Assessing the Impact of COVID-19 on National Productivity in Korea: A Fall 2023 Analysis

Sewon Joung[1], Youngju Kang[2], Ekkehard Beck[3], Keya Joshi[3], Hankil Lee[1,4 *]

[1] Department of Biohealth Regulatory Science, Graduate School of Ajou University, South Korea
[2] Moderna Korea, Seoul, South Korea
[3] Moderna, Inc., Cambridge, MA, USA
[4] College of Pharmacy, Ajou University, South Korea
(Presenting author: joungsw3125@ajou.ac.kr, *Corresponding author: hankil@ajou.ac.kr)
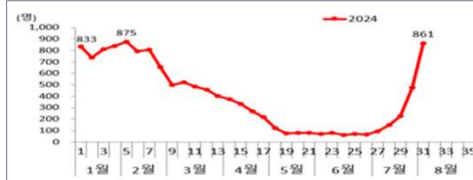
KEYWORDS

COVID-19, Socioeconomic impact, Cost estimation, Productivity loss, Medical cost, Vaccination

BACKGROUND

Trend of COVID-19 Outbreak
- As of August 31, 2023, the cumulative COVID-19 cases in South Korea is *34.57 million*, meaning that *66.8%* has been infected at least once.
- *The trend of hospitalized COVID-19 patients has surged* since July 2024.

Post-COVID
- Post-COVID syndrome refers to *unexplained symptoms lasting over three months* after a COVID-19 diagnosis.
- *The prevalence of post-COVID syndrome in Asia is 49.79%,* as reported in a meta-analysis by (Razak et al. ,2024)

Impact of COVID-19
- *Korea's National Health Insurance spent about 7 trillion KRW* on COVID-19 from 2020 to September 2022, with nearly 50%, or 3.4 trillion KRW, spent during the three-month Omicron surge from March to June 2022. (Choi et al. ,2022)
- Considering *impact of COVID-19 in South Korea*, including medical costs and productivity losses, can inform future response strategies.

OBJECTIVES

- This study aims to predict *the impact of COVID-19 on national productivity in South Korea* from fall 2023 to fall 2024 within the Korean context.

METHODS

Model Structure: Estimating Total Impact of COVID-19

Medical cost
Direct medical costs from clinical outcomes due to COVID-19 infection.
Target population:
The entire population of South Korea

+

Productivity loss
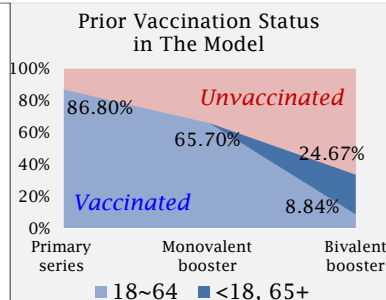Absenteeism and replacement cost due to COVID-19 infection
Target population:
Working population of South Korea

From the government's perspective, the costs include productivity losses due to absenteeism and medical costs covered by National Health Insurance (NHI).
From the individual's perspective, the costs include wage loss due to unpaid sick leave (productivity loss) and medical costs not covered by NHI.

Key Assumptions of Model

- *Cost Estimation Period:* November 2023 to October 2024 (12 months)
- *No one receives the XBB booster (23'-24'), which is administered under NIP starting in October 2023.*
- The population *benefits from residual protection due to prior vaccinations.*

<Vaccination Rollout Schedule※>
→ *February 2021: Primary series*
→ *October 2021: Monovalent booster*
→ *October 2022: Bivalent booster*

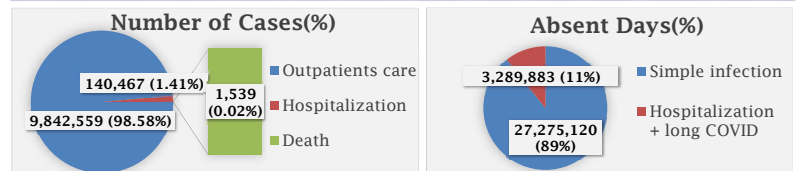※ *The vaccination schedule is referenced by the National Immunization Program (NIP).*

Prior Vaccination Status in The Model

86.80% Vaccinated
65.70%
24.67%
8.84%
Unvaccinated

Primary series / Monovalent booster / Bivalent booster
■ 18~64 ■ <18, 65+

Key Variables for Estimating the Impact of COVID-19

Category	Variable name	Value, *Reference* (Group: 18~64 / <18 & 65+)
1. Population	National population	35,207,507/16,505,112
	Employed population	25,166,010
	Dependents per population	0.47(Total), 0.51(Employed)
2. Prior vaccination status	Vaccinated population(%)	(only prim*) 21.10%, (booster) 65.70%
	Unvaccinated population(%)	13.20%
3. Prior vaccination efficacy (Residual protection)	Infection-VE** (%)	(mono***)56%, (Biv****)56%
	Hospitalization-VE** (%)	(prim*)58%, (mono***)83%, (Biv****)83%
	Infection -monthly VE** waning (%)	4.75%
	Hospitalization -monthly VE** waning (%)	1.37%
4. Probability of case	Hospitalization (%)	0.83% / 6.15%
	Death after Hosp.(%)	0.48% / 1.28%
	Severe Long COVID (%)	2.10%
5. Infection rate	Unvaccinated COVID-19 incidence(%)	21.50%
6. Productivity loss	Maximum paid sick days	15 *(Korean Labor Standards Act)*
	Wage per day & Year (₩→$)	*from KOSIS Labor data*
	Replacement cost (₩→$)	*wage per day * friction days*
7. Absent days & cost	Simple infection (days, ₩→$)	*from HIRA big data open portal (KCD code: U071-COVID19, U099-Long-COVID)*
	Hospitalization (days, ₩→$)	
	Long COVID (days)	
8. Medical cost	Insurance co-payment(%)	30%

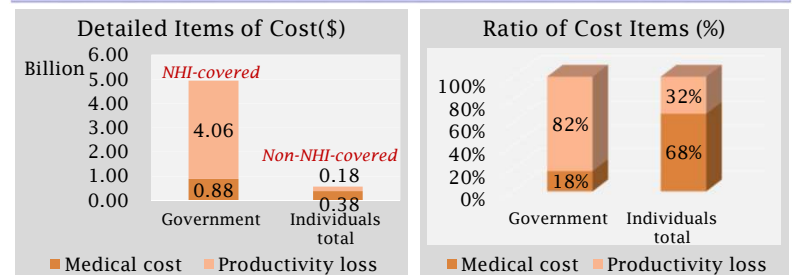**Primary series, **VE : Vaccination efficacy, ***Monovalent booster, ****Bivalent booster*

RESULTS

Clinical Outcomes: Impacting Medical Costs & National Productivity

Number of Cases(%)
140,467 (1.41%)
1,539 (0.02%)
9,842,559 (98.58%)
■ Outpatients care ■ Hospitalization ■ Death

Absent Days(%)
3,289,883 (11%)
27,275,120 (89%)
■ Simple infection ■ Hospitalization + long COVID

Total Impact of COVID-19: Government & Individual Perspective

Detailed Items of Cost($)
Billion
6.00 / 5.00 / 4.00 / 3.00 / 2.00 / 1.00 / 0.00
NHI-covered
4.06
0.88
Non-NHI-covered
0.18
0.38
Government / Individuals total
■ Medical cost ■ Productivity loss

Ratio of Cost Items (%)
100% / 80% / 60% / 40% / 20% / 0%
82%
18%
32%
68%
Government / Individuals total
■ Medical cost ■ Productivity loss

- *From the government's perspective,* the total cost was *USD 4.94 billion*
- *From the individual's perspective,* the total cost was *USD 0.55 billion*

DISCUSSION

- Korea's NHIS spent *KRW 7 trillion on COVID-19-related medical costs over three years (Jan 2020–June 2022)* (Choi et al., 2022), with this study estimating *KRW 1 trillion for Nov 2023–Oct 2024.*
- While U.S. workers faced an annual income loss of *USD 9,000 per person from COVID-19 (March 2020–June 2022)* (Goda et al., 2023), this study estimates Korea's loss at *USD 406.84 per case (Nov 2023–Oct 2024)*
- → *The predicted impact of COVID-19 has decreased since the early stages of the pandemic.*
- → The impact of COVID-19 may change dynamically over time, and it continues *to incur significant costs even in 2023 and 2024.*

<Limitations>
- Some variables were unavailable locally, so we used international values.
- Outdated values may have led to an overestimation of COVID-19 costs.
- In Korea, XBB vaccines have been administered from Oct 2023, but the model did not account for any XBB vaccinations.

CONCLUSION

- This study finds that COVID-19 resulted in *an economic loss of USD 5.49 billion* from a combined government and individual perspective.
- *Productivity losses constitute the largest share of total costs* in the overall national estimate due to COVID-19.
- This study examined the *cost items and scale* associated with infectious diseases, offering valuable insights for *future response strategies*.

ACKNOWLEDGEMENTS & CONFLICT OF INTEREST