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Original Article

Expected cost effectiveness of the fourth dose of COVID-19 vaccine against the omicron variant of COVID-19: a preliminary report

Rujittika Mungmunpuntipantip[1], Viroj Wiwanitkit[2]

[1]*Private Academic Consultant, Bangkok, Thailand;* [2]*Dr. DY Patil University, Pune, India*

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Abstract: Objectives: COVID-19 immunization has been shown to be effective in the prevention of COVID-19. Traditionally, two doses of COVID-19 vaccines are required. Booster immunization is generally required when immunity has deteriorated. Methods: The effectiveness of the alternate boost immunization protocol is still unknown. The authors of this study used a cost-effectiveness analysis, which is a retrospective analysis on datasets on cost and effectiveness, to examine the projected cost-effectiveness of boosting COVID-19 vaccination by a fourth dose. Results: The cost-effectiveness of the fourth-dose COVID booster vaccine was found to be higher in this study. Conclusion: It could imply that vaccinating against the current pandemic of the novel form, omicron, with the additional COVID-19 vaccine is a smarter idea.

Keywords: COVID-19, vaccine, half, dose, booster, variant

Introduction

COVID-19 is still a global emergency, and there is no highly effective disease control available [1]. Vaccination is the best option for disaster management [2]. COVID-19 vaccination is now universally acknowledged as an effective primary COVID-19 preventive strategy. Traditionally, two doses of vaccines are required for full vaccination. After complete vaccination, immunity levels may diminish, necessitating the use of self-protective behavior. Many experts propose giving a third dose of the COVID-19 vaccine when there is a new developing variation and an anticipated decline in antibodies following routine immunization [3-5].

When immunity has diminished, booster immunization is usually required. After receiving the second dose of COVID-19 vaccine, immunity starts to wane. Furthermore, a new concern has emerged concerning a growing SARS CoV2 mutation that could limit vaccination efficacy. Two examples of important problematic variants are the delta and omicron variants.

A proper vaccine is currently a major concern in the treatment of the COVID-19 crisis. The fundamental objective is to adopt a cost-effective booster immunization regimen. In general, third-dose boostering is employed in a variety of settings and has been proven to be cost-effective [3]. However, the notion of using the fourth dosage for boosting has been floated in the area due to low vaccine efficacy during the first and second doses of COVID-19 immunization. The effectiveness of the fourth dose of the COVID-19 vaccine is still not completely known. In this study, the authors performed a cost-effectiveness analysis to compare the expected cost effectiveness of the fourth dose boosting COVID-19 vaccine regimen with the third dose boosting COVID-19 vaccine regimen.

Materials and methods

Boosting vaccination regimens

Using publicly accessible data, the purpose of this study is to compare the cost-effectiveness of the fourth dose boosting COVID-19 vaccine regimen to the third dose boosting COVID-19 vaccine regimen. The main researched booster vaccine in this study is mRNA vaccination. Data from a real-life governmental report in Indochina (https://www.tnnthailand.com/news/covid19/108553/) was used as the major source of information.

Table 1. Cost-effectiveness analysis for the fourth dose boosstering COVID-19 vaccine regimen versus the third dose boosstering COVID-19 vaccine regimen

Boosting COVID-19 vaccination	Cost (USD)	Utility (%)	Cost effectiveness (USD)
third dose boosstering	19.5	68	28.68
fourth dose boosstering	39	82	47.56

Study design, inclusion and exclusion criteria

The current study is a medical economic study. It is a retrospective study. The cost-effective analysis is based on retrospective analysis of available data using medical economics principles. The two primary datasets for retrospective analysis are those on cost and effectiveness. The sources of both datasets will be detailed in the next subheadings.

Considering the inclusion criteria, the basic information on the vaccine's cost and effectiveness is gathered from a standard government official source in a Southeast Asian country (GPS coordinates: 18°49'26.7" N 98°56'58.6" E). The cost and efficacy data will be explained in greater detail in the next subheadings. Exclusion occurs when there is insufficient or non-governmental approval data. The primary data was used for further cost-effectiveness analysis.

In its most basic form, cost-effectiveness refers to how productive or effective something is in comparison to its cost and is currently used in medical economics research [6-11]. In order to evaluate an intervention's health and financial effects in comparison to those of a different intervention. By calculating the cost to obtain one unit of a health result, it compares one intervention to another intervention (effectiveness or utility) [12, 13]. The following equation, "cost effectiveness = cost/utility", is used to compute the cost-effectiveness ratio for analysis [12, 13]. Retrospective reappraisal of the data on cost and effectiveness that is now available can be used to perform the analysis [12, 13]. The resulting data can immediately reflect the situation and have clinical significance because it is a direct mathematical analysis and comparison [12, 13].

Cost analysis

Basic vaccine costs are calculated using publicly available data (https://covid-19.kapook.com/view241253.html). The indicated unit cost of administering the COVID-19 vaccine booster is based on local statistics. According to publicly available information, one dose of the mRNA vaccine costs $19.5 USD.

Cost effectiveness analysis

The authors used a typical medical economics approach to examine the cost and effectiveness of all appraised COVID-19 vaccination regimens. The primary data from a publicly accessible resource is used. As previously said, the price is based on local data. The stated vaccination efficacy against the omicron form is the most important criterion in terms of effectiveness. The information was acquired from a previously established, publicly accessible source.

For cost allocation, the reported proposed vaccine price is employed, whereas for cost-effectiveness evaluation, the indicated protection rate is allocated as efficacy. The cost per effectiveness of each boosting COVID-19 vaccination regimen is calculated, and the cost effectiveness value of vaccine delivery is compared.

Results

Cost analysis

According to information that is readily available to the public, one full dose of the mRNA vaccine costs $19.5 USD. The specific costs are 19.5 USD for the third dosage booster and 38 USD for the fourth dose booster, respectively. It costs twice as much to use the fourth dose boosting regimen as compared to the third dose boosting regimen.

Cost effectiveness analysis

Table 1 shows the cost comparison of both boosting COVID-19 vaccine regimens based on cost analysis. Regarding the cost, the fourth dose booster is about twice as expensive as the third dose booster. Regarding effectiveness or utility, the fourth dose is higher (82 versus 68 for the third and fourth dose boostering regimens, respectively). **Table 1** shows the cost

per unit effectiveness of various vaccination regimens based on cost effectiveness analysis. The cost per effectiveness for the fourth dose COVID-19 vaccine regimen is higher (47.56 versus 28.68 for the third and fourth dose boostering regimens). The cost effectiveness value for the fourth dose COVID-19 boosting regimen is 1.66 times that of the third dose COVID-19 boosting regimen.

Discussion

It has been noted that protection begins to fade after receiving the COVID-19 vaccination, posing a danger of re-infection. Infection with COVID-19 is still possible, so prevention is critical. Furthermore, immunity in some specific groups, such as dialysis patients, is not good after two doses of the vaccine. As a result, suggestions for employing the third vaccination dosage are provided [3-5]. Only a few studies have been done on the efficacy of the third vaccine dose, and they are mostly limited to select populations with immunological deficiencies [14]. Many scientists now feel that the third dose of vaccine can boost immune responses, but further study is needed to confirm this idea [15]. The usefulness of the method has been confirmed by a recent study [16]. A recent study [16] found that the third dosage of COVID-19 vaccine is effective. Additional studies also confirm that using the third dose of the COVID-19 vaccine is more cost-effective than the standard two-dose vaccination [17]. Many countries attempted to use the fourth vaccine dosage as a booster due to the emergence of the omicron form and its subvariant [18-21].

Regarding the fourth dose of COVID-19 vaccine, the induction of immunoprotection is confirmed [22]. Based on the authors' experience, the administration of the fourth dose vaccine can effectively induce immunity against the COVID-19 variant [22]. The present study can support and add to the previous findings. It can confirm the cost-effectiveness of the additional vaccination dose. For the omicron variety of SARS Co-V2, the observed cost-effectiveness of the fourth dose-boosting COVID-19 vaccine regimen is greater than that of the third dose-boosting COVID-19 vaccine regimen in this investigation. It could imply that the fourth dose of the COVID-19 vaccine regimen boosted by mRNA is more cost-effective and that it would be a desirable immunization policy in the current pandemic circumstances. It can confirm the statement that the fourth dose of vaccine might be cost-effective for preventing COVID-19 [17].

The current result, however, might or might not be applicable in different circumstances and settings. This is one of the fundamental shortcomings of retrospective studies. The conclusions of the cost-effectiveness analysis are based on the data that is now available, and thus can only be used as a hint for future planning. The cost-effectiveness status could fluctuate over time and be impacted. It is advised that the investigator carry out a situation analysis in a different setting.

Conclusion

The third dose boosstering COVID-19 vaccine regimen was found to be less cost-effective than the fourth dose boosstering COVID-19 vaccine regimen. In the current pandemic crisis, it could imply that the fourth-dose COVID-19 vaccine schedule is more cost-effective and might be an alternative immunization policy at present. However, the situation might change due to the dynamic nature of the outbreak and local epidemiology in different settings.

Disclosure of conflict of interest

None.

Address correspondence to: Rujittika Mungmunpuntipantip, Private Academic Consultant, 111 Bangkok 112, Bangkok 103300, Thailand. E-mail: rujittika@gmail.com

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