

Cost of providing the expanded programme on immunization: findings from a facility-based study in Viet Nam, 2005

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Objective To estimate and analyse the costs for providing the expanded programme on immunization (EPI) in a rural community in the north of Viet Nam in 2005.

Methods An ingredient approach was used to collect cost data from the perspective of the service providers.

Findings The total annual cost of EPI in Bavi district was US\$ 58 460 [purchasing power parity (PPP) 282 076]. Vaccines and supplies were the largest cost category (33%), followed by personnel costs (30.2%). The largest share of the total cost was due to activities at commune level (38%). The average cost per fully vaccinated child (FVC) was US\$ 4.81 (PPP 23.21), much lower than the figure of US\$ 15 that is generally accepted as the cost-effective threshold for EPI in developing countries.

Conclusion This empirical study indicates that EPI has been implemented efficiently in rural Viet Nam, but that opportunities exist to make it even more efficient.

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Une traduction en français de ce résumé figure à la fin de l'article. Al final del artículo se facilita una traducción al español. الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

Introduction

The expanded programme on immunization (EPI) is universally regarded as a high-priority intervention in developing countries because of its great effectiveness and efficiency.^{1–4} EPI was first introduced in Viet Nam in 1981 with the cooperation of WHO and the United Nations Children's Fund (UNICEF), and became one of the six national targeted health programmes in Viet Nam in 1986. The programme originally covered immunization for children less than one year of age against six preventable diseases (diphtheria, tetanus, pertussis, poliomyelitis, measles and tuberculosis). In 1997, the immunization programme in selected high-risk areas was expanded to cover hepatitis B, Japanese encephalitis, cholera and typhoid.⁵

The EPI in Viet Nam has seen tremendous growth in coverage and has achieved in excess of 90% full immunization for children less than one year of age.⁵ As a result, the prevalence and case fatality rates of vaccine-preventable

diseases have dramatically declined. Diphtheria and tetanus have been eradicated and measles has been considerably reduced.⁶ The incidence of communicable diseases has also fallen, reflected in their decreased share of total morbidity and mortality, from 55.5% and 53.0% in 1976, to 27.4% and 17.4% in 2003, respectively.^{7,8}

In Viet Nam, there have been a few reports on the cost of EPI at national level based on non-empirical data,⁹ but a detailed analysis of EPI cost at local level is lacking. Such information is needed for health planning and health decision-making, as well as for making agreements with development partners. Better estimates of the real cost of providing EPI would help health planners and managers improve their budgeting and planning processes. This information is especially relevant to local health authorities in today's context of decentralization of the health sector; they are now required to do more financial planning for their programmes.¹⁰

The aim of this paper is to provide information on estimates and analyses of the cost of providing EPI in a rural community in the north of Viet Nam in 2005 and to consider the implications for the programme's efficiency. The goal of this work is to contribute to the process of evidenced-based planning and management in Viet Nam and elsewhere.

Methods

Study design and setting

This is a facility-based costing study. The study setting was Bavi district, Hatay province, a rural community located 60 km west of Hanoi in northern Viet Nam. The district has a population of approximately 238 000 spread over 410 km², including lowland, highland and mountainous areas. Bavi district was selected as a location typical of northern Viet Nam in terms of geography, and socioeconomic and health status.¹¹

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Scope of the study

We attempted to estimate the costs of providing EPI from the perspective of the service providers. Our estimates reflect costs spent at the local health facilities involved in delivering EPI in Bavi district. Both national and local levels provided cost data. We were not able to capture some costs spent at central level, such as the cost of making policies; of the planning, management and evaluation of the programme; or of additional operating costs such as storage, training, and information, education and communication activities.

Costing approach

Cost data were collected using an ingredient approach, listing all types of inputs by activity and the quantities and prices for each input.¹² The cost data include a comprehensive list of capital and recurrent expenditure items (Table 1). The costs of land used for buildings, long-term staff trainings, and community contributions (volunteers, irregular support) were not included.

The financial costs of providing EPI were estimated from the data collected in this study. Financial costs included the actual expenditures for all inputs, as well as resources used to deliver the service. However, many items used to provide immunization services were donated or subsidized (vaccines, supplies, etc.). In this case, even though the actual expenditure was zero, the central prices of those items were obtained and included in the cost estimates.

Data collections

Data collection was conducted from October to December 2006 in the Hatay Provincial Preventive Medicine Centre, Bavi District Health Centre and 10 commune health centres (CHCs) of Bavi district. Owing to budget and time constraints, we only surveyed 30% of the CHCs in Bavi district – these were randomly selected from the list of all CHCs in each geographical area: lowland (4 of 11 CHCs), highland (4 of 14 CHCs) and mountainous (2 of 7 CHCs) areas.

A data collection team, consisting of six graduates with bachelor degrees in public health and some knowledge of health economics, was trained on data collection techniques, such as

Table 1. Scope of the costing

No.	Cost component	Province	District	Communes
1	Capital cost^a			
1.1	Building	✓	✓	✓
1.2	Equipment	✓	✓	✓
1.3	Vehicles	✓	✓	✓
2	Recurrent cost^b			
2.1	Personnel	✓	✓	✓
2.2	Vaccines, supplies	–	✓	–
2.3	Operation, maintenance	✓	✓	✓
2.4	Recurrent training	✓	✓	–
2.5	Other costs	✓	✓	✓

^a Capital items: the value of the buildings at the time of the construction was collected and the values of any major renovations were added in. The fixed items vehicles, equipment (e.g. cold chain, refrigerators, cold boxes) and furniture (e.g. desks, tables, chairs) were also listed and their original total purchase prices were obtained from the Finance and Accounting Department at each studied facility.

^b Recurrent items:

- Personnel costs: total income (salaries, allowances, bonuses, insurance fees, other benefits) of managers, vaccinators, physicians, etc. were estimated by taking their total revenues from the Finance and Accounting Department at each studied facility.
- Vaccines, supplies costs (e.g. syringes, ice packs), number of doses supplied, doses administered and their prices were collected from the expanded programme on immunization (EPI) section at each studied facility.
- Operation and maintenance costs (water, electricity, gas, telecommunications, fuel) and other costs (short-term training; information, education and communication activities; monitoring; overheads; etc.) were collected from the finance and accounting department at each studied facility.

how to conduct interviews with EPI programme managers and vaccinators about the implementation of EPI and the time each type of personnel spent on the programme, and how to collect cost data from the facilities' accounting records. Pilot testing was carried out before the official fieldwork. Spot-checking by observation during the actual implementation of EPI activities confirmed the time estimates for health personnel involved in the programme. Data quality was controlled in the field by the investigators of this study through cross-checking of data collected against financial and activity reports of the studied facilities.

Data analysis

The total annual cost of EPI and the average cost of vaccine delivery per dose were calculated using Excel spreadsheets (Microsoft, Seattle, WA, United States of America). The average cost of vaccine delivery per dose was weighted using the number of vaccines administered as the weights. We also estimated the cost per fully vaccinated child (FVC) as defined by the schedule.

For costing the vaccines and supplies, the 2005 domestic prices (for domestic items) and UNICEF average

prices for 2003¹³ (for imported items) were used. The 2003 UNICEF prices were inflated by a factor of 2% per year.¹⁴ Capital costs were annualized using a discount rate of 3%, and the useful life of buildings and equipment was assumed to be 33 years and 10 years, respectively.¹⁵ Sensitivity analyses were also conducted using several cost scenarios. Viet Nam dong (VND) were converted into United States dollars (US\$) and purchasing power parity (PPP) using the 2005 exchange rates: US\$ 1 = VND 16 000, and PPP = VND 3316, respectively.¹⁶

Findings

Implementation

EPI in Bavi district has been implemented through regular monthly immunization sessions at district and health centres. The immunization schedule in Bavi is presented in Table 2. The main outputs of EPI in Bavi in 2005, as well as the vaccine wastage rates, are shown in Table 3 (available at: <http://www.who.int/bulletin/volumes/86/6/07-045161/en/index.html>). Overall in 2005, Bavi achieved almost 98% of its immunization coverage target, delivering 83 064 doses

of vaccines to the local population. However, vaccine wastage rates were high (Table 3); the overall wastage rate was 18.7%. Wastage rates were highest for bacille Calmette–Guérin (BCG) (32.3%), followed by tetanus toxoid (TT) (23%) and oral polio vaccine (OPV) (20.2%), and lowest for Japanese encephalitis (11.5%) and hepatitis B (10.6%).

Total annual cost

The total annual cost of providing EPI in Bavi district in 2005 by various cost items is shown in Table 4 (available at: <http://www.who.int/bulletin/volumes/86/6/07-045161/en/index.html>). The total annual cost of the EPI services in the study site was US\$ 58 460 (PPP 282 076). The capital cost constituted 6.6% and recurrent cost made up 93.4% of the total cost. Among the recurrent costs, vaccines and supplies were the largest category (33% of the total), closely followed by personnel (30.2% of the total).

The percentage breakdown of the EPI cost by level of funding sources is shown in Fig. 1. The figure shows that approximately 42% of the total EPI cost was covered by funds from the national EPI and the remaining 58%

Table 2. The immunization schedule, Bavi district, 2005

Age	Visit	Traditional antigens	New vaccines ^a
Birth	1	BCG	Hepatitis B
2 months	2	OPV1	Hepatitis B
3 months	3	OPV2	
4 months	4	OPV3	
9 months	5	Measles	
1–5 years		Japanese encephalitis (3 doses)	
Women		TT for pregnant women (2 doses) and to child-bearing-age women	

BCG, bacille Calmette–Guérin; DPT, diphtheria–pertussis–tetanus; OPV, oral polio vaccine; TT, tetanus toxoid.
^a Hepatitis B and Japanese encephalitis.

came from local levels (province, district and communes). The largest share of the costs was due to activities at commune level (38%). Of the contributions made by the CHCs, 92% came from their annual budget, which in turn is financed by the central government; only 8% came from local government budgets.

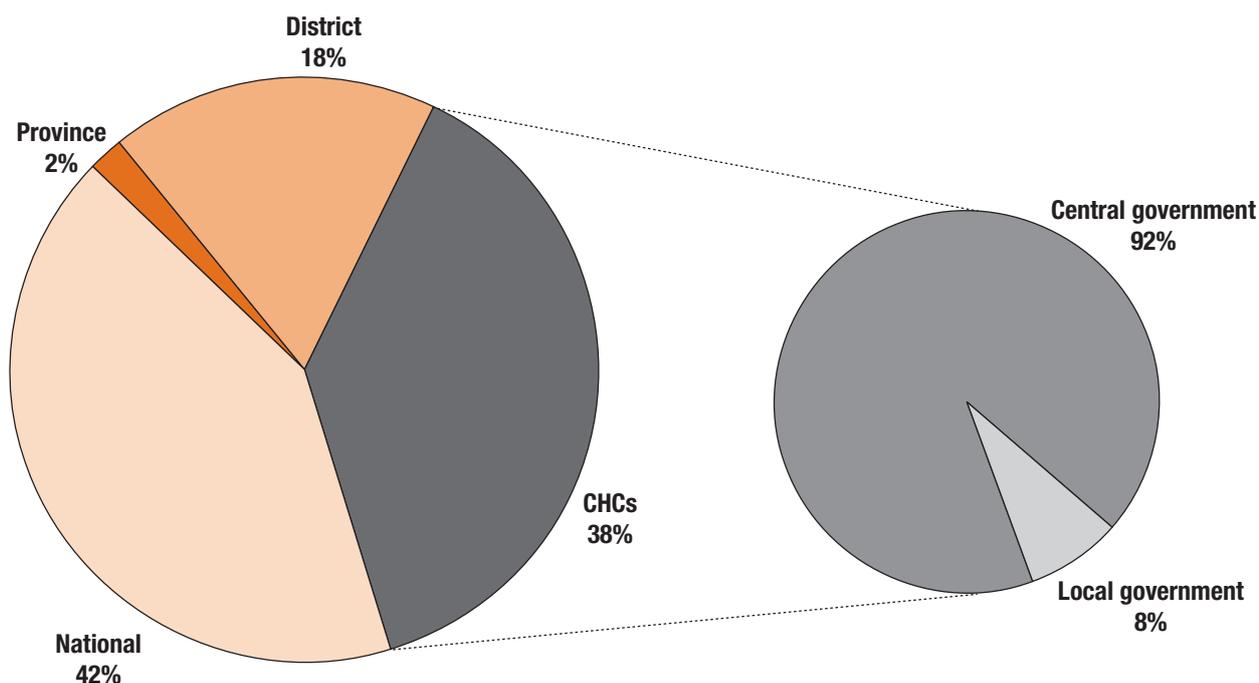
There was little variation in the contribution to EPI by each commune in the district. The cost patterns were also similar between the communes; the largest cost item was personnel, accounting for 85–86% of the total CHC contribution. This proportion reflects the fact that EPI is a labour-intensive programme (data not shown).

Average cost

Table 5 reports the average cost of vaccine delivery in Bavi district in 2005 per unit of various output measures. The average cost per dose of any vaccine was US\$ 0.7 (PPP 3.4), but this average includes the costs of hepatitis B and Japanese encephalitis vaccines, of which the cost per dose was 50–90% higher than the lowest cost per dose for OPV.

The average cost per FVC was US\$ 4.81 (PPP 23.21) when only the traditional EPI vaccines were considered. Where new vaccines were added to the programme, the cost increased by more than 100%. Adding one more new vaccine resulted in a relatively small additional increase (Table 5).

Fig. 1. Percentage breakdown of EPI cost by level of funding sources, Bavi district, 2005



CHCs, commune health centres; EPI, expanded programme on immunization.

Sensitivity analysis

We performed several sensitivity analyses to examine the changes in the average unit costs as well as the annual total cost of providing the EPI services in Bavi district, using different assumptions regarding reduction in the prices and the wastage rates of vaccines. Table 6 illustrates that, in all scenarios, a small reduction in the cost per dose of any vaccine or the cost per FVC would produce a relatively notable decline in the total annual cost of EPI. Reducing wastage would reduce total EPI cost by a few percentage points but procuring the vaccines at a reduced price would have a larger impact on the cost of the programme.

Discussion

Vaccine wastage rate

The immunization schedule in Bavi, presented in Table 2, is typical for rural Viet Nam. The achievement of 98% of the immunization target of Bavi was similar to the results in other districts in Hatay province.¹⁷ The overall vaccine wastage rate of 18.7% was in the range of 15–25%, reported by WHO in 2005.^{9,18} Vaccine wastage rates were high for BCG, TT and OPV vaccines, probably because each of them is provided in 20-dose vials. The lower wastage rates for Japanese encephalitis and hepatitis B vaccines reflect the fact that they are provided in two-dose and five-dose vials, respectively.

Cost and efficiency

This study reports the total annual cost of providing EPI in Bavi district in 2005, as well as the share of total costs by spending items and sources. The breakdown of the annual cost by spending items confirms the finding of a previous study in Viet Nam, that vaccines and supplies are the largest cost component of EPI.⁹ This is partly because of the high prices of imported products, which have commonly been used by EPI, and the high wastage rates. Long-term possibilities for improving the efficiency of EPI would be to increase the use of lower-priced domestically produced vaccines and to decrease vaccine wastage rates.

The implications of these strategies for potential future savings are clearly shown by the results of the sensitivity analyses. In the most realistic pricing

Table 5. Average cost of EPI's different units of output, Bavi district, 2005

EPI's outputs	Unit cost (VND)	Unit cost (US\$)	Unit cost (PPP)
BCG	9.783	0.61	2.95
DPT	9.789	0.61	2.95
TT	8.952	0.56	2.70
Measles	11.828	0.74	3.57
OPV	8.66	0.54	2.61
Hepatitis B	13.777	0.86	4.15
Japanese encephalitis	16.073	1	4.85
Any antigen	11.261	0.7	3.40
FVC ^a	76.958	4.81	23.21
FVC + 3 hepatitis B	118.29	7.39	35.67
FVC + 3 Japanese encephalitis	125.178	7.82	37.75
FVC + 3 hepatitis B + 3 Japanese encephalitis	166.51	10.41	50.21

BCG, bacille Calmette–Guérin; DPT, diphtheria–pertussis–tetanus; EPI, expanded programme on immunization; FVC, fully vaccinated child; OPV, oral polio vaccine; PPP, purchasing power parity; TT, tetanus toxoid; US\$, United States dollars; VND, Viet Nam dong.

^a A child in Bavi who has received one dose of BCG, three doses of OPV, three doses of DPT and one dose of measles vaccine by his or her first birthday is considered fully vaccinated. The cost per FVC was computed by calculating the cost per specific vaccine then summing up the cost of all vaccines used for a FVC.

scenario, if the prices of vaccines were reduced by 25%, the reduction in the total annual cost of providing EPI in one district of Viet Nam would be US\$ 4130. The savings for the country (assuming similar results in all 642 districts)¹⁹ could be as great as US\$ 2.7 million. In another potentially achievable scenario, reducing the wastage rates by 25%, the reduction in the total annual cost of providing EPI in one district would be US\$ 1143, and the savings across the country could reach US\$ 774 000. Both strategies would be good options and feasible, together with other solutions, for filling the future funding gap for EPI in Viet Nam, which is expected to mount to US\$ 6.7 million each year, as recently identified by WHO.¹⁴

The findings on funding sources for EPI in Bavi district reveal that local health authorities, especially CHCs, have played the most important role in financing EPI at their level. The national programme usually only provided vaccines and injection supplies, while each CHC contributed US\$ 600–700 per year from its own budget for all activities (allocated from the central government). The contributions from local governments to EPI have been limited and irregular; difficulties were reported at this level in paying workers for the EPI-related expenses (e.g. motorcycle fuel or information, education and communication

materials). Involving the local community in financing and implementing the EPI activities might be a good solution to enhance resources for the programme because it would not only improve the financial sustainability of the programme but also help to maintain the present high rates of immunization coverage.

This study also provided estimates on the average cost of the EPI vaccine delivery in Bavi district per unit of various output measures. The cost per FVC has been used as a measure of efficiency of the EPI delivery system. The cost of US\$ 4.81 per FVC found in this study is much lower than the figure of US\$ 15 that is generally accepted as the threshold for cost-effectiveness of EPI in developing countries.²⁰ Early cost studies showed that the costs per fully immunized child varied widely, depending on several factors such as the delivery strategy used (fixed facilities, mobile services or mass campaigns), the local costs of personnel, and vaccine procurement and distribution. A review of the cost of EPI in 17 low- and middle-income countries in the 1980s and 1990s reported costs per FVC ranging from US\$ 4.39 to US\$ 59.90.²¹ More recently, research in urban Bangladesh revealed a cost per FVC of US\$ 6.91,²² and in Peru the cost for FVC at health centres was found to be US\$ 17.42.²³ Even though the cost per FVC estimated from this

Table 6. Impact of different scenarios on the cost of providing EPI, Bavi district, 2005

Cost	Current price and use of vaccines	Price of vaccines reduced by 25%	Price of vaccines reduced by 50%	Vaccine wastage rates reduced by 25%	Vaccine wastage rates reduced by 50%
Average cost					
US\$	0.7	0.65	0.6	0.69	0.68
PPP	3.38	3.14	2.90	3.33	3.28
Cost per FVC					
US\$	4.81	4.6	4.39	4.72	4.68
PPP	23.21	22.20	21.18	22.77	22.58
Total annual cost					
US\$	58 460	54 330	50 199	57 317	56 732
PPP	282 076	262 147	242 215	276 560	273 737
Reduction in the total annual cost					
US\$	–	4 130	8 261	1 143	1 728
PPP	–	19 928	39 860	5 515	8 338

EPI, expanded programme on immunization; FVC, fully vaccinated child; PPP, purchasing power parity; US\$, United States dollars.

study reflected only the costs spent at local health facilities, it suggests that EPI is highly cost effective in rural Viet Nam. The EPI delivery system in Viet Nam could be even more efficient if more low-cost domestic vaccines were used and if the vaccine wastage rates were reduced.

Methodological considerations

We have to note that the cost figures found in this study might have been underestimated because, as mentioned in the scope of the costing, we did not include the costs spent at the central level. Because of the weaknesses in the reporting system in Viet Nam, we were unable to capture several cost items at local level, such as the costs of land for buildings, cost of long-term staff train-

ing, or contributions from the private sector. Further costing studies would provide more in-depth information that would be very useful for health planners and policy-makers at all levels.

We also have to note that our discussions on efficiency of EPI in Viet Nam were only suggestive because, when comparing the cost figures from this study with those from other studies, factors that might contribute to any observed differences should be taken into consideration, such as differences in perspective, the scope and method of costing, and inflation.

In summary, this study provided very useful information on economic aspects of EPI implementation in Viet Nam. The findings suggest that EPI has been implemented efficiently in rural Viet Nam but also provide possibilities to make it more efficient. The findings

from this study can serve as a basis for further studies as well as for programme and policy developments. ■

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Competing interests: None declared.

Résumé

Coût de délivrance du programme élargi de vaccination : résultats d'une étude en établissement de santé, menée au Viet Nam en 2005

Objectif Estimer et analyser les coûts de délivrance du programme élargi de vaccination (PEV) dans une communauté rurale du nord du Viet Nam en 2005.

Méthodes On a fait appel à une approche par composants pour collecter les données relatives aux coûts pour les prestataires de services.

Résultats Le coût annuel total du PEV dans le district de Bavi était de US \$ 58 460 [parité de pouvoir d'achat (PPA) : 282 076]. Les vaccins et les fournitures représentaient la catégorie de coût

la plus importante (33 %), suivie par les coûts de main d'œuvre (30,2 %). Les activités au niveau communal totalisaient la plus grande part (38 %) du coût total. Le coût moyen par enfant complètement vacciné était de US \$ 4,81 (PPA : 23,21), soit bien moins que le chiffre de US \$ 15, généralement accepté comme seuil de rentabilité du PEV dans les pays en développement.

Conclusion Cette étude empirique indique que le PEV est mis en œuvre efficacement dans le Viet Nam rural, mais qu'il existe des possibilités de le rendre encore plus efficace.

Resumen

Costos de la aplicación del programa ampliado de inmunización: resultados de un estudio de centros en Viet Nam, 2005

Objetivo Estimar y analizar los costos asociados a la aplicación del programa ampliado de inmunización (PAI) en una comunidad rural del norte de Viet Nam en 2005.

Métodos Se utilizó un sistema de componentes para reunir datos sobre los costos desde la perspectiva de los proveedores de servicios.

Resultados El costo anual total del PAI en el distrito de Bavi fue de US\$ 58 460 [en paridad del poder adquisitivo (PPP): 282 076]. Las vacunas y los suministros fueron la principal

categoría de costos (33%), seguidos de los gastos de personal (30,2%). El mayor porcentaje del costo total correspondió a las actividades realizadas a nivel comunal (38%). El costo promedio por niño totalmente vacunado fue de US\$ 4,81 (PPP 23,21), muy inferior a la cifra de US\$ 15 aceptada en general como umbral de costoeficacia para el PAI en los países en desarrollo.

Conclusión Este estudio empírico muestra que el PAI se ha aplicado de manera eficiente en el Viet Nam rural, pero hay posibilidades de aumentar aún más esa eficiencia.

ملخص

تكاليف تقديم البرنامج الموسع للتمنيع: نتائج دراسة على مرافق الرعاية في فييت نام، 2005

راجعة للأنشطة التي جرت على مستوى الكميونات (38%). وبلغ متوسط تكلفة تطعيم الطفل تطعيماً كاملاً 4.81 دولاراً أمريكياً (تعاوّل القوة الشرائية 23.21)، وهي تكلفة تقل كثيراً عن مبلغ الـ 15 دولاراً أمريكياً الذي يعد مقبولاً بصفة عامة كعتبة عالية المردود للبرنامج الموسع للتمنيع في البلدان النامية.

الاستنتاج: تظهر هذه الدراسة العملية تنفيذ البرنامج الموسع للتمنيع بشكل فعّال في ريف فييت نام، مع وجود الفرص لجعله أكثر فعالية.

الهدف: تقدير وتحليل تكاليف تقديم البرنامج الموسع للتمنيع في مجتمع ريفي شمال فييت نام، في عام 2005.

الطريقة: استخدم الباحثون أسلوباً قائماً على المكونات لجمع المعطيات الخاصة بالتكاليف من منظور مقدّم الخدمات.

الموجودات: بلغ إجمالي التكاليف السنوية للبرنامج الموسع للتمنيع في مقاطعة بافي 58 460 دولاراً أمريكياً [تعاوّل القوة الشرائية 282 076]. وقد مثلت اللقاحات والمستلزمات الفئة الأكبر من التكاليف (33%)، تلتها تكاليف الموظفين (30.2%). وكانت الحصة الأكبر من إجمالي التكاليف

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Table 3. Vaccine doses administered and vaccine wastage rates, Bavi district, 2005

Vaccine	Doses supplied	Doses administered	Wastage rate ^a (%)
BCG	8 780	5 942	32.3
DPT	18 480	14 889	19.4
TT	18 480	14 222	23.0
Measles	7 180	5 942	17.2
OPV	18 660	14 889	20.2
Hepatitis B	15 543	13 902	10.6
Japanese encephalitis	15 000	13 278	11.5
Total	102 123	83 064	18.7
Fully vaccinated infants (traditional vaccines)		4 694	
Infants given 3 doses of hepatitis B vaccine		4 634	
Children under five years given 3 doses of Japanese encephalitis vaccine		4 426	
Pregnant women given 2 doses of TT vaccine		4 913	

BCG, bacille Calmette–Guérin; DPT, diphtheria–pertussis–tetanus; OPV, oral polio vaccine; TT, tetanus toxoid.

^a Vaccine wastage rate = [(doses supplied – doses administered) / doses supplied] × 100.

Table 4. The total annual cost of providing EPI in Bavi district, 2005

Cost items	Total annual cost (VND)	Total annual cost (US\$)	Total annual cost (PPP)	% of total
Capital cost				
Buildings	42 067 583	2 629	12 686	4.50
Equipment	16 616 653	1 039	5 011	1.80
Vehicles	2 896 354	181	873	0.30
Subtotal	61 580 590	3 848.79	18 570.74	6.60
Recurrent cost				
Personnel	282 822 804	17 676	85 290	30.20
Operation, maintenance	173 007 051	10 813	52 173	18.50
Vaccines, supplies	308 566 779	19 285	93 054	33.00
Other costs	109 385 626	6 837	32 987	11.70
Subtotal	873 782 260	54 611	263 505	93.40
Total cost	935 362 850	58 460	282 076	100.00

EPI, expanded programme on immunization; PPP, purchasing power parity; US\$, United States dollars; VND, Viet Nam dong.