

### ***An economic evaluation of the introduction of haemophilus influenzae type b vaccine in Vietnam, including its impact on high-risk HIV-infected children***

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## Introduction

Disease caused by Haemophilus influenzae type b (Hib) is an important public health problem for children less than five years of age in developing countries. In Vietnam, the national incidence of Hib meningitis was 18 per 100,000 children per year. [1] Thanks to funding from the Global Alliance for Vaccines and Immunization, Hib vaccine was introduced for routine use in Vietnam on June 1st, 2010. [2] However, there would be almost a seven fold increase in cost of Hib vaccine compared to the previous DTP-HepB vaccine, which imposes a potential significant financial burden for the Vietnam government once donations wear off.

The study's objectives were (1) to calculate the average total treatment costs for under-five pneumonia and meningitis patients in Hanoi, Vietnam from the health system, household's and societal perspectives; and (2) to analyze the cost-effectiveness of the introduction of Hib vaccine in Vietnam from the societal perspective, including a preliminary assessment of the impact of HIV infection.

## Materials and Methods

A prospective cost survey was conducted from March to December 2012 using two methods: review of patients' medical records and personal interviews with patients' caregivers. The study population was all children from 1-59 months of age admitted to the Department of Pediatrics in Bach Mai Hospital, Hanoi with a clinical diagnosis of meningitis or pneumonia. The final surveyed population included 180 pneumonia patients and 15 meningitis patients. Results were presented in 2012 Vietnam Dong and US dollars.

To conduct the cost-effectiveness analysis, a static cohort model was developed to estimate the impact of Hib vaccine in terms of reduced disease burden and associated economic costs, and to measure the incremental cost-effectiveness ratio of Hib vaccination compared to no Hib vaccination. The 2011 Vietnam live birth cohort of 1.44 million were modeled through 2016. Model inputs included epidemiological parameters related to disease burden, vaccine-related parameters and Hib diseases associated treatment costs. Model outcomes included Hib meningitis and pneumonia cases saved, meningitis sequelae cases prevented, Hib deaths prevented, disability-adjusted life years (DALYs) averted, and Hib associated economic costs saved. All costs were presented in 2011 US\$ using the exchange rate of US\$ 1.00 = VND 21,036 [3] and future costs were discounted at 6.9%. [4] All future benefits were discounted at 5%. [5] One-way sensitivity analysis was conducted for vaccine price, Hib disease incidence, discount rate and costs of productivity losses.

For the supplementary analysis on the impact of HIV infection, the birth cohort was assumed to have 2,000 HIV-positive children. Epidemiologic values applied to the HIV-positive group were from the literature. Treatment cost estimates were inflated to reflect the higher severity of Hib disease among HIV-positive children. All other model inputs were similar as in the primary analysis. Different assumptions on proportion of birth cohort having HIV were used in sensitivity analysis.

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### Results and Discussion

#### Treatment costs of pneumonia and meningitis

From the health system perspective, the mean total direct medical costs for treating pneumonia and meningitis were VND 3.75 million (US\$ 180) and VND 6.25 million (US\$ 300), respectively. From the household's perspective, the average total treatment cost for pneumonia was US\$ 264 and that for meningitis was US\$ 442. From the societal perspective, the average total treatment cost for a pneumonia case amounted to VND 6.16 million or US\$ 296 (SD, US\$ 175; median, US\$ 244) and for a meningitis case VND 14.8 million or US\$ 711 (SD, US\$ 836; median, US\$ 454).

#### Incremental cost-effectiveness ratios (ICERs)

The Hib vaccine would prevent a total of discounted 6,459 Hib cases, 1,227 deaths and 25,125 DALYs over the first five years of lives. The vaccine also saved 87 cases of meningitis sequelae. The net costs of new vaccine introduction were US\$ 4,997,618. The base-case ICERs per discounted case, death and DALY prevented were US\$ 774, US\$ 4,075 and US\$ 199, respectively. When excluding productivity losses, the ICERs were about 2.5 times higher. In either case, the ICER per DALY averted remained less than 2011 Vietnam's GDP per capita, so Hib vaccine introduction was highly cost-effective. [6] ICERs were very sensitive to pneumonia incidence, and in all sensitivity analysis scenarios the Hib vaccine program was highly cost-effective.

When HIV infection was taken into account, the Hib vaccine program would prevent 6,567 Hib cases and 1,244 deaths. The net costs of Hib vaccine introduction would be US\$ 13,039,017. The ICERs were US\$ 1,986 per discounted Hib case and US\$ 10,484 per discounted Hib death. When the assumption of HIV prevalence was increased, the ICERs were decreased, showing a potential of more savings and more cost-effectiveness of the new program in high HIV prevalence settings.

### Conclusions

The treatment of pneumonia and meningitis imposed a huge economic cost to the society, and meningitis was more expensive to treat compared to pneumonia both from societal and household perspectives. [7, 8] Although children under 6 years old were stipulated to have free medical care, user fees were the biggest component of household's out-of-pocket expenditure. More studies on indicators of high user fees and health insurance covered medical services list will provide insights into amelioration of the problem.

In addition, the study demonstrated that from the societal perspective the introduction of Hib vaccine in Vietnam was highly cost-effective. However, our findings do not determine the affordability and sustainability of the program in the future. Besides the issue of an almost seven-fold increase in vaccine budget when self-finance (should the Hib vaccine remains at current GAVI-supported US\$ 2.52/dose), Vietnam would face the uncertainty of market vaccine prices after GAVI support ended. It is required to have a close and careful scrutiny into the government's budget so that the government will be able to allocate its scarce resource to implement this cost-effective program.

Finally, the supplementary analysis on impact of HIV infection suggested that introduction of Hib vaccine in settings with high HIV prevalence would be more cost-effective, hence more preferable to policy makers.



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