

Factors affecting routine immunization coverage among children aged 12-59 months in Lao PDR after regional polio eradication in Western Pacific Region

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SUMMARY

The global poliomyelitis eradication programme had a great impact on routine immunization coverage in Lao PDR: DPT3 increased 23% in 1992 to 56% in 1999; OPV3 27% to 64%. However, after the achievement of regional eradication, coverage became stagnant in accordance with the withdrawal of various sources of financial supports. In place of the former funds, a public-private global partnership began to support EPI. We aim to explore factors affecting routine immunization coverage. From February to March of 2005, a cross-sectional questionnaire survey was conducted, targeting 341 mothers living in two districts where immunization coverage was the lowest and the middle in Oudomxay province. DPT3 coverage was 72%, higher than the national target of 65%; however, the drop-out rate was 21%. Influential factors on fully immunized child was distance, literacy, possession of livestock; mothers knowledge of immunization target diseases, measles immunization schedule; and mother's willingness to pay for immunization. In total, 98% of all mothers lived within a 30-minute walk of the immunization site. Household visits increased the immunization status among mothers who were illiterate, utilizing an outreach site for immunization, not willing to pay for immunization, receiving home delivery, and without health education attendance. The much higher routine immunization coverage especially in a district of poor EPI activities suggests a well-designed primary health care approach under the district strategy, the zone-zero social mobilization strategy and good lines of communications; it also points to the benefits of the polio eradication initiative. Household visits were found to be effective for people living with difficulties in such as education, living location, and finance. An equally shared funding system for the basic health as well as international policy for respecting the existing system in poor country is important.

Key Words: Polio eradication, stagnation of vaccine coverage, routine immunization, campaign, primary health care

Introduction

In Lao PDR, the expanded programme on immunization (EPI) was initiated in 1979. By 1982, EPI was

operating in only two of 18 provinces and in only 10 of the then 121 districts, but it had expanded to cover 97 districts by 1992 (1). In 1991, Lao PDR initiated the global polio eradication programme (2), which made substantial progress by its mass oral polio vaccination campaign and acute flaccid paralysis surveillance (3). This global programme greatly contributed to the progress of basic routine immunization coverage: BCG coverage in 1992, 1995, and 1999 was 34%, 62%, and 63% in 1992, 1995, and 1999; three doses of diphtheria-

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pertussis-tetanus toxoid vaccine (DPT3) was 23%, 54%, and 56%; three doses of oral polio vaccine (OPV3) was 27%, 64%, and 64%; measles vaccine 46%, 68%, and 71%, respectively (4).

Mass polio vaccination campaign for children < 5 years of age was very useful strategy for the country with difficulty in routine immunization service due to limited infrastructure. The Western Pacific Region achieved regional polio eradication in 2000 (5).

However, after this historic achievement, immunization coverage in Lao PDR became stagnant: BCG coverage was in 2000, 2002, and 2004 was 69%, 65%, and 60%; DPT3 was 53%, 55%, and 45%; OPV3 was 57%, 55%, and 46%; measles was 42%, 55%, and 36%, respectively (4). This trend might have been caused by the cessation of the intensive vertical approach in response to the achievement (6,7). The withdrawal of international partners' support was also a factor in this declining coverage: The Japan International Cooperation Agency (JICA) project terminated its technical support for general EPI activities as well as polio eradication, despite the continuation of its free provision of all basic EPI vaccines; the United Nations Children Fund (UNICEF) has shifted its priority back to community-based activities targeting mothers and children; and The Australian Government's overseas aid program (AusAID) withdrew its activities from Lao PDR. However, the Global Alliance for Vaccines and Immunization (GAVI), a public-private global partnership, was created in 1999 to enable even the poorest countries to provide vaccines to all children (8,9), and GAVI started to provide Lao PDR with combination of Hepatitis B-DPT vaccines and auto-disable syringes in 2002 under the three-year plan (10).

The stagnations of vaccination coverage have been observed at the global level after substantial progress towards universal immunization in the 1980s, reaching over 70% coverage for children globally (11). Coverage for DPT3, the benchmark indicator of annual routine immunization coverage, was less than 50% in 10 countries, and Lao PDR was one of them (12).

Lao PDR is categorized as one of the least developed countries with a GDP per capita of \$491 in 2005 (13) and these days donors tend to ask for concrete the achievements for the sake of accountability to contributors of funding and in order to make judgments as to whether or not to continue support, as seen in case such as GAVI (14). However, in the country, no paper exploring authentic immunization status and factors affecting immunization coverage has been presented for publication to international academic journals to date, a paper which might help to attract international or bilateral partners to attain the more stable financial support essential to immunization services. National EPI staff also claimed that official coverage was underestimated because the real target population or denominator must have been lower than the official

estimated population due to the progress of family planning.

As shown in previous studies in resource limited settings, good immunization coverage has been achieved by the efforts of a robust primary health care approach (15), mothers' knowledge (16-18) and the provision of immunization information (17,19,20), results which encouraged us. This study aimed to investigate true immunization coverage in two rural districts in Oudomxay province by field study, and to explore factors affecting routine immunization coverage.

Materials and Methods

District strategy and zone zero social mobilization for immunization service

Since much of the country is mountainous and the transportation network is underdeveloped nationwide, a district strategy developed for universal access to immunization services in 1991 (21). In this strategy the district was considered as the operational unit with the capacity to plan and manage an immunization programme which would deliver services through health facilities and outreach activities to villages. The catchment area for a health facility was divided into four zones: 1) zone 0 containing villages within 3 kilometers of a health facility for immunization delivery; 2) zone 1, villages to which a vaccinator can walk or ride by bicycle; 3) zone 2, villages to which a vaccinator can reach with mechanized transport, conduct a vaccination session and return within one day; and 4) zone 3, villages which require more than one day for travel and to conduct an immunization session. The strategy also proposed that each village should be visited at least four times a year and community should be actively involved in supporting delivery of immunization services.

In 1996, zone zero social mobilization, encouraging villagers residing nearby a health facility to visit the health facility without waiting for the visit of an outreach team, was adopted, and villagers were expected to get additional health services as well as immunization service at the health facility (22).

The Ministry of Health set a 2004 national goal of fully immunized children (FIC) coverage 60%, and basic immunization coverage of BCG, DPT3, OPV3, and measles vaccine of 75%, 65%, 65%, and 60%, respectively (23).

Site and subjects

From February to March of 2005, a community based cross-sectional questionnaire survey was conducted in Oudomxay province located in northern part of the country, targeting mothers living in the Xay and Beng districts where immunization coverage was the lowest and at intermediate levels, respectively, among a total of

7 districts. In 2004 provincial reported official coverage of BCG, DPT3, OPV3, and measles vaccine was 67%, 54%, 59%, and 44%, respectively. In Xay district, 2004 official coverage was 51%, 27%, 26%, and 21%; in Beng district, it was 94%, 75%, 74%, and 58% (24).

The province is mountainous, and consisted of 7 districts with 867 villages. The area is 15,370 square kilometers, and total population was 247,385. There are 189 villages in Xay district and 108 in Beng, and two villages were randomly selected from each zone (0 to 3) in each district. Thus, 8 villages were selected from Beng district and 8 from Xay, containing a total of 1134 households. By visiting all households, we selected 341 mothers with children from 12 to 59 months old. The ethnic groups are predominant: Lao Loum (major ethnic group) and Lao Theung (minor ethnic group).

Measurement and analysis

The research team was composed of a national EPI staff member, two district EPI staff members, two trained interviewers, and a Japanese researcher. A face-to-face interview with mothers at the target households was conducted using a structured questionnaire, developed by the EPI experts from both Lao PDR and Japan and revised after the pre-survey conducted in the capital city of Vientiane. The questionnaire was originally developed in English and translated into the Lao language by the national EPI manager, then translated back into English by Laotian researchers in the team.

The dependent variable was child immunization status, obtained from an immunization card. When the card was not available, the mother was asked orally about the child’s immunization history by the EPI staff. Child immunization status was categorized into two groups: 1) fully immunized children who received all doses of BCG, DPT, OPV, and measles vaccine; and 2) partially or not immunized children who missed any dose of the vaccines. Independent variables were socio-economic characteristics, mother’s KAP (knowledge,

attitude and practice) on vaccination, and sources of information on vaccination.

Ethical approval was obtained from the National Ethics Committee for Health Research of the Ministry of Health in Lao PDR, and the Ethics Committee of the University of Tokyo. Informed consent was obtained from all respondents before the interview.

To assess factors associated with immunization status, univariate, bivariate and multivariate analyses were conducted. Univariate analysis was employed to clarify frequencies and distributions of each variable. Chi-square test and stratified analysis were used for bivariate analyses. From the results of univariate analysis, multivariate logistic regression analysis was conducted to determine the predictors of fully immunized children. A *p*-value < 0.05 was considered to indicate statistical significance. To perform statistical analysis, SPSS 11.0 for Windows was used.

Results

There was no significant difference in immunization coverage between Xay and Beng district (Table 1). The fully immunized children coverage of 60% was equal to the national target, and only 12 children (3.5%) were not immunized. The coverage of BCG, DPT3, OPV3, and measles vaccine in Xay district was 92%, 75%, 74%, and 69%, while official coverage in 2004 was 51%, 27%, 26%, and 21%, respectively. The coverage in Beng district was 86%, 70%, 73%, and 75%, while official coverage 94%, 75%, 74%, and 58%, respectively. The average of DPT1 coverage was as high as 93%; however, drop-out rate was 21% (DPT1-DPT3).

Table 2 shows the association between socio-economic characteristics and immunization status. Zone of residence, ethnic group, literacy, and livestock possession were significantly associated with immunization status. However, household income, place of delivery, and history of anti-neonatal care (ANC)

Table 1. Child immunization status (*n* = 341)

	Xay		Beng		TOTAL	(%)
	N	(%)	N	(%)		
Immunization status						
Fully immunized	93	(66.3)	122	(57.7)	205	(60.1)
Partially immunized	51	(34.7)	73	(37.6)	124	(36.4)
Not immunized	3	(2.0)	9	(4.6)	12	(3.5)
Own immunization card (“Yellow “card)						
Yes					248	(72.7)
No					93	(27.3)
BCG	135	(91.8)	167	(86.1)	302	(88.6)
DPT1	139	(94.6)	177	(91.2)	316	(92.7)
DPT2	126	(85.7)	163	(84.0)	289	(84.8)
DPT3	110	(74.8)	136	(70.1)	246	(72.1)
OPV1	130	(88.4)	170	(87.6)	300	(88.0)
OPV2	121	(82.3)	167	(86.1)	288	(84.5)
OPV3	109	(74.1)	142	(73.2)	251	(73.6)
Measles	102	(69.4)	145	(74.7)	247	(72.4)
Drop-out (DPT1-DPT3)	29	(19.8)	41	(21.1)	70	(20.6)

Table 2. Socio-economic characteristics and immunization status ($n = 341$)

	Fully ($n = 205$)		Partially or Not ($n = 136$)		P value
	N	(%)	N	(%)	
Zone of residence					
	0-1	130 (63.4)	44 (32.4)		< 0.001
	2-3	75 (36.6)	92 (67.6)		
Ethnic group					
	Lao Lum	92 (44.9)	29 (21.3)		< 0.001
	Lao Theung	113 (55.1)	107 (78.7)		
Age of mother (years)					
	< 20	14 (6.9)	16 (11.9)		
	20-29	125 (61.3)	78 (57.8)		
	30-39	55 (27.0)	28 (20.7)		
	≥ 40	10 (4.9)	13 (9.6)		
	N/A [†]	1	1		
Gender of child					
	Male	97 (49.5)	67 (52.8)		
	Female	99 (50.5)	60 (47.2)		
	N/A	9	9		
Literacy					
	Literate	79 (40.7)	29 (22.3)		< 0.01
	Illiterate	115 (59.3)	101 (77.7)		
	N/A	11	6		
Household income/month (Kip)					
	$\leq 100,000$ (≥ 10 USD)	102 (50.8)	68 (52.3)		
	$> 100,000$ (< 10 USD)	100 (49.5)	62 (47.7)		
	N/A	3	6		
Livestock					
	Yes	158 (77.1)	88 (64.7)		< 0.05
	No	47 (22.9)	48 (35.3)		
Place of Delivery					
	Health facility	58 (28.3)	32 (23.7)		
	Other (Home delivery)	147 (71.7)	103 (76.3)		
	N/A	0	1		
History of ANC attendance					
	Yes	128 (62.4)	72 (52.9)		
	No	77 (37.6)	64 (47.1)		

[†]Not available

attendance were not associated with immunization status.

The association between KAP of mothers and immunization status is shown in Table 3. Mothers who knew the target diseases of immunization, knew the schedule for measles immunization, and knew the number of times to visit the immunization site, and mothers who had willingness to pay for immunization had significantly increased chances of having fully immunized children. The place to get immunization (outreach site or health facility) and means of access to immunization site were not associated with immunization status.

Table 4 shows the effect of the source of information on immunization affecting on immunization status. Household visit as a source of information for immunization day was associated with a significant increase in the rate of fully immunized children ($p < 0.05$). Although there was no significant association observed to support the observed result, as many as 63% of the mothers of the fully immunized children were encouraged by village heads to bring their children to an immunization site. Mothers who obtained information on immunization before the delivery significantly influenced the rate of fully immunized children ($p < 0.01$). Health education attendance, village meeting

attendance and birth registration after delivery were not associated with immunization status.

In Table 5, we divided the subjects into two groups of mothers who had received a household visit and mothers who had received no household visit, and explored factors affecting immunization status. Household visits significantly influenced the rate of fully immunized children among mothers who were illiterate, were utilizing an outreach site for immunization, had no willingness to pay for immunization, had delivered at sites other than health facilities (*e.g.*, home delivery, and reported no health education attendance ($p < 0.05$).

To control confounding factors, the data were analyzed by a multivariate logistic regression model (Table 6). Three factors significantly increased the rate of fully immunized children: zone of residence (OR = 2.40, CI = 1.13-5.13); mothers' knowledge of schedule for measles immunization (OR = 3.35, CI = 1.49-7.69); and willingness to pay for immunization (OR = 5.40, CI = 1.48-19.73).

Discussion

Our study revealed remarkably higher immunization coverage compared with official coverage in Xay

Table 3. KAP of mothers and immunization status (n = 341)

	Fully (n = 205)		Partially or Not (n = 136)		P value
	N	(%)	N	(%)	
Knowledge:					
Target diseases of immunization					
	Know	144 (70.2)	75 (55.1)		< 0.01
	Unknown	61 (29.8)	61 (44.9)		
Cause of measles					
	Know	21 (10.2)	7 (5.1)		
	Unknown	184 (89.8)	129 (94.9)		
Benefit of immunization					
	Know	142 (69.3)	86 (63.2)		
	Unknown	63 (30.7)	49 (36.0)		
	N/A [†]	0	1		
Number of doses of DPT					
	Know	82 (40.0)	40 (63.9)		
	Unknown	123 (60.0)	96 (70.6)		
Symptoms of measles					
	Know	139 (67.8)	99 (72.8)		
	Unknown	66 (32.2)	37 (27.2)		
Schedule for measles immunization					
	Know	70 (34.1)	13 (9.9)		< 0.001
	Unknown	135 (65.9)	118 (90.1)		
	N/A	0	5		
Times visiting immunization site to complete the immunization schedule					
	Know	163 (79.5)	86 (63.2)		< 0.01
	Unknown	42 (20.5)	50 (36.8)		
Attitude:					
Will you take your child for getting immunization if you have to pay for it?					
	Yes	195 (95.1)	112 (83.6)		< 0.01
	No	10 (4.9)	22 (16.4)		
	N/A	0	2		
Practice:					
Place where immunization is received					
	Outreach site	122 (59.5)	91 (66.9)		
	Health facility	83 (40.5)	45 (33.1)		
Means of access to immunization site					
	On foot	164 (80.0)	113 (87.9)		
	Bicycle, Motorcycle, etc.	40 (20.0)	16 (12.4)		

[†] Not available

Table 4. Source of information on immunization and immunization status (n = 341)

	Fully (n = 205)		Partially or Not (n = 136)		P value
	N	(%)	N	(%)	
Persons encouraging mother to bring child to immunization site					
	Village head	126 (63.0)	86 (63.7)		
	Hospital staff (Doctor/Nurse)	49 (24.5)	35 (25.9)		
	Others (Relatives etc.)	23 (11.5)	11 (8.1)		
	None	2 (1.0)	3 (2.2)		
	N/A [†]	5	1		
Household visit for informing of immunization day					
	Yes	71 (35.3)	31 (23.7)		< 0.05
	No	130 (64.7)	100 (76.3)		
	N/A	4	5		
Obtained information on immunization before delivery					
	Yes	145 (85.8)	88 (68.8)		< 0.01
	No	24 (14.2)	40 (31.3)		
	N/A	36	8		
Health education attendance in the past year					
	Yes	158 (79.8)	107 (84.3)		
	No	40 (20.2)	20 (15.7)		
	N/A	7	9		
Village meeting attendance in the past year					
	Yes	183 (90.1)	121 (91.0)		
	No	20 (9.9)	2 (9.0)		
	N/A	2	3		
Birth registration after delivery					
	Yes	120 (58.8)	79 (58.1)		
	No	84 (41.2)	57 (41.9)		
	N/A	1	0		

[†] Not available

Table 5. Household visit for information and immunization status ($n = 332^{\S}$)

			Household visit				P value	
			Yes ($n = 102$)		No ($n = 230$)			
			N	(%)	N	(%)		
Literacy								
Literate	Full	Partially or Not	23	(79.3)	55	(70.5)	< 0.05	
		Partially or Not	6	(20.7)	23	(29.5)		
Illiterate	Full	Partially or Not	44	(64.7)	68	(48.6)		
		Partially or Not	24	(35.3)	72	(51.4)		
N/A [†]			5		12			
Type of immunization site								
Outreach site	Full	Partially or Not	47	(68.1)	72	(51.8)	< 0.05	
		Partially or Not	22	(31.9)	67	(48.2)		
Health facility	Full	Partially or Not	24	(72.7)	58	(63.7)		
		Partially or Not	9	(27.3)	33	(36.3)		
Willingness to pay for immunization								
Yes	Full	Partially or Not	63	(71.6)	128	(59.8)		< 0.05
		Partially or Not	25	(28.2)	86	(40.2)		
No	Full	Partially or Not	8	(61.5)	2	(12.5)		
		Partially or Not	5	(38.5)	14	(87.5)		
N/A			1		0			
Place of Delivery								
Health facility	Full	Partially or Not	20	(69.0)	36	(62.1)	< 0.05	
		Partially or Not	9	(30.1)	22	(37.9)		
Others	Full	Partially or Not	51	(69.9)	94	(55.0)		
		Partially or Not	22	(30.1)	77	(45.0)		
N/A			0		1			
Health education attendance in the past								
Yes	Full	Partially or Not	57	(65.5)	97	(56.4)	< 0.05	
		Partially or Not	30	(34.5)	75	(43.6)		
No	Full	Partially or Not	11	(100)	29	(61.7)		
		Partially or Not	0	(0)	18	(38.3)		
N/A			4		11			

[§] Nine Questionnaires were not available

[†] Not available

Table 6. Factors affecting rate of fully immunized children ($n = 341$)

Independent variables		OR	95%CI	P value
Socio-demographic characteristics:				
Zone of residence (Living Zone)	0-1	2.40	[1.13-5.13]	< 0.05
Ethnic group	Lao Lum	1.36	[0.58-3.17]	
Literacy	Literate	1.25	[0.90-1.75]	
Property (Livestock)	Yes	1.83	[0.97-3.45]	
KAP:				
Target disease of immunization	Know	1.23	[0.66-2.30]	
Number of doses of DPT	Know	1.09	[0.56-2.12]	
Times visiting immunization site to complete the immunization schedule	Know	1.21	[0.62-2.35]	
Schedule for measles immunization	Know	3.35	[1.46-7.69]	< 0.01
Willingness to pay for immunization	Yes	5.40	[1.48-19.73]	
Information:				
Information on immunization before delivery	Yes	1.40	[0.69-2.84]	
Household visit by some informants	Yes	1.31	[0.67-2.53]	

district, the district with the poorest EPI activities in the province. This suggests that the real target population in the district might be smaller than the estimated population based on the 1995 census for calculating coverage, probably due to the success of family planning as pointed out by national EPI staff. The total fertility rate fell from 5.6 in 1995 to 4.9 in 2000 by UNFPA report (25). The higher coverage could be expected at cities in Lao PDR where family planning has been successful, and the demonstration of the additional immunization coverage based on the new census conducted in 2005 next to the current official coverage would be useful to obtain a real picture of coverage. The wide gap between our findings and official data might be attributable to incomplete reporting: if some villages do not report, the numerator becomes smaller, resulting in lower coverage (26). In contrast, Beng district, demonstrating the intermediate performance in EPI, exhibited coverage closer to the official report, suggesting good activities in reporting and recording as well as in immunization services. This indicates the necessity of continuous training especially in weak EPI management area, even after the achievement of regional polio eradication. A previous paper describing health workers in Ghana reported that continuing professional education is required to ensure homogenous provision of appropriate quality of services (27). The high drop-out rate of about 20% indicates that there is a chance to increase the coverage from around 70% to more than 90% by overcoming associated factors detected in this study.

This study revealed a successful primary health care approach to immunization in a limited infrastructure setting. Residences near health facilities or zone 0-1 (by multivariate logistic regression), and the major ethnic group of Lao Loum must have great benefits from geographical advantage and presumably better chances of education and communication, which would be attributable to increasing the coverage. Papers from Bangladesh, Nepal, and China also reported the benefits of short distance to immunization site for coverage (19,28,20). However, the efforts made to offer an equal opportunity of utilize immunization services for those residing in zone 2-3 and the ethnic group of Lao Theung who live in highland were also revealed: 335 (98.2%) of the total of 341 mothers lived within a 30-minute walk from immunization sites, suggesting outreach activities enabled people living in remote areas to access to immunization service. Bishai *et al.* also reported outreach services can reduce socioeconomic differentials in vaccine receipt (29).

Literate mothers perhaps had basic knowledge of EPI, such as target diseases, times of immunization, and especially schedule for measles immunization (multivariate logistic regression), which contributed to the rate of fully immunized children. The schedule for measles must have been strongly influenced by the

intensive measles elimination programme instituted after regional polio eradication was achieved. Mothers education was positively correlated with immunization status elsewhere (16,17,30). However, more advanced knowledge such as cause of measles or benefits of immunization did not influence immunization status, suggesting the necessity of more advanced education for mothers. A recent Indian study concluded that increasing women's literacy at the community level, in addition to mother's access to higher education such as matriculation and beyond were effective development tools for child's complete immunization status (18). More willingness to pay on the part of the mother was a strong predictor for full immunization and 90% [(195 + 112)/341] of all mothers reported willingness to pay, which show quite positive on immunization in the areas, and additional higher education could enhance immunization coverage more. Although encouragement by village head did not affect the immunization status statistically, as much as 63% of the mothers have been encouraged to obtain full immunization for their children, suggesting that village head education remains a possible key for improving immunization coverage.

We revealed that household visits and receipt of information before delivery influenced the number of fully immunized children. Further analysis revealed that household visits contributed to higher rate of immunization, especially among classes of marginalized mothers such as those with the indicators of illiterate, use of outreach site, no willingness to pay for immunization, delivery other than health facility, and no health education attendance, which indicates the remarkable achievement of universal access, one of the main principles of primary health care (31) in countries with limited human resources and funds. Previous studies have shown that direct communication through household visits was clearly effective in improving immunization coverage (17,19). The policy of the district strategy for immunization service in Lao PDR has been developed based on a primary health care approach for universal access dating back to 1991 (21), and our findings indicate the strategy was well-designed and implemented efficiently by the efforts of local staff in accordance with the progress of the polio eradication initiative. A similar strategy, the Reaching Every District (RED) strategy has been initiated especially in African countries since 2002 to improve stagnated routine immunization coverage (32), and the RED strategy implemented in five African countries by WHO and UNICEF showed good results due to outreach services and micro-planning (33).

As suggested in a USAID report, even the best-designed and carefully implemented communication interventions in support of immunization will deliver few results if not properly funded (11), and EPI in Lao PDR faces serious funding problems as reported by Save the Children Australia: only 26% of children in

a western province of Lao PDR were fully immunized in 2004 due to vaccine supply problems and a lack of adequate funds (34). After the regional polio eradication in 2000, main donors priorities have shifted from EPI to another priority: The Japanese government started considering the termination of basic vaccines which have supplied since 1989; UNICEF reduced operational costs; and the WHO extra budget seems too small to adequately support vaccine procurement. Under these circumstances, GAVI started to provide a combination of Hepatitis B-DPT vaccines together with auto-disable syringes in 2002. However, the support will be terminated soon, as the outcome did not meet the target set by GAVI. Since Lao PDR is a country with limited budgetary resources and a human development index ranking of 135 (35), a stable supply of the resources necessary for basic public health should be provided free of charge through the international society rather than through a single bilateral donor or ad-hoc private funding. Private involvement in public health in developing countries has been controversial: Lu C *et al.* reported GAVI's successful funding of immunization support in countries with baseline DPT3 coverage of 65% or less (14) and some have argued that GAVI might build health services (36), while some (37-41) have expressed concerns that GAVI investments could distort national priorities and lead to reduction in the delivery of other health services. In Lao PDR, at the time of introduction of GAVI, there had been no discussion of which donors would succeed the fund after termination of its support. From the perspective of sustainability and environmental preservation, as pointed out in the previous studies conducted in African countries (37,38), the international society should share the fund equally for basic human needs in developing countries.

Our study was conducted in two districts, which are not necessarily representative of the country as a whole. However, the data were obtained from typical rural districts and villages with low and intermediate immunization coverage by a scientific approach. Routine immunization coverage was higher than or closer to the official reports, suggesting a well-designed primary health care approach under the district strategy, zone-zero social mobilization strategy and good communications as well as the benefits of the polio eradication initiative. Household visits were found to be effective for people living with difficulties in such as education, living location, and finance. As equally shared funding system for basic health, as well as an international policy for respecting the existing system in poor countries is important.

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