The Thai expanded programme on immunization: role of immunization sessions and their cost-effectiveness

K. Phonboon,¹ D.S. Shepard,² S. Ramaboot,³ P. Kunason,⁴ & S. Preuksaraj⁵

A cost-effectiveness study of the Thai expanded programme on immunization was carried out in district hospitals and health centres in Thailand during early 1987. The total annual spending on immunization was US$ 3852 in hospitals and US$ 813 in health centres. The percentage distribution of annual costs was similar in both facilities. Salaries were the largest component, followed by building and vaccine costs. The frequency of immunization sessions was the most important factor in determining total costs—immunization costs increasing with the frequency of sessions. In hospitals the average number of fully immunized children was 184, compared with 49 in health centres. The cost per fully immunized child varied widely from US$ 5.30 to US$ 33.20, and the most cost-effective facilities were those that immunized the greatest number of children. With the present number of health facilities in all areas of the country, which correspond to saturation levels, the most likely way for the Thai programme to reduce costs would be to make better use of staff time by decreasing the frequency of the services offered, thereby increasing the efficiency of each session. Hospitals should adjust the frequency of their immunization sessions according to the number of children being served, but health centres should offer sessions only monthly or once every two months.

In recent years, cost-effectiveness analysis has become a standard approach used by immunization programmes in most developing countries (1-6). The ultimate purpose of such analysis is to improve the use of scarce health resources, especially in times of economic constraint (7-10). Here, we report the results obtained when this method was used to examine Thailand’s expanded programme on immunization (EPI) and present more cost-effective alternatives for the programme’s strategy in the future.

Materials and methods

Data were collected in Thailand in January—February 1987. Four provinces were selected to examine the costs of the immunization service in the fiscal year 1986. Chosen were a northern province (A) and a central province (B), both of which had high immunization coverage, and two other provinces (C and D) in the north-eastern and southern regions of the country, respectively, that both had moderate immunization coverage. The data obtained were used to calculate the cost per fully immunized child and the cost per fully immunized pregnant woman. The costs obtained were compared among hospitals and health centres that had different activities and served different populations.

For each province, two districts were selected, and a district hospital and two health centres in each were visited. Previously described procedures were used to determine costs. The frequency of immunization sessions and vaccination data, including the number of children aged less than 1 year in the area served, were recorded.

Salaries and transportation costs were allocated according to the time spent directly or administratively on immunization. For capital costs, 1986 replacement costs and a 10% interest rate for all

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capital items were used. The expected useful lives were 30 years for buildings, 10 years for furniture, vehicles, or refrigerators, and 4 years for other cold chain items. Higher level costs were collected from district health offices and provincial health offices in the four study provinces and the regional and national EPI units in the Department of Communicable Disease Control in the Ministry of Public Health. Allocations of costs are based on size of the population and number of health facilities.

At present, the Thailand immunization service is fully integrated into basic health services. While vaccine procurements, technical support, and evaluation are organized at the national level, responsibility for operating the programme is decentralized into 73 provincial health offices. The service is available at well-baby clinics in all hospitals and health centres and is supplemented by outreach activity in some areas according to local needs. The following antigens are used to immunize infants: BCG vaccine at birth, three doses of diphtheria-pertussis-tetanus vaccine (DPT) and oral polio vaccine (OPV), one each at 2, 4, and 6 months of age, and measles vaccine (MV) at 9 months; pregnant women are immunized with two doses of tetanus toxoid (TT). Since MV has only recently been introduced in Thailand, a child was considered to be fully immunized on completion of the third dose of DPT and OPV. The analyses were mainly carried out on immunization data for children aged under 1 year, although the data on immunization of pregnant women were also included where appropriate.

### Results

A total of eight district hospitals and 14 health centres were visited in the four study provinces. The population, area, and immunization coverage in each province are shown in Table 1. Facilities in province A served a wider area with a more scattered population, while the catchment areas in provinces B and D were much smaller and more densely populated. Immunization coverage for BCG, DPT3, and OPV3 was high in provinces A and B, but that for TT2 and MV was only moderate in provinces A, B and C, and very low in province D.

Hospitals that were responsible for providing immunization in the subdistrict in which they were located had a separate unit for EPI and other health promotion activities. The number of staff that were involved in the EPI service in these units was four to five, while the corresponding number in health centres was two to three.

#### Table 1: Population, area, and immunization coverage in the four study provinces, Thailand, 1985

<table>
<thead>
<tr>
<th>Province</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>410,484</td>
<td>637,845</td>
<td>1,501,814</td>
<td>474,277</td>
</tr>
<tr>
<td>Average population per health facility</td>
<td>3429</td>
<td>2307</td>
<td>7475</td>
<td>3854</td>
</tr>
<tr>
<td>Average area served by health facility (km²)</td>
<td>137</td>
<td>12</td>
<td>72</td>
<td>21</td>
</tr>
<tr>
<td>Population served by health facility (per km²)</td>
<td>25</td>
<td>192</td>
<td>104</td>
<td>164</td>
</tr>
<tr>
<td>Immunization coverage (%)</td>
<td>BCG</td>
<td>99</td>
<td>98</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>DPT</td>
<td>95</td>
<td>96</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>OPV</td>
<td>94</td>
<td>94</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>MV</td>
<td>59</td>
<td>43</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>TT</td>
<td>70</td>
<td>65</td>
<td>55</td>
</tr>
</tbody>
</table>

* Adjusted percentage of coverage based on survey results

DPT = diphtheria-pertussis-tetanus, OPV = oral polio vaccine, MV = measles vaccine, and TT = tetanus toxoid

#### Costs

The total costs of immunization activities for both children and pregnant women are shown in Table 2. Although hospitals spent nearly five times more than health centres on immunization, the percentage distribution of costs in both was similar. Salaries were the largest component, followed by building and vaccine costs. The combined operating costs, consisting of salaries, vaccines, transportation and maintenance, amounted to 73% and 78% of the total in

#### Table 2: Percentage distribution of costs, level where incurred, and the mean total costs of immunization for both children and pregnant women in the health facilities studied, Thailand, 1985

<table>
<thead>
<tr>
<th>Distribution of costs (%)</th>
<th>Hospitals</th>
<th>Health centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>59.6</td>
<td>50.7</td>
</tr>
<tr>
<td>Vaccine</td>
<td>7.2</td>
<td>9.4</td>
</tr>
<tr>
<td>Transportation</td>
<td>1.9</td>
<td>3.3</td>
</tr>
<tr>
<td>Maintenance</td>
<td>4.4</td>
<td>4.9</td>
</tr>
<tr>
<td>Buildings</td>
<td>28.3</td>
<td>17.2</td>
</tr>
<tr>
<td>Vehicles</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Cold chain</td>
<td>1.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Sterilization</td>
<td>0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Level</td>
<td>91.3</td>
<td>83.1</td>
</tr>
<tr>
<td>Local</td>
<td>6.6</td>
<td>15.8</td>
</tr>
<tr>
<td>Provincial</td>
<td>6.6</td>
<td>15.8</td>
</tr>
<tr>
<td>National or regional</td>
<td>2.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

| Mean total cost per facility (US$)* | 3852 | 813 |

* Rounded to nearest US$.
Thai expanded programme on Immunization

Fig 1. Total costs and frequency of immunization sessions per month in study hospitals and health centres, Thailand, 1986 (figures in parentheses indicate the number of hospitals or health centres).

For hospitals the average costs per fully immunized child varied from US$ 11.90 to US$ 15.80, except for the US$ 23.80 in the one hospital that offered sessions once every two months (Fig. 2b). The higher average cost associated with the latter hospital arose because it was located in a remote out-of-town area, and despite having the lowest total costs, only 45 children were immunized there. The average costs in health centres ranged from US$ 5.30 to US$ 33.20, with the lowest costs occurring in centres that offered monthly sessions and which immunized the greatest number of children. High average costs were observed in one health centre that offered sessions once every two months and which immunized too few children and in a twice-monthly centre and also in weekly centres with low outputs that spent more on immunization. Sessions at a frequency of once every two months had the lowest costs, but their output of immunized children was also lower, and this resulted in only moderate average costs.

At any particular immunization frequency, hospitals exhibited coverages of over 100% relative to the number of under 1-year-old children in their responsible area (Fig. 2c). No health centres recorded coverage rates of greater than 100% and those with less frequent sessions had the greatest coverage. Most health centres had 100% or nearly 100% coverage, i.e., the number of children born in their catchment areas was the same as the number of fully immunized children shown in Fig. 2a. One centre was responsible for only 13 children, while some

* For hospitals, the number of children immunized exceeded the number of children aged <1 year in their catchment area because some parents from outside the area brought their children to be immunized in hospitals rather than in local health centres.
Fig. 2. Frequency of immunization sessions per month and (a) number of fully immunized children, (b) average cost per fully immunized child, and (c) % coverage in hospitals and health centres. FIC = fully Immunized children.
centres had a responsibility for nearly 100 children. This large inequality in the distribution of the infant population among health centres arose because of the differences in population per facility (Table 1).

**Fixed versus outreach services**

Vaccine was delivered mainly in fixed clinics, the majority of which also carried out supplementary outreach activities. For hospitals, outreach activities contributed only 5.6% and 3.7% to the total number of fully immunized children and pregnant women, respectively, while in health centres such activities contributed, respectively, 22.4% and 15.5%. For fixed and outreach services the total and average costs per fully immunized child are shown in Table 3. Outreach services had slightly higher average costs for both hospitals and health centres.

The overall average cost per fully immunized child was US$ 13.80 in hospitals and US$ 11.80 in health centres, while that per fully immunized pregnant woman was US$ 8.90 and US$ 10.30, respectively.

**Discussion**

The percentage distribution of immunization costs reported is similar to that found previously in Thailand and elsewhere. Salaries and capital costs, especially costs associated with buildings, were the major components, while vaccine costs represented only a small proportion of the total (f–4). However, in these earlier studies immunization services were mixed and involved either a single course or two or full courses of antigens, and for the previous study in Thailand* these were largely BCG and DPT, while OPV was only administered in hospitals. These findings suggest that expansion of the service or use of more or new vaccines, involving low or modest increases in expenses, might change the distribution of costs and the total cost only slightly. Also, the results indicate that, in the long run, salaries and major capital costs, particularly at the local level, are crucial in reducing the cost of immunization per person.

With a greater number of staff and higher building costs, hospitals had higher immunization expenses than health centres. Although other factors such as the number of staff involved or the diverse salaries of staff in hospitals and health centres, can affect immunization costs, the most important reason for the variation in total costs between these two facilities was the frequency of the immunization sessions. Because salary is the major component of both operating and total costs, an increase in operations or in the frequency of sessions leads to more time being spent by staff on immunization activities and results in increased costs in both hospitals and health centres.

Adjustment of the frequency of immunization sessions in hospitals to match the greater immunization or service load seems to justify the higher costs that this involves. The monthly or twice-a-month sessions in the majority of health centres, where the costs were low to modest, are also appropriate for the number of children immunized there. The more frequent sessions in some health centres were, however, not justified and led to unnecessarily high costs.

The relationship between session frequency and coverage is unclear. Hospitals, all of which had coverages greater than 100%, had more frequent sessions, probably because of high case loads. However, for health centres, which served a smaller number of children, frequent sessions did not increase coverage, and it would be better if such centres concentrated their efforts on improving delivery methods by combining outreach and fixed services in each session. In this regard, sessions should be held monthly or once every two months.

Outputs from hospitals were higher than those from health centres and resulted in very high coverages compared with the number of children in their own area. This presumably arose because the community preferred to be immunized in hospitals. Since in Thailand the Ministry of Public Health is currently encouraging the use of health services at the

* See p. 183.

* See footnote a, p. 181.
health-centre level, in future there may be an increase in the number of users of local health services, and this will greatly alter the efficiency of immunization programmes in such facilities. Nevertheless, the very high immunization coverage that we have reported here indicates that the demand for preventive services is considerable in all regions of the country and suggests that lower coverage arises because of ineffective response by the health services, rather than from a lack of interest from communities.

The output of outreach immunization activities confirms that they fulfil only a supplementary role and that fixed services are currently predominant. The target group for outreach services are generally children who live in inaccessible areas or social drop-outs who need special follow-up. Such sessions may immunize fewer children and therefore result in higher than average costs. The catchment areas of district hospitals are in and around towns and here the proportion immunized in outreach sessions was lower. The average costs of outreach activities that serve more inaccessible groups are only slightly greater than those of clinical services, thus confirming the cost-effectiveness of this service in the Thai EPI programme. Outreach services should therefore be promoted as a supplement to routine sessions in clinics in all areas where the population is dispersed, transportation is inconvenient, or social drop-outs occur.

As has been observed in previous investigations (1, 4), in all four study provinces the average cost per fully immunized child decreased as the number of immunizations increased. Lower total costs per se were not important, however, unless they were accompanied by high immunization levels, i.e., their cost-effectiveness was better. Hospitals with weekly and health centres with monthly immunization sessions were the most cost-effective at US$ 11.90 and US$ 5.30 per fully immunized child, respectively. The higher costs in hospitals were balanced by a greater output and this resulted in average costs that were still favourable. The uneconomical programmes in some hospitals and health centres that had higher costs per child immunized arose because their output was low with the expenses spread over fewer children.

The cost per fully immunized child is not only important for analysis of cost-effectiveness but also significant when there is concern for cost recovery of the immunization programme. Because preventive health services are currently being promoted in Thailand, immunization is provided free of charge. Ferranti suggests that since society as a whole benefits from the effects of an immunization programme, fees for this preventive service should be zero or even negative—for which some incentives may be offered (11). The costs per fully immunized child in the present study (US$ 13.80 in hospitals and US$ 11.80 in health centres) was comparable to that found previously for similar numbers of antigens (US$ 9.50 in Cameroon; US$ 14.00 in the Gambia; and US$ 16.60 in Kenya) (3, 4). The cost per fully immunized mother and child (obtained by combining the average cost per fully immunized child and fully immunized pregnant woman) was approximately US$ 22.00.

At present, the health infrastructure in Thailand attains almost complete coverage of the rural and urban populations, with a health centre in each subdistrict and 10-60-bed hospitals in all densely populated districts. Although from a purely economic point of view, distribution of these “standard” facilities, especially health centres, in every community, regardless of size, inevitably contributes to the variations and inequities of service and cost-effectiveness reported in this study, from an administrative or community standpoint it is probably justified. A conflict between efficiency and equity arises here; however, when the population in subdistricts is relatively large this distribution is probably acceptable. The existence of local facilities extends the curative and preventive services and also reduces the travel and opportunity costs for rural users.

Robertson et al. recently described many options for making cost savings in immunization programmes (4). For Thailand, it appears that immunization sessions and outputs, i.e., the number of children and pregnant women immunized, are two important determinants of the immunization performance. Currently the Thai programme can be provided more economically through either reducing expenses, by decreasing the frequency of sessions, or increasing the number of children or pregnant women immunized as much as possible. Of these alternatives, the former can be controlled by the health facilities themselves, while the latter is difficult to accomplish because, as discussed above, the number of health facilities has already reached saturation level in all areas of the country.

The policy of making better use of staff time by decreasing the frequency of immunization sessions to make each session more efficient may need more planning efforts. In this connection, community concerns, such as acceptability and willingness for individuals to attend sessions, need to be taken into account. The number of children immunized is usually limited by the size of the population in the

\* See footnote a, p 181.
area served by each facility. Currently, the size of the population is less critical for immunizations performed in hospitals, most of which attract users from both within and outside their area, while health centres are limited by the fixed population in their immediate area. Immunization sessions in hospitals should be organized according to the service load, using more frequent sessions as the number of children increases; however, in health centres session frequencies should be monthly or once every two months.

In the long term, additional factors such as possible shift of users to local-level care, as discussed above, and a declining birth rate need to be taken into consideration. The target population per facility will then be smaller and less variable. Health facilities in Thailand need to adjust and redeploy their resources according to this changing situation, by either reducing the frequency of immunization sessions or transferring existing staff to other activities or both.

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Résumé

Le programme élargi de vaccination en Thaïlande : rôle et rapport coût/efficacité des campagnes de vaccination

Une étude visant à établir le rapport coût/efficacité du programme élargi de vaccination en Thaïlande a été menée au début de 1987 dans les hôpitaux de district et les centres de santé de quatre provinces du pays. Le total annuel des dépenses consacrées à la vaccination des nourrissons et des femmes enceintes a été de US$ 3852 dans les hôpitaux et de US$ 813 dans les centres de santé. Dans les deux cas, la répartition des coûts annuels a été analogue : les salaires ont constitué le poste le plus important (59,6% dans les hôpitaux et 60,7% dans les centres de santé), suivi des postes bâtiments (26,3% et 17,2% respectivement) et coût des vaccins (7,2% et 9,4% respectivement). Le coût total a été surtout fonction de la fréquence des campagnes de vaccination. des campagnes moins fréquentes se sont traduites par un coût beaucoup plus bas, tandis que des campagnes plus fréquentes ont entraîné des coûts plus élevés. Les hôpitaux et la majorité des centres de santé ont établi la fréquence des campagnes en fonction de la charge de travail ou du nombre d’enfants complètement vaccinés. Toutefois, certains centres de santé ont organisé des campagnes plus nombreuses mais ont vacciné moins d’enfants.

Le nombre moyen d’enfants complètement vaccinés a été de 184 par centre de vaccination pour les hôpitaux, contre 49 pour les centres de santé. Dans l’ensemble, le coût par enfant complètement vacciné s’est échelonné entre US$ 5,30 et US$ 33,20. Les centres où le rapport coût/efficacité a été le plus favorable sont ceux qui ont vacciné le plus grand nombre d’enfants. La vaccination a eu lieu principalement dans des dispensaires fixes, bien que la majorité d’entre eux aient également établi des antennes mobiles. Les antennes mobiles ont assuré 5,6% des vaccinations en ce qui concerne les hôpitaux et 22,4% pour ce qui est des centres de santé. En Thaïlande, les principaux déterminants du service de vaccination sont la fréquence des campagnes et le nombre d’enfants ou de femmes enceintes vaccinés. Compté tenu de la saturation des services de santé que l’on constate actuellement dans toutes les régions du pays, on pourrait probablement réaliser des économies en utilisant plus judicieusement le personnel, c’est-à-dire en diminuant la fréquence des campagnes de façon à rendre chacune de celles-ci plus efficace. Les hôpitaux pourraient décider de la fréquence des campagnes qu’ils organisent en fonction du nombre d’enfants vaccinés, par contre, les centres de santé devraient se limiter à une campagne tous les mois ou tous les deux mois.

References


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