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Scaling up interventions to eliminate neonatal tetanus: Factors associated with the coverage of tetanus toxoid and clean deliveries among women in Vientiane, Lao PDR

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ABSTRACT

The Lao People's Democratic Republic (PDR) is one of seven countries that have not eliminated maternal and neonatal tetanus in more than 50% of districts. We conducted a community-based household survey to assess the achievements of strategies towards maternal and neonatal tetanus elimination in the capital province. The coverage of tetanus toxoid (TT) was 79.7% by the protection-at-birth (PAB) method. The percentages of deliveries attended by skilled personnel and of deliveries at a health facility were 68.4% and 63.7%, respectively. The progress towards eliminating neonatal tetanus in Lao PDR is not sufficient despite the study sites being placed in the capital province. The lack of continuum of care for mothers and newborns is the major obstacle to scale up the tetanus toxoid coverage and PAB as well as clean deliveries.

1. Introduction

Neonatal tetanus is one of the major causes of neonatal deaths. It can be prevented by simple and cost-effective interventions including tetanus toxoid (TT) vaccine and clean delivery among pregnant women. Neonatal tetanus nevertheless continues to be a major public health problem in low-income countries, mostly in Asia and Africa [1]. Since 1989, a joint effort to eliminate maternal and neonatal tetanus by the year 2005 had been implemented, notably by the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the United Nations Population Fund (UNFPA). In their strategy document, the elimination of neonatal tetanus is defined as less than one case per 1000 live births in every district in every country [2]. To achieve this goal, scaling up of TT and clean deliveries, together with timely and accurate surveillance systems, have been promoted [3].

Such a concerted effort has contributed to a substantial reduction in the burden of neonatal tetanus around the world. Although there is no consistent time-series estimate of the burden of neonatal tetanus, one study suggested that in 1988, neonatal tetanus accounted for 787,000 neonatal deaths globally [1]. The recent estimate from a systematic review of available data showed that, in 2000, the number of neonatal deaths from tetanus was around 200,000 (or 7% of all neonatal deaths) [4]. However, neonatal deaths in developing countries often take place at home and the lack of death registration with causes of death makes it difficult to assess the true magnitude of the disease burden from neonatal tetanus. One government report suggested a mortality rate from neonatal tetanus of 0.1 per 1000 live births in 2000 [5], but the subsequent retrospective verbal autopsy study in rural areas reported a much higher cause-specific mortality rate, ranging from 8.6 to 10.5 per 1000 live births [6].

Neonatal tetanus is still endemic in Lao PDR—one of the poorest countries in the world—due to the stagnation of both TT and clean delivery coverage. Although vaccine has been offered free of charge throughout the country, the nationwide coverage from the latest UNICEF's Multiple Indicators Cluster Survey (MICS3) in 2006 showed that the proportion of pregnant women who received at least two doses of TT (TT2+) was 38%, a decline from 45% in MICS1 (1995) [7,8]. Laotian government's report, which is not nationally representative, also consistently suggests the declining trend in TT2+ coverage since 2000 [8].

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Table 1
Sample characteristics.

		n	(%)
Age	Mean ± SD	30.7 ± 6.9	
	15–19	5	(2.4)
	20–29	100	(47.2)
	30–39	79	(37.3)
	40–45	28	(13.2)
Ethnicity			
	Lao Lum	210	(99.1)
	Lao Theung	2	(0.9)
Distance to hospital			
	≤3 km	67	(28.2)
	>3 km	145	(71.8)
Household monthly income (Kip)[a]			
	Median	400,000	
	Lowest quartile (<200,000)	47	(22.2)
	Middle 50% (200,000–600,000)	113	(53.3)
	Highest quartile (>600,000)	52	(24.5)
Husband's education (years)			
	Mean ± SD	7.8 ± 4.0	
	0	13	(6.1)
	1–5	65	(30.7)
	≧6	134	(63.2)
Wife's education (years)			
	Mean ± SD	6.2 ± 3.2	
	0	7	(3.3)
	1–5	111	(52.4)
	≧6	94	(44.3)
Parity			
	Mean ± SD	2.3 ± 1.4	
	Primiparous	71	(33.5)
	Multigravida	141	(66.5)
Wife's occupation			
	Housewife	78	(36.8)
	Work outside	134	(63.2)
Radio usage			
	No	52	(24.5)
	Yes	160	(75.5)
Key source of information			
	Village staff	156	(73.6)
	Others	56	(26.4)
Total number		212	

[a] 10,000 Kip = US$ 1 (September, 2005).

Likewise, the WHO–UNICEF estimate of the protected-at-birth (PAB), which takes into account the duration between last TT and delivery and is more accurate measure of the effectiveness of TT, has declined from 58% in 2000 to 47% in 2007 [9]. Studies in rural areas showed that geographical barriers and lack of knowledge were the two major obstacles in scaling up vaccine coverage [10,11].

The clean delivery coverage is also low, as shown in official report in 2001: the proportion of deliveries assisted by skilled personnel such as medical doctor, nurse, and midwife and of institutional deliver was 21% and 15%, respectively [12]. Data from MICS2 in 1999 are consistent with these findings [13]. In addition, unhygienic practices by non-skilled personnel are very common. Some report cases where the umbilical cord is cut with a kitchen knife or piece of bamboo. Traditional beliefs are influential factors tending to lower the clean delivery coverage rate [10,11].

Despite the efforts made by UNICEF, which launched the major activity to eliminate neonatal tetanus in Lao PDR in 2003, the coverage of interventions to tackle neonatal tetanus show a declining trend during the past 5 years. As no community-based representative household surveys of vaccine practices and clean delivery have been done recently, the major objective of the present study was to identify the factors associated with scaling up of the tetanus toxoid and clean delivery coverage in Lao PDR in the context of maternal and neonatal tetanus elimination.

2. Methods and materials

2.1. Study sample

This study employed multi-stage probabilistic sampling. In the first stage, five districts with a total population of 5653 were selected randomly from eight districts in Vientiane Municipality. One village from each district was selected randomly. In Lao PDR, a typical village consists of 20 subunits, which in general include 10 households. In the final stage, we selected subunits randomly and visited all households within a subunit to sample up to 30% of all registered women with children under 5 years of age.

A face-to-face interview with 212 mothers in total selected from 806 households was done from September to October 2005. These five villages were accessible by car within two hours from the center of the capital. We asked village leaders to request the mothers to stay at home on the day of the interview. The study team included two Expanded Program on Immunization officers, a gynecologist from the National Medical University of Lao PDR, three trained staff members with a medical background, and a Japanese researcher. Informed consent was obtained from the respondents before the interview.

2.2. Questionnaire

The survey questionnaire was developed by modifying and refining a field manual developed by WHO and the questionnaires used previously in Lao PDR [14]. The local expert translated the draft

Table 2
Characteristics at last delivery.

	n	(%)
Protected at birth		
Yes	169	(79.7)
No	43	(20.3)
Minimum 2 doses of TT		
Yes	109	(51.4)
No	103	(43.6)
Confirmation of TT		
Vaccination card	167	(78.8)
Recall	45	(21.2)
Number of antenatal care visits		
Mean±SD	5.7 ± 3.0	
0	14	(6.6)
≥1	198	(93.4)
Antenatal care from skilled personnel[a]		
Yes	189	(95.5)
No	9	(4.5)
Antenatal care including TT counseling		
Yes	168	(84.8)
No	30	(15.2)
Delivery assistance		
Skilled personnel[a]	145	(68.4)
Others	67	(31.6)
Delivery at health facility		
Yes	135	(63.7)
No	77	(36.3)
Previous death of child		
Yes	40	(18.9)
No	172	(81.1)
Total number	212	

[a] Skilled personnel is defined as medical doctor, nurse or midwife.

Table 3
Multivariate logistic regression model.

		Protection-at-birth		Delivery by skilled birth attendant		Delivery at health facility	
		OR	95% CI	OR	95% CI	OR	95% CI
Age	Younger than 30	1		1		1	
	30 or more	0.93	0.38–2.27	1.91	0.82–4.45	2.37	1.04–5.42
Distance to hospital	≤3 km	1		1		1	
	>3 km	0.62	0.24–1.57	1.66	0.72–3.81	1.74	0.79–3.84
Household income	≤Median	1		1		1	
	>Median	1.6	0.65–3.89	0.42	0.19–0.93	0.58	0.27–1.25
Husband's education	≤5	1		1		1	
	>6	1.08	0.41–2.84	0.88	0.41–1.91	0.71	0.33–1.51
Wife's education	≤5	1		1		1	
	>6	2.48	1.04–5.88	0.45	0.21–0.96	0.47	0.23–0.98
Wife's occupation	Housewife	1		1		1	
	Work outside	0.544	0.23–1.31	2.17	0.94–5.00	2.43	1.10–5.40
Radio usage	No	1		1		1	
	Yes	1.45	0.76–2.77	1.11	0.66–1.86	1.24	0.75–2.07
Key person of TT	Village staff	1		1		1	
	Others	0.62	0.27–1.42	1.82	0.82–4.04	3.06	1.38–6.81
Parity	Primipara	1		1		1	
	Multigravida	8.38	2.35–29.84	1.27	0.50–3.22	1.06	0.44–2.60
Previous death of child	No	1		1		1	
	Yes	0.71	0.28–1.84	0.57	0.25–1.31	0.41	0.18–0.91
Antenatal care received a minimum of four times	No	1		1		1	
	Yes	1.2	0.42–3.48	3.85	1.52–9.80	4.24	1.65–10.87
Antenatal care including TT counseling	No	1		1		1	
	Yes	3.12	1.16–8.43	1.04	0.39–2.78	0.91	0.34–2.42

questionnaire into Laotian, and a back translation was done by two trained researchers to check consistency. After a pilot test, the final set of modules was agreed upon among Laotian researchers and interviewers, including (1) socio-demographic characteristics, (2) complete history of TT vaccination, (3) knowledge about TT, (4) detailed birth and pregnancy history with information about related medical care practices, (5) child health outcomes, (6) attitudes and practices related to health-related activities. In addition to the face-to-face interviews with administration of the questionnaire, information on the participants' immunization history around the last pregnancy and delivery of their youngest child was recorded from vaccination cards where available. If respondents did not keep vaccination records, approximate dates of TT were collected from mothers' recall [15,16].

2.3. Statistical analysis

All statistical analysis was done by SPSS version 11.0J. The coverage of interventions was estimated for TT2+ during the last pregnancy, PAB, and clean deliveries. We estimated PAB by counting children whose mothers met the following criteria: (A) two or more doses of TT during the last pregnancy; (B) one TT during the last pregnancy and one or more doses prior to the last pregnancy; and (C) no TT during the latest pregnancy, but two or more doses prior to the last pregnancy and mothers still in the expected period of protection at the last delivery [17]. In case the mothers were classified as category (C), they are considered to be protected if the following conditions are met: (1) received at least two doses of TT, the last within the prior 3 years; (2) received at least three doses, the last within the prior 5 years; (3) received at least four doses, the last within 10 years; or (4) received at least five doses during lifetime [17].

The coverage of clean delivery was estimated by the percentage of deliveries which took place at a health facility and by the percentage of deliveries which were assisted by certified medical personnel (medical doctor, nurse, or midwife), regardless of the place of delivery. Multivariate logistic regression was used to assess the relationship between the intervention coverage and covariates.

3. Results

Table 1 shows the sample characteristics of 212 respondents in the present study. Respondents were women with children less than 5 years of age, and primarily of Lao Lum ethnic origin. Their mean age was 30.7 years with a standard deviation of 6.9 years. The overall response rate was 100%.

Respondents had immunization records with the type and dates of past vaccinations. Table 2 represents the coverage of interventions for neonatal tetanus. The coverage of tetanus toxoid among mothers measured by TT2+ during the last pregnancy and PAB were slightly higher than national averages in previous surveys: 51.4% and 79.7%, respectively. The proportions of delivery attended by skilled personnel and delivery at health facility were 68.4% and 63.7%, respectively.

The regression results of the multivariate logistic models are shown in Table 3. Outcome variables included PAB, delivery assisted by skilled birth attendant (doctor, nurse, or midwife), and delivery at a health facility, and their association with explanatory variables was examined.

Table 3 represents the adjusted odds ratios for the explanatory variables on outcome variables. Neonates who were born to the mothers with higher education, who had experienced delivery before, and who had received antenatal care (ANC) with counseling about TT were more likely to be protected against tetanus at birth. Mothers who had an occupation and more chances to receive antenatal care were more likely to deliver assisted by a skilled birth attendant or deliver at a health facility. Monthly household income was also associated with assisted delivery. Mother's age, deaths of a

child in the past and key person for TT (i.e., a person who encourages mothers to get vaccinated for TT such as members of Lao Women's Union) were also associated with institutional delivery. Traditional practices during pregnancy were common among respondents but were not statistically significant.

4. Discussion

This study was, as far as we know, the first community-based study to investigate simultaneously the coverage of tetanus toxoid vaccination and clean delivery in Lao PDR in the context of the maternal and neonatal tetanus elimination initiative. In this study, the coverage of tetanus immunization was 51.4% when measured as TT2+ during the last pregnancy and 79.7% when PAB was used. The coverage estimates in the present study were higher than national averages (38.1% and 55.5% for TT2+ during the last pregnancy and PAB, respectively) but consistent with the results for the urban area (47.4% and 69.6% for TT2+ and PAB, respectively) [7]. Relatively high coverage in the present study is not surprising as the study was done in the capital where many Expanded Program on Immunization activities as well as routine activities and campaigns have been in place. The discrepancy between TT2+ during the last pregnancy and PAB suggests that evaluation only by TT2+ would underestimate the protection against tetanus [18].

Facility-based records are generally poor sources of representative PAB data and thus periodic household surveys or a combination of the two measures would be necessary to obtain consistent and timely information on PAB, particularly in rural areas. Furthermore, it is important to scale up the coverage of DTP1 sufficiently so that PAB estimates can provide accurate monitoring [18]. The national coverage of DTP1 by 12 months of age was 64.1% in 2006 [7]. Thus, in Laos, TT and DPT continue to be an integral part of an Expanded Program on Immunization program not only to maximize the accuracy of PAB monitoring but also to prevent tetanus more effectively.

In the latest MICS3, 20.3% and 67.8% of deliveries in 2006 were assisted by skilled birth attendants in Lao PDR as a whole and in the urban area, respectively [7]. In the present study, 68.4% of deliveries were assisted by skilled birth attendants. According to the classification suggested by Roper et al., the study area with the coverage of clean delivery less than 70% and TT2+ less than 80% in the setting without robust surveillance system is categorized as high risk area concerning to the risk of neonatal tetanus [1]. More efforts to promote clean delivery are needed. Given the low coverage of delivery by skilled birth attendant and given the lack of emergency obstetric services, more effective use of available services and training of traditional birth attendants, although controversial in its efficacy, should be considered with operational research if needed [19–21].

There was a statistically significant positive association between antenatal care services and the coverage of tetanus toxoid and clean deliveries, which is consistent with previous studies in other countries [22–24]. However, the causal relationship between ANC, skilled birth attendants, and immunization is difficult to confirm. In the present study, the distance from health facilities, which was one of the key determinants of service coverage in previous studies, was not associated with any of the dependent variables. Possible explanations might be that the study site was located in the capital province and health facilities were accessible by road vehicles. The majority of them were classified as "Zone 0" or "Zone 1", which is located within approximately 15 km from the nearest health facility, according to the classification used by EPI programs in Lao PDR.

This study has several limitations. First, 21.2% of respondents did not have a vaccine card, and thus information on vaccination status was based on mothers' recall, which is obviously subject to recall bias. However, the recent analysis of the extent of recall bias by using the same cohorts in two consecutive Demographic and Health Surveys showed that any potential differences in rates due to recall were within the survey's sampling error [16]. Thus, we combined information both from vaccination card and mothers' recall when estimating the coverage of tetanus toxoid. Second, the present study would have missed those mothers whose children had died in the period between birth and the survey due to neonatal tetanus. Although the coverage estimate was consistent with other nationally representative survey [7,13], the exclusion of such mothers would have over-estimated the coverage of tetanus toxoid and underestimated the magnitude of the problem. Third, TT2+ in the present study was evaluated when two or more doses during last pregnancy were given within 5 years. Routine vaccine coverage in the government reports are based on the data collected for each calendar year. Therefore, figures from this study and figures from routine activity are not directly comparable. Finally, the study design does not allow an assessment of causal relationships, because it was a cross-sectional study designed to assess the current situation in Lao PDR.

Despite these limitations, however, and despite the fact that the study sites were located in the capital province, the present study shows that the progress made towards eliminating neonatal tetanus in Lao PDR is insufficient. The lack of continuum of care for mothers and newborns is the major obstacle to scaling up of tetanus toxoid coverage and PAB as well as clean deliveries. Although the Global Immunization Vision and Strategy (GIVS) launched in 2005 focuses on rural areas [25], its current status in Lao PDR is insufficient to achieve the goal of eliminating neonatal tetanus.

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