Cost-Effective Strategies for Achieving Polio Eradication: Lessons from Turkey and Cambodia
The Global Initiative to Eradicate Polio

The World Health Assembly meeting in 1988 launched the global Polio Eradication Initiative and accelerated polio eradication activities in 1994/95. Since then, the global campaign has made substantial progress. According to WHO, the number of reported polio cases declined to the lowest levels ever, with 2,583 cases in 2000 (as of February 1, 2001) compared with 7,141 cases in 1999—even with and increase in performance against surveillance indicators. This suggests that the global goal of eradication is in sight. The Latin American and Western Pacific regions have been certified polio-free. Despite these accomplishments, pockets of wild poliovirus are still present in Asia and Africa.

To achieve global eradication, WHO, USAID, and other partners are advocating continued acceleration of polio eradication activities. However, current funding shortfalls make information on how to conduct more cost-effective polio eradication campaigns critical at this juncture.

The Partnerships for Health Reform (PHR) Project, funded by USAID’s Office of Health and Nutrition and Office of Child Survival, conducted two case studies on the cost-effectiveness of the mixed operational approaches used, Turkey and Cambodia. Cambodia’s program increased campaigns effectiveness through the use of mobile teams along the waterways. Turkey increased its effectiveness through increasing management support for polio eradication activities. These cases illustrate that cost considerations can be beneficial to the eradication effort and that cost savings can be realized without lowering effectiveness. (The full technical report is available from the PHR Resource Center.)

Planning Campaigns in Africa

The experiences in Turkey and Cambodia provide lessons learned during eradication activities that are useful for two purposes:

1. To assist countries currently conducting polio eradication activities to make more informed choices on the best mix of operational approaches for their campaigns
2. To compare mixes of approaches that can be used for other campaign activities

The results of the case studies are of most interest to countries that are still mid-way through their campaign to eradicate polio.

In Africa, Ministries of Health are trying to determine the best mix of operational approaches to eradicate polio. While most of these countries are conducting National Immunization Days (NIDs), many of them are struggling with questions about how to attain total coverage, such as:

- When to begin mop-up activities?
- Where should mop-up activities take place and on what scale?
- How much and what type of resources do mop-up activities require?
Ministries of Health in Africa can use information from countries that have already had to make these choices and found strategies that work best. In addition, the case studies demonstrate a need for a higher initial investment, made possible by supplementary donor funds, to effect the greatest cost savings. Higher effectiveness may cost more in some instances, but a greater investment return signifies overall cost savings for the eradication initiative.

When, Where, and How to Invest Resources to Eradicate Polio

Two Country Case Studies

The two case studies involved mass immunization campaign approaches that combined both fixed site immunization with targeted house-to-house immunization. The cost-effectiveness of these approaches is compared to non-targeted approaches with lower investment in surveillance as well as varying levels of investment in training, supervision and social mobilization.

Cambodia’s program increased campaign effectiveness through the use of mobile teams along the waterways. Turkey increased its effectiveness through increasing the management support for polio eradication activities. These cases illustrate that cost considerations can be beneficial to the eradication effort and cost savings can be realized without lowering effectiveness.

Many countries seek the best use of limited resources in order to eradicate polio; and the experiences in Cambodia and Turkey provide some direction. Their respective data shows:

▲ Targeted house-to-house immunizations with reasonable surveillance (non-polio acute flaccid paralysis rate >1) are more cost-effective than non-targeted house-to-house immunization with inadequate or no surveillance.
A campaign that combines two approaches is more cost-effective than conducting the two approaches separately.

House-to-house campaigns are more cost-effective when an intensified management approach is taken (i.e. the introduction of additional resources for supervision, social mobilization, and training) than house-to-house campaigns with less intensified management.

Methods to Determine the Costs of Polio Eradication

The majority of the costs associated with polio eradication activities are for the provision and evaluation of supplemental immunization activities. These include expenditures made for national immunization days, mop-up activities, and surveillance by ministries of health, WHO, UNICEF, donors, communities, and others.

To determine the costs of polio eradication approaches, three types of analysis can be conducted:

Cost Analysis. Cost analysis is a tool used to value the resources associated with service provision, such as supplemental polio immunizations (total costs) or the unit costs of delivering them (average cost). Total costs provide planners with data for budgeting purposes. Average costs allow comparisons among approaches. Yet a third measure is marginal costs, the additional cost of delivering one more immunization. This measure takes into account varying costs at different levels of output.

Cost-effectiveness Analysis. A second type of analytical tool is to compare the costs of different operational approaches of polio immunization with their effectiveness. The advantage to using this tool is that it allows the costs of an approach to be compared with its outcome. Using this type of analysis, an approach is considered more cost-effective than another if its cost per output or outcome measure is less.

On one hand, if two approaches to polio eradication are found to be equally effective, but differ in costs, program managers would be more likely to choose the one that is less costly. On the other hand, a more costly approach may still be cost-effective if its effectiveness is significantly higher. Measures of effectiveness for polio eradication campaigns range from process indicators such as a service provided or coverage levels to outcome indicators such as cases of polio averted.

As part of the analysis, the costs and measures of effectiveness of alternatives are compared through cost-effectiveness ratios. This ratio is calculated by dividing the cost of an alternative, expressed in monetary terms, by the effectiveness of that alternative, expressed in non-monetary terms. For example, this ratio can be used to estimate the cost per immunization of each polio case averted.

Marginal cost-effectiveness refers to the additional cost-effectiveness associated with one additional unit of outcome.

Cost-benefit Analysis. A third type of analysis relates the costs of providing a service to the monetary benefit that it provides. In cost-benefit analysis, the costs of activities related to a polio eradication campaign are compared to the cost savings that will occur after eradication when polio immunization is no longer necessary. The difficulty with this type of analysis is putting a monetary value on the benefit from an activity. For example, for polio eradication, assumptions about the size of the benefits of eradication need to be made. These include the amount of cost savings associated with the cessation of polio immunization and treatment of polio cases.

PHR used a cost-effectiveness analysis in the case studies, most appropriate since it allows comparisons to be made between different approaches for polio eradication and does not require monetary values to be placed on outcomes.

Cambodia’s program increased campaign effectiveness through the use of mobile teams along the waterways.

Turkey increased its effectiveness through increasing the management support for polio eradication activities.

These cases illustrate that cost considerations can be beneficial to the eradication effort and cost savings can be realized without lowering effectiveness.
Cost-Effectiveness of Mixed Approaches to Polio Eradication

A cost-effectiveness analysis of an eradication campaign differs from other analyses of health services because, by its very nature, full efforts must be made to immunize every child or the benefits of the campaign will not be realized. The costs of reaching hard-to-reach groups, such as children of transient populations, or those living in remote areas or in high-security risk areas of conflict, are higher than costs to reach the general population. Additional costs to fully immunize target populations are necessary in the short-term to ensure the long-term benefits of stopping immunization with the particular antigen. Countries that invest to eradicate polio now earn higher returns in the future.

There are choices to make between different approaches to reach the goal of polio eradication. The case studies in Turkey and Cambodia examine the cost effectiveness of the different options.

Measures of Cost-Effectiveness

Three measures of cost-effectiveness are used in the country case studies:

1. Cost per administered dose
2. Cost per case of polio-related acute flaccid paralysis averted
3. Cost per partially non-susceptible

The cost per administered dose is a process indicator rather than an outcome measure and is obtained by dividing the cost of the polio eradication activity by the total number of administered doses.

The other two measures are outcome measures of cost-effectiveness. The cost per case of paralysis averted relates the cost of an activity to its health benefit—preventing cases of polio-related paralysis.

The second outcome measure, cost per partially non-susceptible, is added due to the unique nature of polio eradication activities. Since the goal of the activity is to lower transmission of poliomyelitis, the conversion of susceptible children (under five years with two or less doses of OPV) to at least partially non-susceptible ones (under five with four or more doses of OPV) is an outcome of the activity. For that reason, the cost of the conversion to non-susceptible is calculated as a measure of cost-effectiveness.

The following summaries of the case studies illustrate the context and conditions for the application of these approaches and how they proved to be more cost-effective.

Cambodia Polio Eradication

Cambodia is a small country in Southeast Asia, bordered by Thailand to the west, by the Lao People’s Democratic Republic to the north, by the Socialist Republic of Vietnam to the east and by the Gulf of Thailand to the south. Its population was estimated to be 10.7 million in 1996, with approximately 1 million people living in the capital city, Phnom Penh. Its infant mortality rate in 1996 was reported at 115 per 1,000 live births and the under 5 mortality rate was 165 per 1,000 live births. The maternal mortality ratio in 1996 was 650 per 100,000 live births and the total fertility rate was 3.7. The coverage rates for OPV3 and DPT3 are 64%.
The country conducted its first National Immunization Days (NID) in February/March 1995 and continued to conduct NIDs through 1997. During NIDs, campaigns were conducted primarily through fixed sites around the country. Exhibit 1 shows the percent of children under five that were immunized during the 1997 NIDs.

The MOH changed its approach in 1997 after surveillance data identified the remaining cases of wild polio virus among the waterways of Cambodia. In May/June 1997, the country started an intensive, targeted house-to-house and boat-to-boat approach called *high-risk response immunization* (HRRI) in areas that were identified as high-risk (60% of the country).

The following selection criteria were used to identify the high-risk areas for HRRI:

- Districts with clinically confirmed cases of polio in 1996 and 1997
- Districts where wild poliovirus was found in 1996 and 1997
- All districts of newly liberated areas

Exhibit 1: **Coverage during Polio Eradication Activities, 1997-1998**

![Coverage during Polio Eradication Activities, 1997-1998](chart.png)


*Note:* Zero-dose refers to the proportion of children for whom no vaccination dose was recorded previously.
Each round of HRRIs took place over a time period of twelve days rather than one day as in the case of NIDs and had intensified supervision. The percentage of children under five immunized during the May/June HRRI rounds was higher than that of the NIDs reported; coverages were 97.7% and 100%, respectively.

Two additional rounds of campaign activities took place in November to December 1997 and February to March 1998, financed largely by WHO, Japan, Australia, and Rotary International. The November/December NID/HRRI differed from other NIDs because it combined approaches that had been used in both NIDs and HRRIs. In low-risk areas, children under five were vaccinated on a single day at fixed posts as during previous NIDs, while in high-risk areas, mobile teams were used to vaccinate populations along the waterways.

The February/March 1998 HRRI was conducted in target areas with intensive supervision and extensive use of mobile teams as in the case of the May/June HRRI in 1997. The coverage during the two rounds was 96.9% and 97.7% respectively.

Cambodia’s surveillance of AFP has steadily improved since its introduction in 1992. In 1996, Cambodia brought its laboratory component of its surveillance system up to WHO standards.

Cost-Effectiveness Results: Combining Approaches and Improving Surveillance Produce Savings

To assess the cost-effectiveness of having a good surveillance system, the cost-effectiveness of conducting the February/March HRRI (covering 60% of the population) with good surveillance is compared with the simulated costs of conducting a nationwide HRRI with poor surveillance. The latter approach would likely have taken place if surveillance of non-polio AFP had been poor since the source of the last few remaining cases of polio in Cambodia could not be identified. The analysis indicates that a nationwide HRRI would cost approximately $600,000 more than a targeted HRRI with good surveillance. Costs per dose administered and per case averted were also higher.

The cost-effectiveness of combining campaign approaches, as in the 1997 November/December NID/HRRI, is compared with the cost-effectiveness of two separate campaign activities, as in the February/March 1997 NID and May/June 1997 HRRI. Combining activities saves costs by sharing resources and allowing economies of scale to develop. In fact, the analysis shows that the cost of the combined activity was $600,000 less than the combined costs of the two separate campaigns. Exhibit 2 summarizes these results.

Exhibit 2: Alternative Approaches in Cambodia

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Alternative 2</th>
<th>Most Cost-effective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment in Surveillance</strong></td>
<td>Targeted HRRI with high investment in surveillance Coverage = 97%</td>
<td>Simulated nationwide HRRI with limited investment in surveillance Assumed coverage = 96%</td>
</tr>
<tr>
<td><strong>Combining Approaches</strong></td>
<td>Separate NID and HRRI</td>
<td>Combined NID/HRRI campaign Coverage = 95%</td>
</tr>
<tr>
<td></td>
<td>Campaigns</td>
<td>NID Coverage = 89% HRRI Coverage = 99%</td>
</tr>
</tbody>
</table>

Cost-Effective Strategies for Achieving Polio Eradication: Lessons from Turkey and Cambodia
Turkey Polio Eradication Campaign

Turkey is located in southwestern Asia. In 1998, the total population was estimated at 63.4 million with a population growth rate of 1.5%. The country’s infant mortality rate was 42.7 per 1,000 live births and the total fertility rate in the country was 2.6. While the coverage for OPV3 was approximately 70% for the country, there was considerable variation between regions. For instance, in the Eastern Region, only 47% of children aged 12-23 months had received OPV3.

Each year in April and May since 1995, Turkey conducts two rounds of NIDs, simultaneously with bordering countries, Iran, Iraq, and Syria, as part of the Operation MECACAR (Mediterranean, Caucasus, Central Asian Republics). In 1998, the MOH changed its approach towards NIDs. After determining that many women were not coming out of their homes to immunize their children, particularly women living in rural settlements known as mesras, the MOH decided to use door-to-door immunization in most rural areas. In 1998, 60% of children under five were vaccinated at home using the door-to-door strategy. The NIDs differed from mop-up activities since they were characterized by low central level involvement during this campaign and mostly provincial-level planning and supervision.

The April/May 1999 NIDs differed from those in 1998 since more strategic planning and supervision took place and more resources were provided by the MOH. The central government also increased its support for social mobilization, including the use of mass media. For example, the funding for advertising doubled in the province of Sanliurfa. In addition, the number of personnel receiving training increased by 50% and 150% in Sanliurfa and Mardin, respectively. A final difference was a heavier reliance on the door-to-door strategy during the 1999 NIDs. In each round, mobile immunization teams delivered 85% of vaccinations via household visits, as shown in Exhibit 3.

Mop-up campaigns began in 1998, targeting high-risk and low-coverage areas primarily in the southern and eastern parts of the country. Provinces were selected for inclusion in mop-ups based on the following criteria:
- Less than 80% routine immunization coverage
- Poor AFP surveillance
- Detection of wild polio virus or high risk of poliovirus transmission from neighboring countries

The 1998 October/November mop-up campaign targeted 11 provinces in the southern and eastern parts of the country. Extensive training was carried out to prepare this mop-up campaign. Due to enhanced planning and central level involvement, the overall quality of the mop-up immunization activities improved in 1998.

Mop-up campaigns continued in 1999, particularly given the confirmed transmission of wild poliovirus in Iraq. The campaign in October/November 1999 targeted 22 high-risk provinces primarily in the southern and eastern parts of the country. This campaign focused on 29% of the total target population, roughly 1.9 million children in the country.

Provinces were selected according to the following criteria:
- Provinces with polio cases in 1997 and 1998
- Provinces having borders with areas with polio cases
- Provinces with low routine OPV3 coverage.

This campaign had high central level involvement and additional resources for operational costs. Coverage rates during the first and second rounds were 83 and 87% respectively.
AFP surveillance in Turkey has improved steadily since start-up in 1989. In 1997, the WHO viral classification scheme for AFP cases was introduced, and only AFP cases with wild poliovirus isolations were confirmed as polio. The national non-AFP rate was close to the targeted 1 per 100,000 in 1998 and the country exceeded the rate in 1999. However, some variation persists across areas in the Marmara, Black Sea and Aegean regions. AFP surveillance is strong in the areas of highest risk in the southern and eastern parts of the country.

**Cost-Effectiveness Results: Investments in Management Can Have a Positive Impact**

The study evaluated the cost-effectiveness of different approaches to house-to-house campaigns in the Southeastern Region, the only region of the country with recent cases of polio. This analysis addressed the question: Were house-to-house campaigns more cost-effective with more intensified management, in terms of additional resources for supervision, social mobilization, and training?

Two sets of comparisons were made between house-to-house campaign approaches. First, the cost-effectiveness of NID activities in 1998 was compared with the mop-up activities of 1999.

The reason for this comparison is that the NID activities were conducted through house-to-house immunization in rural areas due to the difficulty of bringing child caretakers out of the household and so were similar to mop-up activities. However, the NIDs involved less microplanning, supervision and training than the mop-ups. The comparison is therefore between two approaches to house-to-house immunization: the former with less supervision, training and funding for operational costs (per diems and transport), and the latter with more supervision, supplies and training. The analysis shows that while the mop-up activity had higher costs, the cost per case averted was lower by $24 and by $0.18 for conversion to non-susceptible status compared to the less resource-intensive NID.

The second comparison focuses on the NID activities in 1998 and 1999 since the MOH changed the NID approach in 1999. The main difference between these two activities is that the MOH invested more
in supervision and training in the 1999 NIDs. The results indicate that the 1999 NIDs were more cost-effective.

Lessons Learned

The case studies compare alternatives that differ in the means of allocating resources. In the case of Cambodia, the cost-effectiveness of polio eradication activities having adequate surveillance was compared to non-targeted activities without substantial investments in surveillance. A second comparison determines whether conducting two separate activities, a NID and a HRRI, was more or less cost-effective than conducting a combined activity.

The results indicate that NIDs and HRRIs are more cost-effective when an adequate surveillance system is in place and cost savings are realized since a non-targeted approach costs more than the targeted approach. Having reasonable surveillance allows countries to target where they conduct house-to-house activities. Countries that make strong efforts to improve their AFP surveillance will realize cost savings without lowering the effectiveness of their activities.

A second approach that was tried in Cambodia in November/December 1997 was to combine the two approaches of NIDs and house-to-house immunization into one activity. Using this approach realized cost savings for the combined activity since resources, such as some personnel, transportation, procurement, and publicity, were shared by the two activities. The cost per dose administered was about $1.00 for the two separate activities and only about $0.70 for the combined activities. In addition, the cost per case of paralytic polio was about 30% higher when the two activities were conducted separately. Though the combined approach requires additional planning and training, countries should consider a combined approach when they have limited resources for campaigns but are still trying to target the harder-to-reach groups.

Wise use of existing resources and additional investments required to achieve eradication in the short term have high long-term returns for governments and donors in terms of money and public health.

Exhibit 4: Alternative Approaches to Polio Eradication in Turkey

<table>
<thead>
<tr>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Most Cost-effective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment in Training, Supervision and Social Mobilization for house-to-house NIDs and Mop-ups</strong></td>
<td><strong>Investment in Training, Supervision and Social Mobilization for NIDs</strong></td>
<td></td>
</tr>
<tr>
<td>NID in 22 Provinces (mop-up provinces) with limited investment in management support</td>
<td>Countrywide NID with limited investment in management support</td>
<td>Alternative 2</td>
</tr>
<tr>
<td>Mop-ups in 22 provinces with more intensive investment in management support</td>
<td>Countrywide NID with more intensive investment in management support</td>
<td>Alternative 2</td>
</tr>
</tbody>
</table>

In the case of Turkey, the results indicated that well-managed house-to-house immunization activities in 1999, while being costlier, are on average more cost-effective than those with limited management support, as in the case of the NIDs in 1998. The mop-ups are more cost-effective because they increase the coverage of children with their intensified approach. Another benefit was the higher health
worker motivation in the provinces due to greater training and supervision and, consequently, greater recognition for the importance of their efforts. Greater investments in management support yield sufficient benefits to offset the increased activity costs. Similarly, the 1999 NIDs with greater management support were more cost-effective than the 1998 NIDs. Even without high central level involvement, as in the case of the mop-up campaigns, additional funding for management support increased the cost-effectiveness of the campaign.

**Policy Implications**

The two case studies indicate that it is possible to realize cost savings and improve cost-effectiveness of a polio eradication campaign without lowering effectiveness. Expending more now to achieve higher effectiveness yields savings later.

The Cambodia case study demonstrates:

- Investment in AFP surveillance is a priority since targeted mop-up campaigns are conducted effectively with this information, leading to cost savings.
- Combining activities such as NIDs and house-to-house campaigns serves countries that require house-to-house campaigns and want to lower costs, assuming sufficient planning and management capacity exists.

The Turkey case study demonstrates:

- The benefits of a well-supervised house-to-house campaign with increased training and social mobilization costs justify the additional expense.
- To reach more of the target population in areas with low coverage requires additional management support resources from the central level MOH.
- Central level involvement in supervision and training increases the motivation of campaign health workers around the country.

Targeting hard-to-reach populations often involves increasing marginal costs since they must be reached through expensive mobile campaigns, much like the one conducted in Cambodia. Nevertheless, there are ways to realize cost savings by targeting mop-up campaigns with appropriate investments in AFP surveillance and by combining activities rather than conducting them separately. Wise use of existing resources and additional investments required to achieve eradication in the short term have high long-term returns for governments and donors in terms of money and public health.

**Selected Background Reading References**


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