Cost-Effectiveness of Universal Asymptomatic Preoperative SARS-CoV-2 PCR Screening: A Cost Utility Analysis

EE643
ISPOR Europe
In Copenhagen
November 12-15, 2023

Shunsuke Uno[1, 2], Rei Goto[2,3,4], Kimiko Honda[2,4,5], Sho Uchida[1], Yoshifumi Uwamino[6], Ho Namkoong[1], Ayumi Yoshifuji[1], Kei Mikita[1], Yaoko Takano[7], Morio Matsumoto[8], Yuko Kitagawa[9], Naoki Hasegawa[1]

1) Department of infectious diseases, Keio University School of Medicine; 2) HTA Unit, Department of Preventive Medicine and Public Health; 3) Graduate School of Business Administration, Keio University; 4) Graduate School of Health Management, Keio University; 5) Center of Health Economics and Health Technology Assessment, Keio University Global Research Institute; 6)Department of Laboratory Medicine, Keio University School of Medicine; 7) Division of Infectious Diseases and Infection Control, Keio University Hospital; 8) Department of Orthopedics, Keio University School of Medicine; 9) Department of Surgery, Keio University School of Medicine

INTRODUCTION

– Some guidelines recommend implementing preoperative asymptomatic SARS-CoV-2 PCR screening to minimize the risk of postoperative pulmonary complications (PPCs) in major surgery [1,2].

– Prior research has demonstrated the benefits of the preoperative SARS-CoV-2 asymptomatic screening test in improving patient outcomes before major surgeries or in high SARS-CoV-2 risk areas [3].

– Another report revealed that the implementation of preprocedural SARS-CoV-2 testing might be a low-yield approach with high direct healthcare costs to identify a single patient [4].

– Compared to the early days of the pandemic, vaccines have become widely available, and the severity and morbidity of the disease have changed [5].

RESEARCH OBJECTIVE

– We aimed to investigate the cost-effectiveness of universal preoperative screening in asymptomatic patients for SARS-CoV-2 with polymerase chain reaction (PCR) tests.

METHODS

Model design

– We applied decision tree model to evaluate performing preoperative screening 2 to 3 days before admission vs no screening.

– The screening test method: PCR with a nasopharyngeal swab sample, the most sensitive of the routinely performed tests

– Test positive rate assumption: 0.07% in the base case analysis [6]

– Time horizon: 3 months, without discounting

– A willingness-to-pay threshold was set at 5,000,000 JPY.

– We analysed using TreeAge Pro 2022 (TreeAge Software, LLC, Massachusetts, US)

METHODS (continued)

Data Sources

– The treatment cost of COVID-19 was based on our previously calculated data, which was based on hospital claims data of patients admitted due to COVID-19 at Keio University Hospital [7]

– The screening cost assumption: 8500 JPY (64.6 USD)

– We calculated at 1 USD = 131.56 JPY.

– We extrapolated utility values widely used in cost-utility analyses of COVID-19 therapeutics as COVID-19 disutility [8,9].

– The model transition probabilities and the sensitivity and specificity of the SARS-CoV-2 PCR test using nasopharyngeal swab specimens were derived from the best available evidence reported in the peer-reviewed literature.

Modeling assumptions and Sensitivity analyses

– The related expenses would be added to the surgical cost if a PPC occurred.

– The cost of treating PPCs and their treatment duration were assumed to be the same as those of inpatient COVID-19 care, regardless of surgical procedures.

– Utilities were calculated by subtracting the disutility due to a PPC, where the disutility due to COVID-19 was extrapolated from the baseline value, which was set at 1.0 in this study.

– The reduction in utility due to surgery or primary diseases was not considered.

– The utility would return to its baseline level once acute COVID-19 or a PPC had healed.

– The positive PCR test in the base case was the first positive and not the detection of residual SARS-CoV-2 virus.

– We performed deterministic sensitivity analyses.

RESULTS

Table 1. Result of base case analysis

	with screening	without screening
Cost, USD	8,635.47	8,575.97
incremental cost, USD	59.5	(ref)
Mortality	0.00429	0.0044
decreased mortality	0.000105	(ref)
Utility	0.248306	0.248279
incremental utility	0.000029	(ref)
Incremental cost of one death averted, USD	566,047	-
ICER, USD/QALY	2,212,856	-

Table 2. Input parameters and ranges used for sensitivity analyses

Parameters	Base case value	Ranges for sensitivity analysis		References
		lower bound	Upper bound	
Test-positive rate at asymptomatic screening	0.0007	0.0003	0.295	[6, 10, 11]
Sensitivity of SARS-CoV-2 PCR test	0.848	0.768	0.924	[12]
Specificity of SARS-CoV-2 PCR test	0.989	0.974	0.998	[12]
Cost for COVID-19 or PPC treatment, JPY				
mild	1,113,680	914,748	1,454,288	[7]
moderate	1,643,909	1,352,123	2,512,986	[7]
severe	6,210,607	4,755,954	11,234,745	[7]
Cost for SARS-CoV-2 PCR test (screening test), JPY	8,500	4,500	15,000	
Surgical cost, JPY	1,000,000	500,000	1,500,000	assumption
Duration of COVID-19 or PPC treatment, days				
mild	9	7	11	[7]
moderate	12	10	15	[7]
severe	17	14	26	[7]
Disutility for COVID-19 or PPC				
mild	−0.19	−0.285	−0.095	[8]
moderate	−0.4	−0.6	−0.2	[8,9]
severe	−0.6	−0.9	−0.3	[8,9]
Probability inputs				
being asymptomatic among SARS-CoV-2 PCR-positive individuals	0.425	0.296	0.778	[13]
being moderate COVID-19	0.139	0.136	0.142	[14]
being severe COVID-19	0.047	0.045	0.049	[14]
mortality with severe COVID-19	0.49	0.469	0.512	[14]
developing PPC among SARS-CoV-2 positive patients	0.512	0.0416	1	[15]
developed PPC being severe among SARS-CoV-2 positive patients	0.522	0.48	0.563	[15]
mortality with severe PPC in SARS-CoV-2 positive patients	0.728†	0.674	0.777	[15]
developing PPC among SARS-CoV-2 negative patients	0.0416	0.0364	0.0473	[16]
developed PPC being severe among SARS-CoV-2 negative patients	0.308	0.248	0.373	[16]
mortality with severe PPC in SARS-CoV-2 negative patients	0.333†	0.224	0.457	[16]

†As a breakdown of mortality by severity was not available in the literature, we assumed that all mortality was among severely ill patients.
JPY: Japanese Yen; PCR: polymerase chain reaction; PPCs: postoperative pulmonary complications

QR code to access the published article.

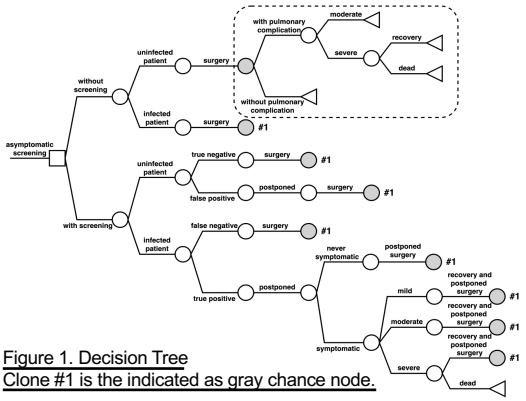

Figure 1. Decision Tree
Clone #1 is the indicated as gray chance node.

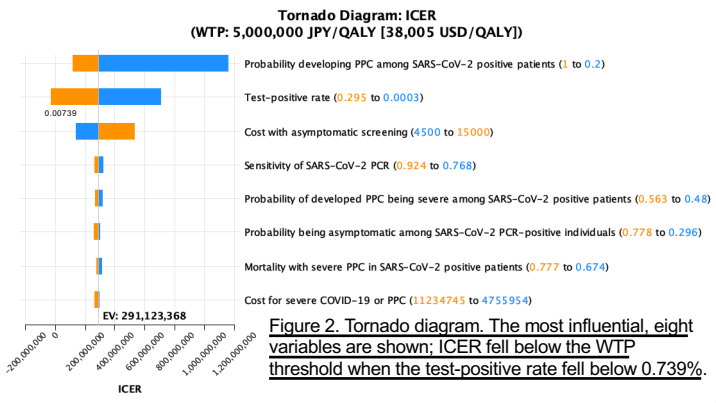

Figure 2. Tornado diagram. The most influential, eight variables are shown; ICER fell below the WTP threshold when the test-positive rate fell below 0.739%.

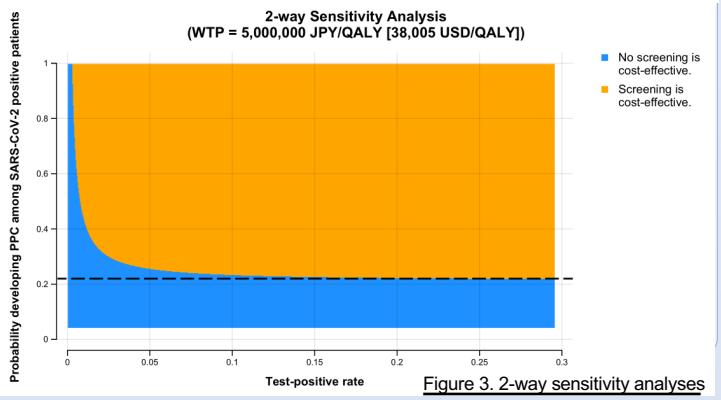

Figure 3. 2-way sensitivity analyses

CONCLUSIONS

Asymptomatic preoperative universal SARS-CoV-2 PCR screening is not cost-effective in the base case analysis. The cost-effectiveness of asymptomatic screening depends mainly on the test-positive rate, the incidence of PPCs, and screening costs; however, if the vaccine reduced the incidence of PPCs to the same level as in the pre-COVID-19 era, asymptomatic screening would not be cost-effective, regardless of the test-positive rate.

REFERENCES

[1] https://www.idsociety.org/practice-guideline/covid-19-guideline-diagnostics/ [2] https://www.asahq.org/about-asa/newsroom/news-releases/2022/06/asa-apsf-statement-on-perioperative-testing-for-covid [3] Br J Surg **2021**; 108:88–96 [4] Infect Control Hosp Epidemiol **2023**; 44:824–826. [5] JAMA Netw Open **2023**; 6:e232598 [6] J Clin Virol **2021**; 142:104915 [7] Cost Eff Resour Alloc **2023**; 21:43 [8] https://icer.org/wp-content/uploads/2020/11/ICER-COVID_Updated_Report_11102020.pdf [9] Clin Ther **2021**; 43:1877-1893.e4 [10] Clin Microbiol Infect **2021**; 27:658–659 [11] PLoS One **2020**; 15:e0238409 [12] JAMA Intern Med **2021**; 181:353–360 [13] Ann Intern Med **2021**; 174:655–662 [14] JAMA **2020**; 323:1239–1242 [15] Lancet **2020**; 396:27–38. [16] Eur J Anaesthesiol **2015**; 32:458–470.

ACKOWLEDGMENTS

Ethics approval and consent to participate: Personal data were not handled; therefore, based on the Ethical Guidelines for Medical and Health Research Involving Human Subjects issued by the Japanese Ministry of Health, Labour and Welfare, ethics approval did not apply to this study. We acknowledge the National Institute of Public Health for the funding support of the this poster presentation.

www.PosterPresentations.com