Int J Physiol Pathophysiol Pharmacol 2022;14(2):129-133
www.ijppp.org /ISSN:1944-8171/IJPPP0141514

Original Article

Cost-utility-safety analysis of alternative intradermal versus classical intramuscular COVID-19 vaccination

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Received January 4, 2022; Accepted March 19, 2022; Epub April 15, 2022; Published April 30, 2022

Abstract: COVID-19 immunization has been shown to be effective in the prevention of COVID-19. Traditionally, two vaccination doses given by intramuscular injection are required. Many scientists present ideas for an alternative administration of COVID-19 for reducing the cost and solving the problem of insufficient COVID-19 vaccine supply. Regarding the new alternative vaccine administration, the important consideration is on cost, utility and safety. Herein, we performed cost-utility-safety analysis of alternative intradermal versus classical intramuscular COVID-19 vaccination. From cost analysis, a 80% cost reduction was derived from using intradermal COVID-19 vaccine administration comparing to intramuscular vaccination. Additional, cost-utility and cost-safety analysis also show that the cost per utility and cost per safety values for intradermal vaccination are lower than those of intramuscular vaccination. According to current research, intradermal immunization is a viable alternative to traditional intramuscular COVID-19 vaccine and may even be superior.

Keywords: COVID-19, vaccine, cost, utility, intradermal

Introduction

Coronavirus disease 2019 (COVID 19) has already caused health concerns in over 200 million people worldwide. Vaccination is the most effective strategy to avoid this developing coronavirus disease [1]. Many pharmaceutical companies recently announced success in COVID 19 vaccine research (November 2020). There are also reports about the vaccine's efficacy and a planned immunization price. As a new immunization, the cost and accessibility of the vaccine are critical considerations [2].

COVID-19 is still a global emergency, with no effective disease control [1]. Vaccination is the best hope for disaster management [3]. COVID-19 immunization is now widely acknowledged as an effective primary COVID-19 preventive strategy. COVID-19 vaccination has been found to be effective in COVID-19 prevention. Two immunization doses are usually given. A total of two intramuscular vaccine doses is necessary. Many scientists provide methods for minimizing the risk and eliminating the problem of insufficient COVID-19 vaccination supply by administering COVID-19 in a different way. The cost, usability, and safety of the new alternative vaccination administration are all key factors to consider. In this study, we compare the cost-utility-safety of alternate intradermal COVID-19 vaccine administration to regular intramuscular COVID-19 vaccine administration.

Materials and methods

Vaccine administration methods

In this study, only new mRNA COVID-19 vaccine administration is focused. Classical two dose vaccine administration is primarily conditioned. We studied on two vaccine administration methods, intramuscular injection and intradermal injection. For intradermal vaccine administration, based on a recent publication [4], one-fifth of the standard intramuscular mRNA vaccine dose is delivered intradermally.

Cost analysis

The unit cost of vaccine administration based on our setting is referred to (https://covid-19.kapook.com/view241253.html). Based on the public data, cost per 1 dose COVID-19 administered by intramuscular injection is equal to 19.5

Table 1. Cost-utility analysis for alternative intradermal versus classical intramuscular COVID-19 vaccination

Vaccination methods	Cost (USD)	Utility (%)	Cost-utility value (USD)
Intramuscular	39	7469	0.522
Intradermal	7.8	3773	0.207

USD. For cost comparison, a direct overall cost for intradermal versus traditional intramuscular COVID-19 vaccine is performed. For cost analysis, the unit costs of a complete vaccination by intradermal and traditional intramuscular administration are calculated. The unit cost is equal to "cost per one dose of COVID-19 vaccine x number of required dose".

Cost-utility analysis

The authors employed a normal medical economics approach to analyze the cost and utility of the new COVID 19 vaccines, which is available to the public, using a cost-utility analysis. The cost is directly quoted from public data as earlier mentioned. Regarding utility, reported vaccine efficacy in the previous comparative study is referred to. The utility is assigned as SARS-CoV-2 Anti-RBD antibody response comparing to no vaccination at 4 weeks after vaccination and presented in %. According to the referencing study [4], the utility for intradermal versus traditional intramuscular COVID-19 vaccine administration are equal to 3773% and 7469%, respectively.

The public available data, which has already been mentioned, is the primary data for study. The reported suggested vaccination price is allocated as cost, while the stated vaccine efficacy is assigned as a utility for analysis. Each COVID 19 vaccine administration cost per utility is determined, and the cost-utility value of vaccine administration is compared. In this study, the cost-utility is equal to the cost per unit utility and is calculated according to this formula "cost-effectiveness value = unit cost/unit utility".

Cost-safety analysis

The analysis of cost-safety is performed using the previously published concept for analysis of adverse effect of vaccine [5]. Briefly, a safety is assigned to a rate of no adverse effect. The data on rate of adverse effect following intradermal and traditional intramuscular COVID-19 vaccine administration is directly quoted from referencing study [4]. According to the referring study, the rates of side effects for intradermal and traditional intramuscular COVID-19 vaccine delivery are 19.4% and 40%, respectively, for intradermal and traditional intramuscular COVID-19 vaccine administration.

Supplementary materials

The primary data for the present study is based on a previous publication on the by Intapiboon et al., which can be directly accessed at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8703694/.

Results

Cost analysis

From cost analysis, the cost comparison between alternate intradermal versus traditional intramuscular COVID-19 vaccine administration showed that the cost per one vaccine recipient for intramuscular and intradermal vaccination is equal to 39 USD and 7.8 USD, respectively. A 80% cost reduction was derived from using intradermal COVID-19 vaccine administration comparing to intramuscular vaccination.

Cost-utility analysis

Based on cost-utility analysis, cost per unit utility of using intradermal COVID-19 vaccine administration is lower than that of intramuscular vaccination (**Table 1**).

Cost-safety analysis

Based on cost-safety analysis, cost per unit utility of using intradermal COVID-19 vaccine administration is lower than that of intramuscular vaccination (**Table 2**).

Discussion

COVID-19 is a coronavirus that causes severe acute respiratory syndrome (SARS-CoV-2). This deadly disease has infected over 200 million people and killed over 5 million people over the planet. Furthermore, the epidemic has deplet-

Table 2. Cost-safety analysis for alternative intradermal versus classical intramuscular COVID-19 vaccination

Vaccination methods	Cost (USD)	Safety (%)	Cost-safety value (USD)
Intramuscular	39	60	65
Intradermal	7.8	80.6	9.677

ed massive medical resources and has had a significant impact on the worldwide economy. The only way to stop this pandemic appears to be to have adequate vaccine coverage [8]. The mass vaccination, on the other hand, has proven to be a difficult task for vaccine developers, policymakers/regulators, and principal investigators [9]. On the balance of safety and efficacy of vaccinations and immunization regimens, emergency use of several vaccines has been allowed [10].

At present, the problem of insufficiency of COVID-19 still exists in many developing countries. How to find a new alternative way for vaccination is a challenge. Principally, a lower volume of vaccine dosages was chosen to reduce dose-dependent adverse effects. Intradermal delivery was then proposed as a good way to introduce reciprocal doses and minimize cost and the amount of the required vaccine [4, 11-13]. Indeed, the immunogenicity and efficacy of fractional intradermal vaccination in comparison to full dose immunizationfor prevention against several pathogens, such as influenza virus, rabies virus, poliovirus (PV), hepatitis B virus (HBV), and hepatitis A virus (HAV) has been investigated and confirmed [4].

For a new vaccine administration technique in preventive medicine, a cost-utility analysis is required. For COVID-19 vaccination, there are some reports on cost-utility comparison among different types of vaccines, but there are limited data on different vaccine administration methods [14-16]. The authors utilized a standard medical economics approach to analyze the cost and utility of the new COVID 19 vaccine administration methods, which will be offered to the general population soon. The public available data, which has already been mentioned, is the primary data for study. The reported suggested vaccination price is allocated as cost, while the stated vaccine efficacy after administration is assigned as a utility for analysis. Each COVID 19 vaccine administration cost per utility is determined, and the cost-utility value of vaccinations is compared. In addition, for a new vaccine administration, adverse effect is also important consideration. It is suggested that vaccine administration that has a lower unit cost for a safe outcome of vaccination might be better. The cost-safety value of vaccinations is also compared in this study.

Regarding intradermal COVID-19 vaccine administration, it is proposed as a new alternative approach that might be a solution to the vaccine insufficiency [17, 18]. Aside from concerns about the efficacy of intradermal COVID-19 vaccination, cost, utility, and safety are major considerations that should be investigated. An assessment of this topic is carried out in this work. Using intradermal COVID-19 vaccine injection instead of intramuscular immunization resulted in a cost savings of 80%, according to cost analysis. Furthermore, cost-utility and cost-safety analyses reveal that intradermal immunization has a lower cost per utility and cost per safety than intramuscular vaccination. According to current research, intradermal immunization is a viable alternative to traditional intramuscular COVID-19 vaccine and may even be superior.

It should note that this study is based on the medical economic analysis and data from the previous report [4] are the primary source for analysis in the present report. The innovative point is the new data from medical economic analysis. The result from cost effectiveness analysis is the new data useful for decision in selection on vaccine administration technique. In the present study, we examined the cost, usefulness, and safety of alternate intradermal COVID-19 vaccine administration to traditional intramuscular COVID-19 vaccine administration and concluded that intradermal vaccination may be a preferable option for COVID-19 vaccination. However, the most important benefit of vaccinations is protection, and according to a recent report by Intapiboon et al. [4], the intradermal vaccine is only half as protective as the intramuscular injection, thus the number of intradermal injections should be increased to get the same level of protection. Nevertheless, as already mentioned, the present study is a medical economic evaluation and the intradermal vaccination is currently in used

with the main aim for corresponding to the problem of insufficient COVID-19 immunization supply.

Finally, an update on the intradermal COVID-19 immunization issue should be mentioned. Some new intradermal DNA-based COVID-19 vaccines have previously been designed and are currently being tested in clinical studies [19, 20]. There are currently ongoing studies to develop more modern vaccination administration techniques in order to improve efficacy, safety, and cost effectiveness. In addition to the traditional intradermal vaccine delivery, a revolutionary vaccination administration technology based on microneedles is already introduced [21].

Conclusion

Based on result from cost-utility and cost-safety analysis, an intradermal COVID-19 vaccination should be considered as a good alternative approach for reducing of cost and increased sufficiency of vaccine supply.

Disclosure of conflict of interest

None.

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