Cost-Effectiveness Analysis of Nuvaxovid® Vaccination for Japanese Elderly Population

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BACKGROUND

A mass vaccination program, which deployed four different COVID-19 vaccines, was implemented in Japan in 2023 under the Immunization Act including NVX-CoV2373 (Nuvaxovid) [1]. Discussions around Japan's COVID-19 vaccination programme beyond the fiscal year of 2023 are ongoing. Given the enormous health and economic burden caused by COVID-19, information on the cost-effectiveness of the vaccinations is essential for making well-informed decisions on the future of the programme. NVX-CoV2373 is a recombinant severe respiratory syndrome coronavirus 2 (SARS-CoV-2) spike protein nanoparticle vaccine with Matrix-M adjuvant and has been available in Japan's COVID-19 vaccination programme since July 2023.

To date, the cost-effectiveness of vaccination with NVX-CoV2373 in Japan has not been evaluated. The aim of this study was to assess the cost-effectiveness of NVX-CoV2373 vaccination in elderly people (i.e., aged ≥65 years), who are at high risk of severe COVID-19, from the public healthcare payer's perspective in Japan.

OBJECTIVES

To evaluate the cost-effectiveness of vaccination with NVX-CoV2373 in Japanese aged over 65 years old.

METHODS

Analysis Framework

Two different analysis populations were defined to evaluate the cost-effectiveness of NVX-CoV2373 vaccinations in Japan, both of which consisted of elderly individuals aged ≥ 65 years. The definitions and corresponding comparators are shown in Table 1.

Table 1. Analysis Framework

Analysis population	Definition	Comparator
Analysis population 1	Elderly Japanese individuals (≥ 65 years) who had not received any COVID-19 vaccine OR Elderly Japanese individuals (≥ 65 years) who had not completed two primary vaccinations with an approved COVID-19 vaccine	No vaccination
Analysis population 2	Elderly Japanese individuals (≥ 65 years) who had received two primary vaccinations with an approved COVID-19 vaccine for at least 180 days	No booster vaccination

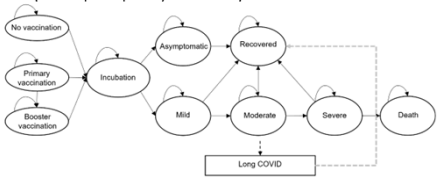
Model structure

A Markov state transition model was used in this analysis. The model used a 1-day cycle, and results were reported over a 1-year time horizon. Discount rates were not accounted for owing to the short-term time horizon. The model structures were based on Li et al. 2022 [2] with the exception of consideration of the 'long COVID' state.

In analysis population 1, individuals are assigned to the 'primary vaccination' or 'booster vaccination' states, according to prior numbers of vaccination, both started from the 'primary vaccination' state where they received two NVX-CoV2373 vaccinations. They then received a third NVX-CoV2373 vaccination 180 days later and moved to the 'booster vaccination' state. Individuals in the comparator started from the 'no vaccination' state (Fig1A). In analysis population 2, individuals who received NVX-CoV2373 booster vaccinations started from the 'booster vaccination' state and individuals in the comparator started from the 'no booster vaccination' state (Fig1B). The subsequent model structures were the same for analysis populations 1 and 2.

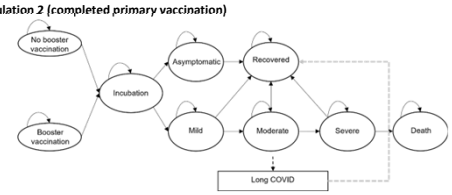
Fig 1. Model structure

A: Population 1 (not completed primary vaccinations)



Analysis population 1 comprised Japanese elderly individuals ≥ 65 years of age who had either not received any COVID-19 vaccine or had not completed two primary vaccinations with an approved COVID-19 vaccine.

B: Population 2 (completed primary vaccination)



Analysis population 2 comprised Japanese elderly individuals ≥ 65 years of age who had received two primary vaccinations with an approved COVID-19 mRNA vaccine.

Model parameters

Vaccine Efficacy

- The vaccine efficacy (VE) of NVX-CoV2373 against infection and severe disease were 88.9% and 86.9%, respectively, derived from elderly individuals (aged ≥65 years) in the pivotal Phase 3 study in the UK [3].
- The VE was assumed that it will be similar for omicron variants owing to lack of evidence of VE against omicron variants. It was also assumed that the VE of primary vaccinations was maintained by a booster vaccination and that VE did not wane over the 1-year time horizon.
- Among individuals in analysis population 2, VE of COVID-19 mRNA vaccines from their primary vaccinations against infection was 50.6%, derived from the period in which the delta variant was prevalent in Japan [4]. VE against severe disease was 83.4%, derived from studies conducted in Israel and Qatar in 2021. [5, 6]

COVID-19 Infection Rates

- Like Li et al. 2022 [2], the calculation of COVID-19 infection rates in unvaccinated individuals used relevant data derived from the period in which the omicron BA.5 variant was dominant. The average number of COVID-19 cases was calculated to be 34.5 cases per 100,000 person-days using data reported by the Ministry of Health, Labour and Welfare (MHLW) (Jun 2022 - Nov 2022) in individuals aged ≥60 years [7].
- In analysis population 1, the infection rate of individuals who did not receive NVX-CoV2373 primary and booster vaccinations was used to calculate the infection rate of individuals who received NVX-CoV2373 primary and booster vaccinations. In analysis population 2, the infection rate of individuals who received an NVX-CoV2373 booster vaccination and individuals in the 'no booster vaccination' comparator were used.

Costs

- In this analysis, the overall cost of an NVX-CoV2373 vaccination was assumed with the cost of the vaccine (Japanese yen [JPY] 9,000 per vaccine) and the administration (JPY 3,700 per vaccination).
- The average treatment costs for COVID-19 for each disease severity(except for death) were calculated using the Medical Data Vision Company Limited claims database in Japan, weighted with percentages of hospitalized patients and outpatients. The treatment cost for long COVID was based on average monthly outpatient consultation fees.

Utilities

- The utility values were derived considering utility decrements used in the NICE and utility in Japanese general population.
- The disutility value of long COVID was based on the EQ-5D-3L score determined in a survey of Japanese participants aged ≥20 years who had a documented history of COVID-19.

All model parameters in the analysis are summarized in SUPPLEMENTAL MATERIAL, Table S1.

METHODS (cont.)

Analysis

Base-case analysis

- Using the model over a 1-year time horizon, cost-effectiveness analysis was conducted from the public healthcare payer's perspective, which outcome measure was the Quality-adjusted life-years (QALYs). All costs included in the model are expressed in JPY. JPY 5 million per QALY was used as the threshold value [8, 9].

Sensitivity analysis

- To test parameter uncertainty and assess the robustness of the results, deterministic sensitivity analyses (DSAs) and probabilistic sensitivity analyses (PSAs) were performed with the settings shown in SUPPLEMENTAL MATERIAL, Table S1.

Scenario analysis

- Cost-effectiveness of the vaccination strategies in analysis populations 1 and 2 were also analysed from societal perspective, which used the parameters displayed in SUPPLEMENTAL MATERIAL, Table S2. In this scenario, absence from work and loss of productivity associated with COVID-19 were considered.

RESULTS

Base-case analysis: Public healthcare payer's perspective (Table 2)

- In analysis population 1, NVX-CoV2373 primary and booster vaccinations were estimated to cost JPY 50,480 per person and lead to a gain of 0.867 QALYs. In contrast, no vaccination was estimated to cost JPY 88,127 per person and lead to a gain of 0.851 QALYs. NVX-CoV2373 primary and booster vaccinations were dominant against the no vaccination strategy.
- In analysis population 2, NVX-CoV2373 booster vaccination was estimated to cost JPY 25,261 per person and lead to a gain of 0.867 QALYs. In contrast, no booster vaccination was estimated to cost JPY 20,251 per person and lead to a gain of 0.862 QALYs. The resulting ICER of a booster vaccination compared with no booster vaccination was JPY 910,566 per QALY.

Sensitivity analysis: Public healthcare payer's perspective (SUPPLEMENTAL MATERIAL, Figure S1 and S2)

- DSAs showed that varying any individual model parameter did not alter the overall findings in both analysis population 1 and 2. The ICER was most sensitive to the parameters 'VE against infection with primary and booster vaccinations' and 'VE against infection with booster vaccination' in analysis population 1 and 2, respectively.
- PSAs showed that the probabilities of cost effective that NVX-CoV2373 primary and booster vaccinations, and NVX-CoV2373 booster vaccination were estimated as 81.5% compared with no vaccination and 75.9% compared with no booster vaccination, respectively.

Scenario analysis: Societal perspective (Table 3)

- Even incorporating absence from work and loss of productivity associated with COVID-19, NVX-CoV2373 primary and booster vaccinations were dominant against the no vaccination strategy in analysis population 1. The ICER of an NVX-CoV2373 booster vaccination compared with no booster vaccination in analysis population 2 was JPY 865,886 per QALY.

Table 2. Base-case analysis results: Public healthcare payer's perspective

	Strategy	Cost (JPY)	Incremental cost (JPY)	Effectiveness (QALY)	Incremental effectiveness (QALY)	ICER (JPY/QALY)
Analysis population 1	Primary and booster vaccinations	50,480	−37,647	0.86714	0.01601	Dominant
	No vaccination	88,127	-	0.85113	-	-
Analysis population 2	Booster vaccination	25,261	5,010	0.86714	0.0055	910,566
	No booster vaccination	20,251	-	0.86163	-	-

Table 3. Scenario analysis results: Societal perspective

	Strategy	Cost (JPY)	Incremental cost (JPY)	Effectiveness (QALY)	Incremental effectiveness (QALY)	ICER (JPY/QALY)
Analysis population 1	Primary and booster vaccinations	54,437	−37,998	0.86714	0.01601	Dominant
	No vaccination	92,435	-	0.85113	-	-
Analysis population 2	Booster vaccination	26,955	4,764	0.86714	0.0055	865,886
	No booster dose	22,190	-	0.86163	-	-

DISCUSSION and LIMITATION

Overall, both NVX-CoV2373 primary and booster vaccinations and NVX-CoV2373 booster vaccination strategies were indicated to be highly likely to be cost-effective in the target population. In addition, in the scenario analysis from the societal perspective, the overall findings were not changed. On the other hand, several limitations exist as the following.

- Long-term VE data and data demonstrating waning of immunity from natural infection were not available at the time of this analysis. Thus, we were unable to incorporate any assumption in the model regarding attenuation of vaccine protection during the analysis period ,which may have resulted in VE overestimation.
- At the time of this analysis, data on VE of NVX-CoV2373 were only available for primary vaccinations against SARS-CoV-2 variants of the time. The VE of NVX-CoV2373 was based on primary vaccination data that pre-date the emergence of the omicron variant, and data on VE of an NVX-CoV2373 booster vaccination were not available at the time of this analysis. We cannot exclude the possibility that the VE of a primary vaccination may not be the same as that of a booster vaccination; however, immunogenicity data from studies of NVX-CoV2373 booster vaccinations suggest that the magnitude of difference in VE are not critical.
- The utility values were derived using values set in the UK, with the exception of the durations of asymptomatic infection and long COVID.

CONCLUSION

This study provides the first results of a cost-effectiveness analysis of NVX-CoV2373 vaccinations in Japan.

In unvaccinated elderly individuals (aged ≥65 years), an NVX-CoV2373 primary and booster vaccination strategy would be dominant strategy over no vaccination. Similarly, in elderly individuals who have received primary vaccination with a COVID-19 mRNA vaccine, an NVX-CoV2373 booster vaccination strategy would be cost-effective over no booster vaccination.

REFERENCES

References are listed in SUPPREMENTAL MATERIALS.

DISCLOSURES

MK, TO and HD are employees of Takeda Pharmaceutical Company Limited. NO has no competing interests to declare. AI has received honoraria from Moderna, Pfizer, Shionogi and Takeda Pharmaceutical Company Limited. This study was funded by Takeda Pharmaceutical Company Limited, Tokyo, Japan.

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