and could be highly cost-effective in mobilizing demand for immunizations.

- The decision to emphasize bringing vaccines to the people, combined with the successful mobilization of demand meant average provider and consumer costs would each be low. The creation of some 45,000 vaccination stations was the main element of this approach.

The team members felt that the cost-effectiveness of accelerated EPI appeared to be high enough that for countries with large target groups and with mass media capable of extensive coverage, regular mini-campaigns should be seriously considered as a routine medium-term component of EPI support.

***** For further information, see Rapid Assessment: Turkish National Immunization Campaign of 1985, UNICEF Evaluation Publication No. 3. The cost study was performed by REACH staff member Alan Fairbank.

APPENDIX E

Sample Questionnaire for a Cost-Effectiveness Study

SAMPLE FACILITY QUESTIONNAIRE
USED IN A COST-EFFECTIVENESS STUDY

QUESTIONNAIRE NUMBER [ ]
DATE OF INTERVIEW _____
NAME OF INTERVIEWER _____
DURATION OF INTERVIEW [ ]
NAME OF RESPONDENT _____
NAME OF FACILITY _____

1. WHAT ARE YOUR FULL-TIME WORKING HOURS PER WEEK? [ ]

2. ARE IMMUNIZATIONS GIVEN AT THE FACILITY ITSELF DURING THE MONTH? Y N (CIRCLE ONE)

****IF YES, GO ON TO QUESTION 3. IF NO, COMPLETE 3.1, THEN SKIP TO QUESTION 4.

3.1 WHAT TYPE OF IMMUNIZATION AREA IS USED AT THE FACILITY? (VERIFY BY OBSERVATION) [ ]
KEY: ROOM=1; CORRIDOR=2; VERANDAH=3; OTHER=4 _____(specify)

3.2 WHAT IS THE SIZE OF THE FACILITY (MEASURE IN SQ FT)? [ ]

3.3 WHAT IS THE SIZE OF THE IMMUNIZATION AREA (SQ. FT)? [ ]

4.1 COLD CHAIN EQUIPMENT: WHAT KIND AND HOW MANY OF THE FOLLOWING TYPES OF EQUIPMENT DOES THE HEALTH WORKER USE FOR IMMUNIZATION OF WOMEN AND CHILDREN? IF YOU ARE NOT USING THE EQUIPMENT EXCLUSIVELY FOR IMMUNIZATION, WHAT PERCENT OF ITS TOTAL USE IS FOR IMMUNIZATION?

TYPE	NUMBER USED	<100% USED
a. Styrofoam box/Thermocole Box	[ ]	[ ]
b. Vaccine carrier (white)	[ ]	[ ]
c. Day carrier (grey)	[ ]	[ ]
d. Day Carrier (blue)	[ ]	[ ]
e. Ice packs 0.4 liters (small)	[ ]	[ ]
f. Ice packs 0.6 liters (large)	[ ]	[ ]
g. Ice pack (round)	[ ]	[ ]
h. Other _____ (specify type)	[ ]	[ ]
i. Other _____ (specify)	[ ]	[ ]

4.2 IMMUNIZATION EQUIPMENT: WHAT KIND AND HOW MANY OF THE FOLLOWING TYPES OF EQUIPMENT DOES THE HEALTH WORKER USE FOR IMMUNIZATION OF WOMEN AND CHILDREN? IF YOU ARE NOT USING THE EQUIPMENT EXCLUSIVELY FOR IMMUNIZATION, WHAT PERCENT OF ITS TOTAL USE IS FOR IMMUNIZATION?

TYPE	NUMBER USED	<100% USED
a. Forceps: Big Small (circle)	[ ]	[ ]
b. Child Care Register	[ ]	[ ]
c. Antenatal Care Register	[ ]	[ ]
d. Under-1 Register	[ ]	[ ]
e. Stock Register	[ ]	[ ]
f. Electric sterilizer	[ ]	[ ]
g. Pressure cooker	[ ]	[ ]
h. Kerosene stove	[ ]	[ ]
i. Metal bowl	[ ]	[ ]
j. Sterilizing bin	[ ]	[ ]
k. Sterilization rack	[ ]	[ ]
l. Steel tray	[ ]	[ ]
m. Enamel basin	[ ]	[ ]
n. Plastic box (storage)	[ ]	[ ]
o. Other _____ (specify)	[ ]	[ ]

4.3 FURNITURE/MEDIA: WHAT KIND AND HOW MANY OF THE FOLLOWING TYPES OF EQUIPMENT DOES THE HEALTH WORKER USE FOR IMMUNIZATION OF WOMEN AND CHILDREN? IF YOU ARE NOT USING THE EQUIPMENT EXCLUSIVELY FOR IMMUNIZATION, WHAT PERCENT OF ITS TOTAL USE IS FOR IMMUNIZATION?

TYPE	NUMBER USED	<100% USED
a. Wooden table	[ ]	[ ]
b. Wooden chair	[ ]	[ ]
c. Wooden stool	[ ]	[ ]
d. Wooden cupboards	[ ]	[ ]
e. Metal cupboards	[ ]	[ ]
f. Wooden bench	[ ]	[ ]
g. Bucket: Plastic Metal (circle)	[ ]	[ ]
h. Waste bin _____	[ ]	[ ]
i. Tin boards	[ ]	[ ]
j. Posters	[ ]	[ ]
k. Immunization pamphlet	[ ]	[ ]
l. Bag to carry supplies_____	[ ]	[ ]
m. Other _____ (specify)	[ ]	[ ]

*** THE FOLLOWING QUESTIONS REQUIRE THE STOCK BOOK ***

5.1 HOW MANY OF THE FOLLOWING SUPPLIES WAS THE HEALTH WORKER ISSUED IN THE LAST THREE MONTHS AND WHAT IS THE STOCK ON HAND AT THE PRESENT TIME?

	3 MONTHS ISSUE	STOCK ON HAND
a. 2ml plastic disposable syringes	[ ]	[ ]
b. 2ml plastic reuseable syringes	[ ]	[ ]
c. 5 ml Reconst. syringe (glass)	[ ]	[ ]
d. 1cc Tuberculin syringe (glass)	[ ]	[ ]
e. 2 ml glass syringe	[ ]	[ ]
f. 26 gauge needle	[ ]	[ ]
g. 23 gauge needle	[ ]	[ ]
e. Other _____ (specify)		

*** IF THREE MONTHS ISSUE IS "0", CALCULATE 6 MONTHS AND MAKE A NOTE IN THE MARGIN. ***

5.2 WHEN WAS THE HEALTH WORKER LAST ISSUED THE FOLLOWING SUPPLIES AND HOW MUCH IS IN STOCK NOW?

	DATE OF LAST ISSUE	AMOUNT OF LAST ISSUE	STOCK ON HAND
a. Rubbing Alcohol (liters)	[ ]	[ ]	[ ]
b. Spirit (liters)	[ ]	[ ]	[ ]
c. Immunization cards	[ ]	[ ]	[ ]
d. Road-to-Health cards/Covers	[ ]	[ ]	[ ]
e. Other _____ (specify)	[ ]	[ ]	[ ]

5.3 HOW MUCH DOES THE HEALTH WORKER USE FOR EACH CHILD RECEIVING IMMUNIZATION?

a. Asprin tablets	[ ]
b. Cotton balls	[ ]

6. WHAT IS THE DISTANCE BETWEEN THE:

Facility and the PHC?		[ ]	
Facility and its villages?	A	[ ]	Name _____
	B	[ ]	Name _____
	C	[ ]	Name _____
	D	[ ]	Name _____
	E	[ ]	Name _____

7. HOW MANY TRIPS ARE TAKEN PER MONTH BY THE FACILITY STAFF FOR IMMUNIZATION ACTIVITIES? WHAT IS THE DISTANCE TRAVELLED? WHAT IS THE MEANS OF TRAVEL? WHAT IS THE AVERAGE COST OF A ROUND TRIP?

ACTIVITY	Vaccine Stock	Weekly Meetings	Village A	Village B	Village C	Village D
a. # roundtrips/month	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Distance/roundtrip	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Means of travel	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Cost/roundtrip	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
e. Time travelling/trip	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

KEY: BUS=1; TAXI=2; PHC VEHICLE=3 _____ (specify); FOOT=4; BICYCLE =5; 2-WHEELER=6; ANIMAL=7; OTHER=8 _____(specify)

*** IF VACCINE STOCK IS REPLACED DURING THE WEEKLY MEETING, COMPLETE THE FIRST COLUMN ONLY. ***

*** COMPLETE COST/ROUNDTRIP ONLY IF BY BUS OR TAXI. ***

7.1 PLEASE LIST THE ACTIVITIES PERFORMED BY THE HEALTH WORKER AND ESTIMATE THE TIME PER DAY SPENT ON IMMUNIZATION ACTIVITIES.

	ACTIVITIES (ALL)	IMMUNIZATION HOURS
Monday	_____	[ ]
Tuesday	_____	[ ]
Wednesday	_____	[ ]
Thursday	_____	[ ]
Friday	_____	[ ]
Saturday	_____	[ ]
Sunday	_____	[ ]
Total		[ ]

7.2 HOW MANY HOURS ARE SPENT EACH WEEK ON IMMUNIZATION ACTIVITIES?

a. Community Worker [ ]
b. Multipurpose Health Asst [ ]
c. Other village level staff [ ] (specify _____)

7.3 HOW MANY HOURS ARE SPENT PER WEEK ON THE FOLLOWING IMMUNIZATION ACTIVITIES FOR WOMEN AND CHILDREN FOR EACH PERSONNEL LISTED IN 7.1 AND 7.2?

	HEALTH WORKER	COMMUNITY WORKER	MPH ASST	TOTAL
a. Sterilization	[ ]	[ ]	[ ]	[ ]
b. Preparation	[ ]	[ ]	[ ]	[ ]
c. Record keeping	[ ]	[ ]	[ ]	[ ]
d. Injections	[ ]	[ ]	[ ]	[ ]
e. Travel to villages	[ ]	[ ]	[ ]	[ ]
f. Mobilization	[ ]	[ ]	[ ]	[ ]
g. Weekly meetings	[ ]	[ ]	[ ]	[ ]
i. Total (a-g)	[ ]	[ ]	[ ]	[ ]
j. Total from 7.1, 7.2	[ ]	[ ]	[ ]	[ ]
k. Difference (j-i)	[ ]	[ ]	[ ]	[ ]

8. HOW MANY DOSES OF VACCINE WERE ADMINISTERED TO CHILDREN LESS THAN ONE YEAR OF AGE AND WOMEN LAST MONTH?

CHECK IMMUNIZATION OR UNDER-1 REGISTER

BCG	[ ]	
OPV1	[ ]	
OPV2	[ ]	
OPV3	[ ]	
Total OPV	[ ]	** CALCULATED **
DPT1	[ ]	
DPT2	[ ]	
DPT3	[ ]	
Total DPT	[ ]	** CALCULATED **
Measles	[ ]	
TT1	[ ]	
TT2	[ ]	
Total TT	[ ]	

9. HOW MANY CHILDREN LESS THAN ONE YEAR WERE FULLY IMMUNIZED
LAST MONTH? [ ]
LAST THREE MONTHS? [ ]

END OF QUESTIONNAIRE

NAME OF PERSON REVIEWING QUESTIONNAIRE _____ DATE _____

NOTES: