VACCINATING THAI ADOLESCENTS AGAINST HEPATITIS A: IS IT COST-EFFECTIVE?

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Abstract. Hepatitis A infection is a common disease in tropical countries, including Thailand. Hepatitis A vaccination of children and adolescents has been recommended by many countries. We performed a cost-benefit analysis in order to determine the best strategy for Thailand. Three strategies were tested: a) no intervention; b) vaccination without screening; c) vaccination after screening. A review of the literature was performed in order to set the path probability of each strategy. The cost of intervention of each strategy was identified; the outcome cost was the total economic loss due to hepatitis A infection as the result of each strategy. Benefit was the final total cost according to each strategy (cost of intervention and economic loss due to possible hepatitis A infection). Surprisingly, the most benefit was gained from a strategy of no intervention. Vaccination after screening was the worst strategy. Our results indicated that hepatitis A vaccination for Thai adolescents was not cost-effective.

INTRODUCTION

Within the last decade, hepatitis A has been recognized as a growing child health problem. This disease is easily transmitted via the fecal-oral route and from person-to-person. In some cases, hepatitis A may be spread through contaminated water and food. Children may easily spread the infection to household adults who develop serious illness and may, subsequently suffer from liver disease (Kemmer and Miskovsky, 2000; Cuthbert, 2001). The highest incidence of infection is among children of the 5 - 14 year-old age group. Though the prevalence is lower, adolescents and young adults are particularly prone to severe hepatitis infection (Sung, 2000).

Hepatitis A is a common infectious disease in tropical countries, including Thailand (Poovorawan *et al*, 2000). Because hepatitis A infection is a viral infection with non-specific treatment, preventive strategies should be used. One of the present preventive strategies is hepatitis A vaccination. The recommendation for immunization against hepatitis A was issued primarily for travelers who might come into contact with contaminated food and water in endemic areas (Marchou *et al*, 1998) and persons who are particularly susceptible to hepatitis A infection (Bell, 2000). In many countries, hepatitis A vaccination in the childhood and adolescence has been recommended (Bell, 2000; Van Damme and Van der Wielen, 2001). However, the hepatitis A endemic areas are in the developing countries and, therefore, the affordability of vaccination programs should be considered. A cost-effectiveness analysis of alternative preventive strategies in each endemic area should be performed before selecting anyone strategy. Here, we address the question "Is it worth vaccinating Thai adolescents against hepatitis A infection?"

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MATERIALS AND METHODS

This study is a cost-effectiveness analysis of several methods of immunizing Thai adolescents against hepatitis A. We focused on the adolescent group (12 - 18 years of age) because passive immunity in this group is lower than in the younger group; it is also the first age group that is prone to the severe complications of hepatitis A (Sung, 2000).

A crucial factor in the choice of a strategy for hepatitis A vaccination is the likely cost and benefit. In this study, we tested three strategies: 1) no intervention; 2) vaccination without screening; 3) vaccination after screening. A review of the literature was performed in order to set the path probability of each strategy. The hepatitis A vaccine mentioned in this study is the inactivated type, which is highly immunogenic producing protective antibodies in 98-100% (Linglof *et al*, 2001; Lopez *et al*, 2001); in this study, we accepted the immunogenicity at the level of 99%.

RESULTS

Cost estimation

An estimation of the costs of each strategy was made. The costs were estimated in Thai baht (1 US$ ≃ 43 bahts). We used primary data from the Financial Unit, King Chulalongkorn Hospital. Only the direct

cost of each strategy (cost of hepatitis A screening test and cost of hepatitis A vaccine) was estimated.

The investment cost of the first strategy, no intervention, was zero (0 baht); the second strategy, vaccination without screening, cost 2,860 baht (the cost of two doses of hepatitis A vaccine, each worth 1,430 baht); the third strategy, vaccination after screening, cost 3,140 baht [the cost of two doses of hepatitis A vaccine plus cost of the hepatitis A screening test (280 baht)].

Determination of the effectiveness of each strategy

Effectiveness is the difference between the investment cost and the expected outcome cost of each strategy. Epidemiological data relating to the outcome of each strategy (prevalence of natural immunity, immunogenicity of vaccination, prevalence of infection in susceptible groups and outcome of infection) were used in order to estimate the expected outcome cost of each strategy; this estimate is presented in Table 1 (Willner *et al*, 1998; Poovorawan *et al*, 2000; Linglof *et al*, 2001; Lopez *et al*, 2001). Then the expected outcome cost of each strategy was calculated according to an assigned path probability (Table 2). The costs

Table 1
Epidemiological data relating to the outcome of each strategy.

Parameter	%
Prevalence of natural immunity	
Existing	7.9
Not existng	92.1
Immunogenicity of vaccine	
Effective (prevent)	96
Not effective (susceptible)	4
Prevalence of infection in susceptible group	
Infection (disease)	0.08
No infection (no disease)	99.92
Outcome of infection	
OPD case	90.76
IPD case	9.24

Table 2
Path probability of each strategy.

Strategy	Path probabilities (%)[a]
1. No intervention	
1.1 No infection	99.92
1.2 Infection, disease	0.08
1.2.1 OPD case	0.0726
1.2.2 IPD case	0.0074
2. Vaccination without screening	
2.1 Effective immunogenicity	96
2.2 Not effective, susceptible	4
2.2.1 No infection	3.9968
2.2.2 Infection, disease	0.0032
2.2.2.1 OPD case	0.0031
2.2.2.2 IPD case	0.0001
3. Vaccination after screening	
3.1 Natural immunity existed	7.9
3.2 Not existed, given vaccine	92.1
3.2.1 Effective immunogenicity	88.4160
3.2.2 Not, susceptible	3.6840
3.2.2.1 No infection	3.6811
3.2.2.2 Infection, disease	0.0029
3.2.2.2.1 OPD case	0.0026
3.2.2.2.2 IPD case	0.0003

[a] The path probability for each consequence of particular action was calculated by multiplying the probabilities involved for each path; *eg* 0.08 % x 90.76 % = 0.0726 %, which would be the path probability for the item 1.2.1.

Table 3
Expected cost of the outcome of each strategy[a].

Strategies	Cost of the outcome (baht)
1. No intervention	
For OPD cases[b] (p = 0.0726)	106.48
For IPD cases[c] (p =0.0074)	138.13
Total cases	244.61
2. Vaccination without screening	
For OPD cases (p = 0.0031)	4.54
For IPD cases (p = 0.0001)	1.87
Total cases	6.41
3. Vaccination after screening	
For OPD cases (p = 0.0026)	3.81
For IPD cases (p = 0.0003)	5.60
Total cases	9.41

[a] as the model in 100 adolescents
[b] expected cost of the outcome per OPD case equaled to 1466.67 baht (direct cost + indirect cost = 1000 + 466.67 baht)
[c] expected cost of the outcome per IPD case equaled to 18,666.67 baht (direct cost + indirect cost = 15,400 + 3,266.67 baht)

Table 4
Cost - effectiveness analysis of each alternative strategy[a].

	Strategy	Cost in performing the strategy[b] (baht)	Expected outcome cost (baht)	Total cost (baht)
1.	No intervention	0	244.61	244.61
2.	Vaccination without screening	2,860	6.41	2,866.41
3.	Vaccination after screening	3,140	9.41	3,149.41

[a] as the model in 100 adolescents
[b] derived from the previous cost identification process

mentioned in this study included the direct costs (drug cost and hospitalization cost), and indirect costs (cost in loss of productivity relative to net income per capita per year, and transportation costs) of each infection, as described in a recent study (Berge *et al*, 2000). As the model in 100 adolescents, the calculated cost of each strategy is shown in Table 3.

The benefit, defined as the total cost (cost of performing the strategy derived from the previous cost identification process plus expected outcome cost) is presented in Table 4. The most benefit was gained by the no intervention strategy (Table 4), while the least beneficial strategy, that with the greatest cost, was vaccination after screening.

DISCUSSION

Hepatitis A is endemic in developing countries, and most residents are exposed in childhood. In contrast, the adult population in developed countries demonstrates falling rates of exposure with improvements in hygiene and sanitation (Kemmer and Miskovsky, 2000; Cuthbert, 2001). Therapy remains supportive and prevention holds the key to elimination

of widespread infection. However, only a low infection rate among the susceptible cases is detected. Acute infection can be prevented with inactivated, highly immunogenic vaccines.

Challenges for the future include strategies for broad-based population vaccination, including cost-effective approaches. The recommendations for hepatitis A vaccination are different due to the settings. Some indicated the effectiveness of vaccination after screening (Rajan *et al*, 2000; Chodick *et al*, 2001), some indicated vaccination without screening (Jacobs *et al*, 2000). Therefore, specific approach for each setting is necessary.

Our results indicated that it is not cost effective to give hepatitis A vaccination to Thai adolescent at present. However, if the cost of the vaccine decreases, the re-evaluation for each strategy is needed for a new conclusion. A sensitive analysis to determine the effect of a decrease in the cost of the vaccine should also be studied.

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