

Comparison of the Clinical and Economic Impact of Two mRNA COVID-19 Vaccines in High Risk Individuals in Japan

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BACKGROUND

- In Japan, messenger RNA (mRNA)–based vaccines against SARS-CoV-2 infection have been effective in preventing symptomatic disease¹
- Immunocompromised individuals and those aged ≥65 years are considered to be at high risk of severe COVID-19 disease,² and updated COVID-19 vaccination may be beneficial for these populations
 - A recent meta-analysis³ and study⁴ found that previously approved formulations of mRNA-1273 (Spikevax; Moderna, Inc., Cambridge, MA, USA) were more effective than BNT162b2 (Comirnaty; Pfizer Inc., New York, NY, USA) in preventing severe COVID-19 outcomes and hospitalization in immunocompromised populations and in older adults (≥65 years) in the United States, respectively
- Evaluating the effectiveness of the Moderna mRNA-1273 and Pfizer-BioNTech BNT162b2 Fall 2023 vaccines updated to target the XBB.1.5 variant in Japan can inform vaccination strategies

OBJECTIVE

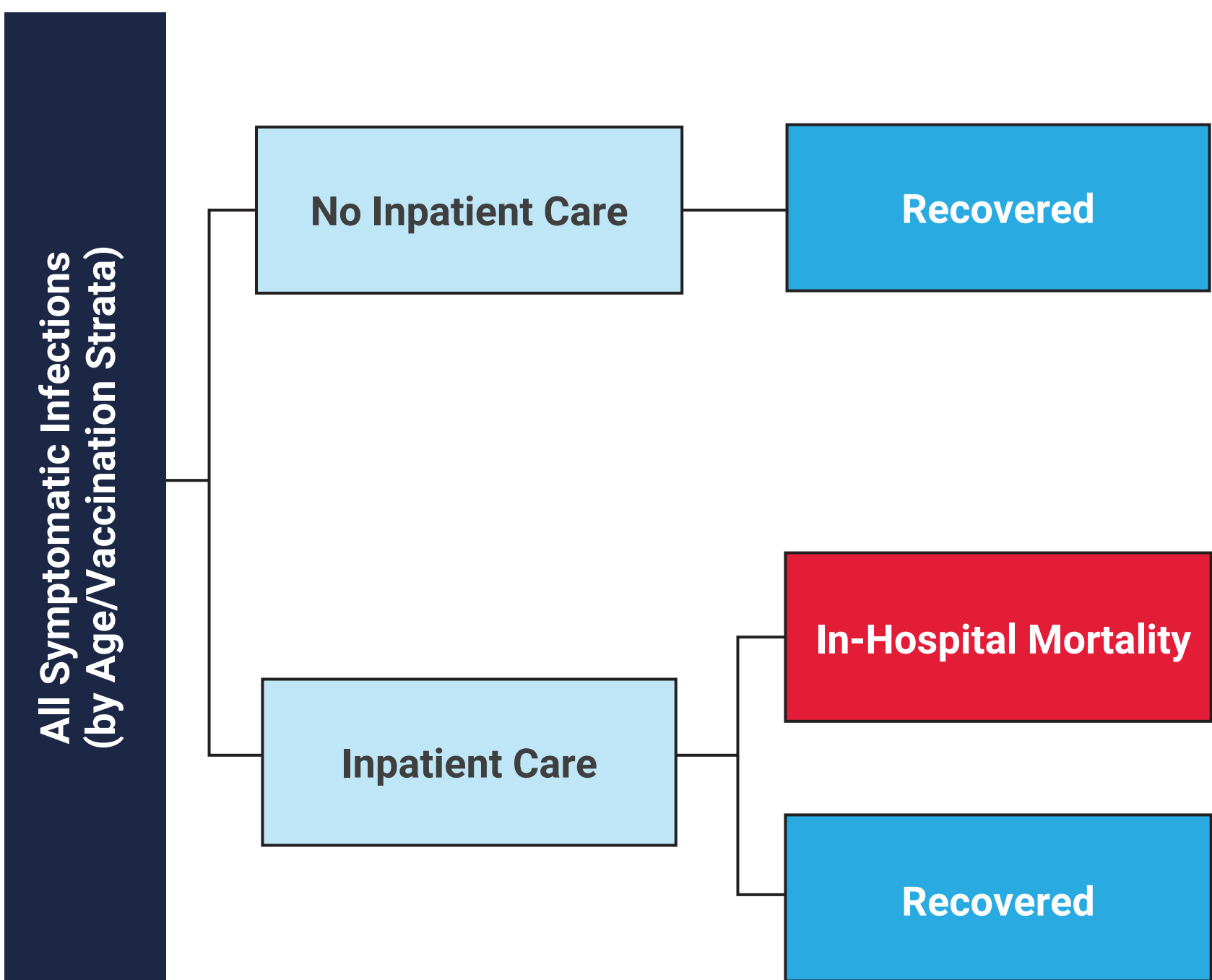
- To estimate the impact of VE on clinical outcomes and treatment costs for the Moderna Fall 2023 updated COVID-19 mRNA vaccine (Moderna Fall 2023 vaccine) versus the Pfizer-BioNTech Fall 2023 updated COVID-19 vaccine (Pfizer BioNTech Fall 2023 vaccine) over a 1-year time horizon in Japan in: 1) older adults (≥65 years) and 2) immunocompromised adults

METHODS

Model Overview

- A static decision-analytic model was used to estimate the clinical and economic outcomes between September 2023 and August 2024
 - A simple Markov model with tunnel states was used to track the vaccination status through monthly cycles
 - Individuals who developed medically attended symptomatic SARS-CoV-2 infection entered an infection consequences decision tree (Figure 1)
- The following consequences of SARS-CoV-2 infection were calculated in the model: medically attended symptomatic infections, hospitalizations, death, long COVID cases, and COVID-19 treatment costs

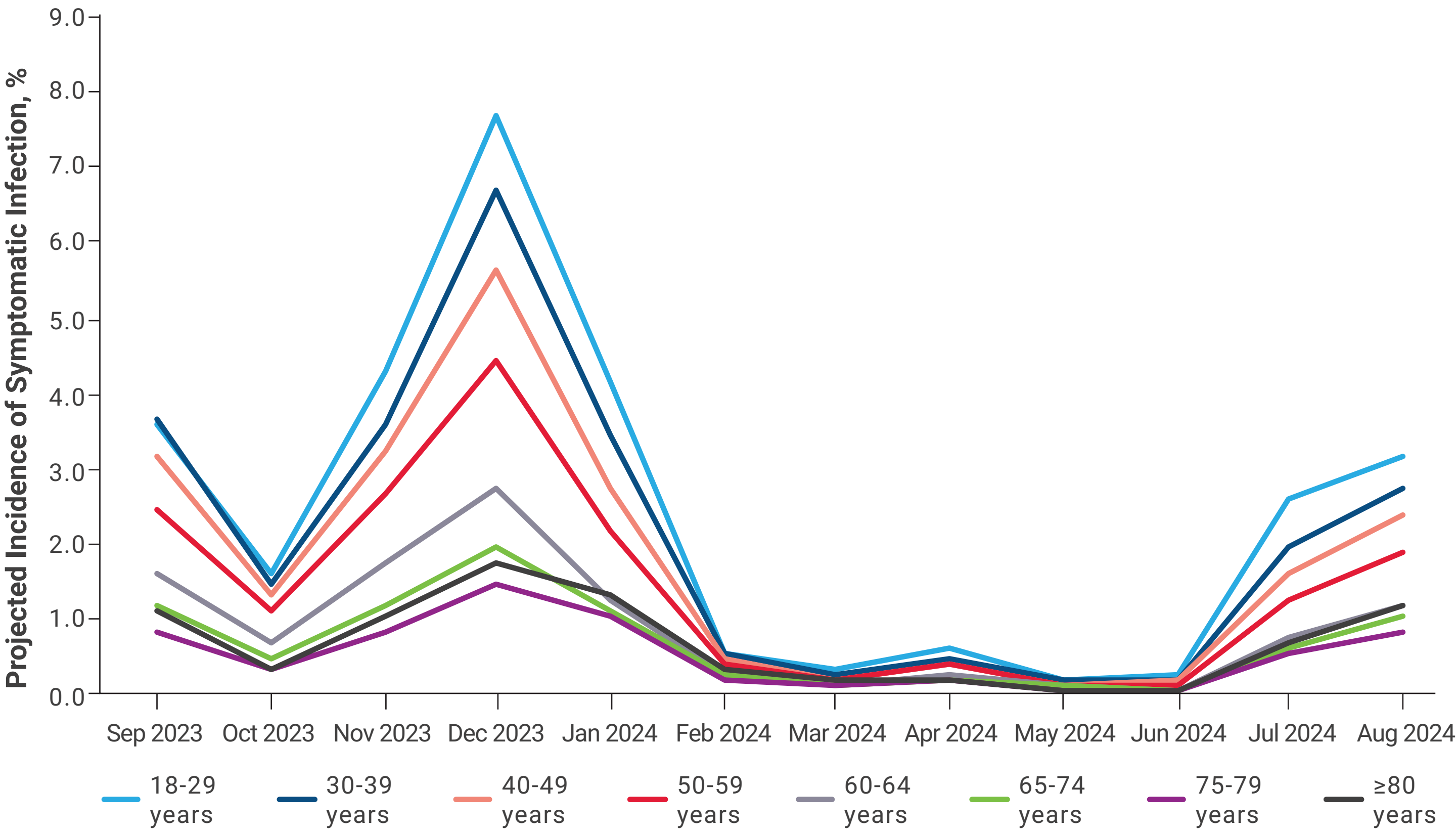
Figure 1. Infection Consequence Decision Tree



Model Inputs: Population Size and COVID-19 Incidence

- Assumptions for population size and COVID-19 incidence for both target populations are described in the **Supplementary Methods** (accessible through the QR code)
- The model considered the incidence of symptomatic COVID-19 by age (Figure 2)
 - Medium scenario incidence rates (base case) were derived from infection counts from the Tokyo prefecture between June 2022 and May 2023⁵
 - High and low incidence rates were set to 25% above and below the medium incidence scenario, respectively

Figure 2. Projected Incidence of Symptomatic Infection by Age Group (Medium Incidence Scenario)



CONCLUSIONS

- Vaccinating adults aged ≥65 years and individuals who are immunocompromised with the Moderna Fall 2023 vaccine could prevent more COVID-19–related infections, hospitalizations, deaths, and long COVID cases, and reduce the associated treatment costs in Japan compared with the Pfizer-BioNTech Fall 2023 vaccine
- The comparative effectiveness of the updated Fall 2023 mRNA COVID-19 vaccines is based on observations of past formulations of these vaccines
 - Current assumptions were based on studies of previously approved formulations of mRNA-1273 and BNT162b2
- Continued study of the clinical outcomes of VE for 2023–2024 is required to determine the comparative VE and validate these modeled projections

Model Inputs: COVID-19–Associated Outcomes and Vaccine Coverage

- Base-case input probabilities of infection-related myocarditis, infection-related hospitalization, and mortality are provided in **Supplementary Table 1** (accessible through the QR code)
- Vaccine coverage for Fall 2023 was estimated from previous vaccination campaigns^{6,7} (**Supplementary Figure 1**, accessible through the QR code)

Model Inputs: VE of Moderna and Pfizer-BioNTech Fall 2023 Vaccines

- The Moderna and Pfizer-BioNTech Fall 2023 vaccines were assumed to be well matched against the current variant; VE was approximated by assuming the same VE of bivalent vaccines against BA.4/BA.5 (**Table 1**)
- VE against infection and hospitalization for adults aged ≥65 years and ≥18 years for the Moderna bivalent vaccine were obtained from the VERSUS study, a multicenter surveillance study in Japan⁸
 - In immunocompromised individuals, the VE of the Moderna Fall 2023 vaccine was adjusted down by using data on the relative risk (RR) of hospitalizations in the immunocompromised compared to the general population⁹
 - As there were no data on the RR of infection, VE was assumed to be the same as the general population⁹
- The VE of the Pfizer-BioNTech Fall 2023 vaccine was approximated by using the relative VE (rVE) between the bivalent vaccines in those aged ≥65 years⁴ and for immunocompromised individuals³

Table 1. VE and Monthly Waning Inputs

Outcome	VE (%)	Monthly Waning ^a (%)
Adults ≥65 years		
Infection		
Moderna Fall 2023 vaccine ⁹	75.2	1.4
Pfizer-BioNTech Fall 2023 vaccine ⁴	72.2	1.4
Hospitalization		
Moderna Fall 2023 vaccine ⁸	84.9	4.8
Pfizer-BioNTech Fall 2023 vaccine ⁴	82.5	4.8
Immunocompromised adults (18-64 years)		
Infection		
Moderna Fall 2023 vaccine ⁹	54.7	1.4
Pfizer-BioNTech Fall 2023 vaccine ³	46.7	1.4
Immunocompromised adults (≥65 years)		
Infection		
Moderna Fall 2023 vaccine ⁹	75.2	1.4
Pfizer-BioNTech Fall 2023 vaccine ³	70.8	1.4
Immunocompromised adults (≥18 years)		
Hospitalization		
Moderna Fall 2023 vaccine ⁹	63.1	4.8
Pfizer-BioNTech Fall 2023 vaccine ³	58.1	4.8

VE, vaccine effectiveness.
^aAssumed to be same as monovalent booster waning against the omicron variant.¹⁰

Model Inputs: Cost and Resource Use

- Base-case inputs for cost and resource use are summarized in **Supplementary Table 2**, accessible through the QR code

RESULTS

- In both the population aged ≥65 years and the immunocompromised population, the use of the Moderna Fall 2023 vaccine was predicted to prevent more COVID-19–related infections, hospitalizations, deaths, and long COVID cases compared with the Pfizer-BioNTech Fall 2023 vaccine for all incidence and rVE scenarios (**Table 2**)
- This reduced morbidity was projected to save ¥20,086 million in treatment costs for those aged ≥65 years and ¥3682 million for the immunocompromised population using the medium incidence scenario with base-case rVE (**Table 2**)

Table 2. Cases Prevented and Treatment Cost Savings of the Moderna Fall 2023 Vaccine Versus the Pfizer-BioNTech Fall 2023 Vaccine in Japan

Incidence Scenario	Symptomatic Infections (n)	Hospitalizations (n)	Deaths (n)	Long COVID (n)	Costs (¥, million)
Adults ≥65 years					
Low	63,902	16,624	1845	14,503	15,064
Medium	85,203	22,166	2460	19,337	20,086
High	106,503	27,707	3075	24,171	25,107
Medium (low CI for rVE)	63,517	8266	917	14,612	8920
Medium (high CI for rVE)	107,194	37,299	4139	24,104	32,170
Immunocompromised adults (≥18 years)					
Low	14,198	2895	404	3633	2762
Medium	18,930	3860	539	4844	3682
High	23,663	4826	674	6055	4603
Medium (low CI for rVE)	35,758	7525	1051	9143	7127
Medium (high CI for rVE)	3318	876	122	843	791

CI, confidence interval; rVE, relative vaccine effectiveness.

References

- Maeda H, et al. *Clin Infect Dis*. 2022;75(11):1971-1979.
- Centers for Disease Control and Prevention (CDC). Underlying Medical Conditions Associated With Higher Risk for Severe COVID-19. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html>
- Wang X, et al. *Front Immunol*. 2023;14:1204831.
- Kopel H, et al. *medRxiv*. 2023.07.12.23292576.
- Open Data. Number of Infected Patients in Tokyo Prefecture. https://www.opendata.metro.tokyo.lg.jp/fukushihoken/130001_tokyo_covid19_patients_9e4b6290e76826a41c5e34ac575ee04f.csv
- Ministry of Health Labour and Welfare. Government of Japan. The 80th Meeting of the Adverse Reactions Subcommittee of the Immunization and Vaccine Subcommittee of the Health and Welfare Science Council, and the 5th Meeting of the Pharmaceutical Affairs and Food Sanitation Council in FY Reiwa 4 (jointly held). https://www.mhlw.go.jp/stf/shingiz/0000208910_00043.html
- Prime Minister's Office of Japan. About the New Coronavirus Vaccine. <https://www.kantei.go.jp/jp/headline/kansensho/vaccine.html>
- Maeda H. Effectiveness of COVID-19 vaccines in Japan (VERSUS Study). Paper presented at: 97th JAID Congress; April 29, 2023; Tokyo, Japan.
- Ferdinands JM, et al. *BMJ*. 2022;379:e072141.
- Higdon MM, et al. *Lancet Infect Dis*. 2022;22(8):1114-1116.

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Disclosures

MK is a shareholder in Quadrant Health Economics Inc., which was hired by Moderna, Inc., to conduct this analysis. MM and AL are consultants to Quadrant Health Economics Inc. AI has received honoraria from Moderna Japan Inc., Pfizer Japan Inc., Shionogi Co Ltd., Takeda Pharmaceutical Co Ltd., and AstraZeneca Japan Inc. YH, KJ, NvdV, and EB are employees of Moderna, Inc., and may hold stock/stock options in the company.

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