EE329

The Value-Based Price for a Bivalent COVID-19 Booster Vaccine in the United Kingdom

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BACKGROUND

- Several COVID-19 vaccines are approved to prevent COVID-19 outcomes, including hospitalizations and deaths[1]
  - Although these vaccines have been shown to be highly effective, waning immunity and emerging variants of concern remain a global challenge
  - To counteract the emergence of omicron subvariants, bivalent mRNA boosters against the ancestral SARS-CoV-2 strain and the omicron variant have been developed and have received authorization in several countries[2,3]; mRNA-1273.222 (ancestral- and BA.4/BA.5-specific) is one such bivalent booster that has been approved for use
- The Joint Committee on Vaccination and Immunisation in the United Kingdom has advised that a bivalent booster could be offered in autumn 2023 to individuals who are at risk of severe COVID-19, including adults aged ≥50 years, to ensure optimal protection against hospitalization and death[4]

OBJECTIVE

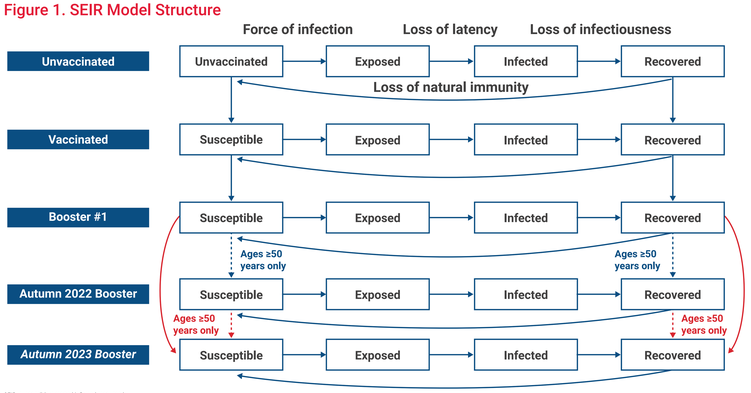
- To estimate the value-based price (VBP) in the United Kingdom for a bivalent COVID-19 vaccine used during the upcoming autumn 2023 booster campaign in individuals aged ≥50 years

METHODS

Study Design

- A previously developed susceptible-exposed-infected-recovered (SEIR) model[5] was adapted for the United Kingdom and was used to predict infections by vaccination status (with and without an autumn 2023 booster) across a 1-year time horizon from September 2023 to August 2024 (**Figure 1**)
- The model assumed that the autumn booster will be delivered from September 2023 to December 2023, with coverage peaking at 86% of that achieved after the initial COVID-19 booster, similar to the spring 2022 COVID-19 booster coverage[6] and the rate of annual influenza vaccine uptake[7]
- Initial vaccine effectiveness (VE) was predicted to be 89% and 97% against infection and hospitalization, respectively, based on omicron BA.4/BA.5 antibody titers and correlates of protection[8-10]
  - A monthly decline in protection of 4.8% (95% confidence interval [CI], 3.05-6.75) and 1.4% (95% CI, 0.62-2.38) against infection and hospitalization, respectively, was assumed based on a meta-analysis of monovalent vaccine data during the omicron (BA.1) period[11]
  - VE estimates assume that the vaccine composition is well-matched to circulating variants; both the variants and vaccine composition are likely to change in autumn 2023

Figure 1. SEIR Model Structure

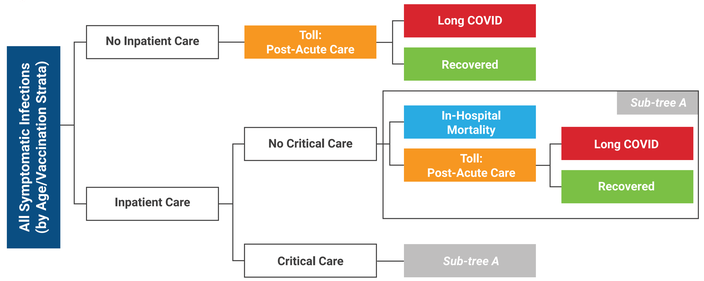


SEIR, susceptible-exposed-infected-recovered.

METHODS (CONT'D)

- A decision tree was used to predict the quality-adjusted life-years lost and to estimate the costs associated with symptomatic infections (**Figure 2**)
  - Protection against COVID-19–associated hospitalization over time was calculated using the SEIR model and applied in the decision tree to account for incremental reduction of severe over symptomatic COVID-19 in the vaccinated population

Figure 2. Decision Tree



- Rates of symptomatic COVID-19 infections, hospitalizations, and deaths were examined by age group; base case values for costs are also shown (**Table**)
- Sensitivity analyses were performed to assess the impact of specific parameter estimates for both the SEIR model and the economic consequences model

Table. Base-Case Model Inputs

Clinical Outcomes			
Age Group	**Symptomatic Infections[a]**	**Hospitalization[b]**	**Death[c]**
0-4 years	85.27%	0.10%	2.00%
5-17 years	85.21%	0.20%	2.00%
18-29 years	85.30%	0.61%	2.50%
30-39 years	85.30%	0.99%	2.50%
40-49 years	85.30%	0.88%	3.06%
50-64 years	85.14%	1.33%	8.34%
65-74 years	80.84%	2.99%	17.13%
75-84 years	80.84%	6.80%	24.68%
≥85 years	80.84%	8.19%	28.36%

Costs		
Cost Parameters	**Value**	**Source**
Hospitalization costs	£3,661	National Health Service 2022[12]
Post-discharge recovery	£383.92	Metry 2022[13]; Jones 2021[14]
Cost for patients who are not hospitalized	£171.73[d]	Jones 2021[14]
Proportion of hospitalized cases with long COVID	100%	Metry 2022[13]
Proportion of outpatient cases with long COVID	5%	Office for National Statistics 2022[15]
Long COVID costs	£2,115.61	Metry 2022[13]

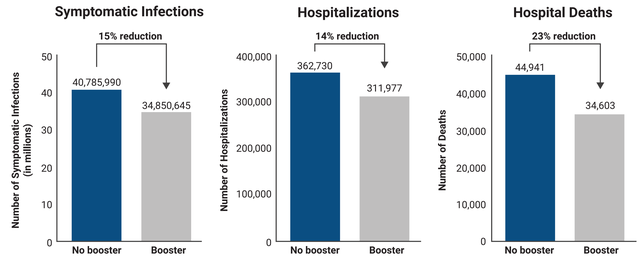
[a]Inputs calculated from Reese 2021.[16]
[b]Inputs calculated from Ferguson 2021[17] and Nyberg 2022.[18]
[c]Inputs calculated from Shiri 2021.[19]
[d]Assumes that 50% of the those not hospitalized seek medical care.

RESULTS

Base Case

- In the base case scenario, 5.9 million symptomatic infections, 51,000 hospitalizations, and 10,000 deaths would be averted with the use of an autumn 2023 bivalent booster in individuals aged ≥50 years; this equates to a 15%, 14%, and 23% reduction in symptomatic infections, hospitalizations, and deaths, respectively (**Figure 3**)
- Considering a willingness-to-pay (WTP) threshold of £20,000, the VBP associated with an autumn 2023 booster campaign, including administration, is £343/dose
  - Considering a WTP threshold of £30,000, the VBP is £476/dose

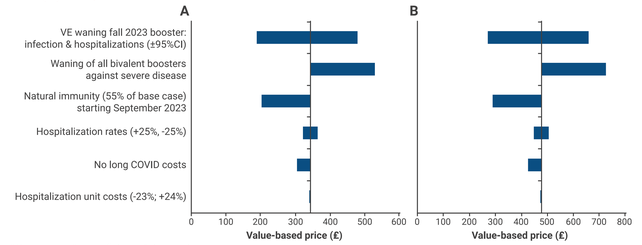
Figure 3. Potential Reduction in Symptomatic Infections, Hospitalizations, and Deaths Following Receipt of an Autumn 2023 Bivalent Booster



Sensitivity Analyses

- The VBP is most sensitive to changes in the rate of waning of the autumn 2023 booster, which changes the overall VE throughout the year (**Figure 4**)
  - Doubling the rate of waning for booster effectiveness increases the VBP by 54% because the effectiveness provided from past campaigns falls faster and an autumn 2023 booster becomes more valuable
- The VBP is also sensitive to changes in the incidence of symptomatic infections, which varied by changing the waning rate of natural immunity
- Excluding the post-infection costs (e.g., long COVID) reduces the VBP by 11%
- Varying hospitalization rates by ±25% changes the VBP by ±6%
- Varying hospitalization unit costs only impacts the VBP by 1%
- For the sensitivity analyses, the number of symptomatic infections, hospitalizations, and deaths averted with the use of an autumn 2023 bivalent booster is shown in the **Supplemental Table**, which can be accessed through the **QR code**

Figure 4. Impact of Sensitivity on the VBP Considering a WTP Threshold of (A) £20,000 and (B) £30,000



VBP, value-based price; VE, vaccine effectiveness; WTP, willingness-to-pay.

CONCLUSIONS

- While the trajectory of COVID-19 incidence is highly uncertain, pricing the bivalent booster lower than the VBP is expected to result in a cost-effective strategy for the United Kingdom
- As long as COVID-19 continues to circulate, maintaining protection against severe outcomes in at-risk populations is expected to reduce morbidity and mortality and the impact on the National Health Service in the United Kingdom

ABSTRACT PLAIN LANGUAGE SUMMARY

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Disclosures

MK is a shareholder in Quadrant Health Economics Inc., which was contracted by Moderna, Inc., to conduct this study. MM, AL, and MD are consultants at Quadrant Health Economics Inc. SC and NV are employees of Moderna, Inc., and hold stock/stock options in the company.

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