Cost-minimization analysis on vaccination strategies of DTaP-containing combination vaccines: evidence from China

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How is "National Immunization Program" in China

Immunization remains most cost-effective health investments, averting 2 to 3 million deaths from infectious diseases globally each year. The National Immunization Program (NIP) for China was created in 1978. Since 2007, China has been expanding the scope of its national immunization program. Nowadays, the NIP schedule includes an infant primary vaccination series of 14 kinds of vaccines which can prevent 15 diseases.

To complete full immunization of children, more than 20 doses are needed before the age of 2, under a crowded and complex schedule. Excessive numbers of doses not only increase service and social costs, but also increase the risk of adverse reactions.

Why research on "Combination vaccine"

Combination vaccine bringing together particles comparable to single component vaccines that are effective in the prevention of multiple infectious disease, being a highly efficient way of vaccination.

WHO recommended that countries develop and use combination vaccines . More than 180 countries around the world have included combined vaccines based on DTP in their national Expanded Program of Immunization (EPI) .

In China, there are two kinds of combination vaccines in the private market, the tetravalent vaccine - DTaP/Hib (New Meilianjitai， Beijingminhai), and the pentavalent vaccine - DTaP-IPV/Hib (Pentaxim, Sanofi Pasteur).

Advantages of combination vaccine

For children, it can:

increase vaccine coverage

reduce number of injections and infants' pain and crying;

For caregivers, it can:

reduce caregivers' time and effort spent

transportation cost and laborious expense;

For health service providers, it can

reduce the cost of management and inventory and

provide time space for the introduction of new vaccines .

Methods

A cost-minimization analysis (CMA) was performed from societal perspectives, and from the national and provincial dimensions.

1. **Perspectives** Societal perspective.
2. **Scenarios** Three schemes were evaluated:

   (1) DTaP, IPV, bOPV, Hib: four doses of DTaP, two doses of IPV, two doses of bOPV, and four doses of Hib.

   (2) DTaP/Hib, IPV, bOPV: four doses of DTaP/Hib, two doses of IPV, and two doses of bOPV.

   (3) DTaP-IPV/Hib: four doses of DTaP-IPV/Hib
3. **Temporal Horizon** As all of the vaccines we assessed should be administered for 2-month to 4-year of life, the time horizon for the analysis was 4 years.
4. **Discounting** All costs were estimated in 2022 values in Chinese Yuan (RMB). The past costs were inflated to 2022 according to annual consumer price index (CPI) issued by China National Bureau of Statistics (NBS).

Costs and Costing Methods

Direct medical, direct nonmedical, and indirect social costs were taken into account in the 3 schemes. Costs were obtained from multiple sources (second data, a questionnaire-based survey in Hangzhou, Zhejiang Province).

Table 1. Cost components and categories in the study.

Cost category	Items included
Direct medical costs	
Vaccine acquisition	Procurement of vaccines
Vaccine wastage cost	Costs arising from reduced quantities of vaccines for various reasons during production, transportation, storage and use
Vaccination service cost	Paid by the vaccinee to the vaccination unit.
Immunization costs	Swabs, Syringe, Hazardous wastage disposal, Surveillance, Communication, Training, Supervision, Personnel, Cold chain and other costs
Treating severe adverse reaction	Cost of treatment following serious adverse reactions
Direct nonmedical cost	
Transportation	Transportation costs to and from vaccination
Indirect cost	
Loss of productivity	Loss of productivity due to absence from work

Results

Totally, the cost per child of scheme 1,2,3 was RMB 5030.83 v.s. 4715.24 v.s. 4106.19 from societal perspective. The total cost of 2022 birth cohort of scheme 1,2,3 was 48.095 v.s. 45.078 v.s. 39.255 billion RMB.

Table 2. Summary of total cost per child and 2022 birth cohort /CNY

Cost catrgory	Scheme 1	Scheme 2	Scheme 3
Direct medical cost	814.92	1904.63	2700.89
Direct nonmedical cost	159.77	106.51	53.26
Indirect cost	4056.14	2704.10	1352.05
Total cost per child (RMB)	5030.83	4715.24	4106.19
Total cost of 2022 birth cohort (billion RMB)	48.095	45.078	39.255

At the provincial level, the scheme 3 was the least from societal perspective in 26 provinces, except Gansu, Guangxi, Guizhou, Heilongjiang and Jilin Province.

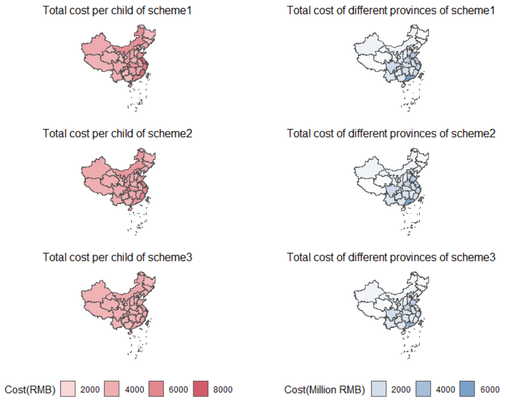

Table 1. Total cost of individual and birth cohort by schemes of different provinces in 2022.

Conclusion

The results of this study recommended immunization strategies containing DTaP/Hib and especially DTaP-IPV/Hib, for the cost saving from a societal perspective compared with the scheme containing DTaP, bOPV, IPV and Hib.and the fewer clinic visits, number of injections, and children's discomfort.

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