

# The future of vaccination and herd immunity in the COVID-19 pandemic Supriyadi<sup>22</sup>

Biostatistic Department, Health Science Faculty, Universitas Muhammadiyah Purwokerto, Banyumas, Central Java, Indonesia

## ABSTRACT

Since a year ago, pandemic covid 19 has entered Indonesia, and efforts to reduce and control have been carried out several programs, one of which is vaccination. The ideal projection is two direct strategies: hybrid distribution that combines active outreach into priority groups with passive distribution to the general public and single-dose distribution to as many populations as possible. The previous plan was to save a second dose as a backup. The proper fulfillment of vaccination needs in each population required to achieve herd immunity to stop the spread of the virus will vary, depending on the variant of the virus in circulation and the heterogeneous level of that population, also depending on the density and mobility of the population. In addition, the duration of protection provided by natural immunity and vaccine-induced immunity is not well established, and different vaccines can provide different durations and degrees of humoral and cellular immunity.

### INTRODUCTION

Since a year ago, the covid 19 pandemics has entered Indonesia, and efforts to reduce and control have been carried out several programs, one of which is vaccination. After going through phase III clinical trials, Worl Health Organization (WHO) said the Sinovac vaccine has efficacy values to prevent 51 percent of symptomatic COVID-19 cases in people aged 18 years and over. At the same time, research conducted in Indonesia found that the efficacy of the Sinovac vaccine reached about 65 percent. Vaccines can also prevent potential hospitalization cases by up to 100 percent in the vaccine-receiving population.<sup>1</sup>

So far, millions of vaccine doses have been given to the public to achieve the met target of 70% of the population being vaccinated to form herd immunity. Vaccination is prioritized for those at high risks, such as the elderly, health workers, and people with chronic diseases such as heart disease, cancer, and diabetes.<sup>2</sup> The development of vaccination on 25 Juli2021, about 27.3% of the world's population has been vaccinated the first dose, but people in low-income countries only 1.1% and Indonesia has obtained breast milk vaccines much as 16.26%, with details that have received complete vaccination 6.55% and first vaccination 9.71%.<sup>3</sup>

Referring to the achievement of national vaccination obtained data until July 25, 2021, it takes as long as 162 days to achieve vaccination coverage of 16.26%; then, it takes an additional 521 days (1.5 years) if you want to reach the target of 70% with a normal vaccination rhythm. The Indonesian government needs to accelerate vaccination more massively. However, given the number of international vaccine production that is experiencing constraints will have an impact on the potential to increase the number of high-risk communities for exposure. Protection and prevention measures against immediate transmission should be taken to anticipate the high rate of virus reproduction by strengthening 5M (Mask, Handwashing, physical distancing, avoiding crowds, and reducing mobility).

The reproductive rate (R0) of the virus is very high: 2.24-3.58 to 72 hours or more on the surface of an object. If this occurs in people over the age of fifty-five and people with chronic diseases at risk, it is greater to experience the severity of even.<sup>4</sup> A variant of the virus falls into the VOI category (Varians of Interest) known as delta. Varian Delta is predicted to be 40 percent more contagious than the Alpha variant. One person infected with the Delta variant can transmit the same virus to 7-8 others. The emergence of the delta variant (B.1617.2) has spread very quickly. Some countries are protecting with vaccinations, one of which is Pfizer's vaccine. Vaccine BNT162b2(Pfizer), the effectiveness of two doses is 93.7% (95% CI, 91.6 to 95.3) among people with alpha variants and 88.0% (95% CI, 85.3 to 90.1) among those with delta variants. With the ChAdOx1 nCoV-19 vaccine, the effectiveness of two doses was 74.5% (95% CI, 68.4 to 79.4) among people with alpha and 67.0% (95% CI, 61.3 to 71.8) variants among those with delta variants.5

#### CHALLENGES OF VACCINATION PROGRAM

Single-dose (82%) is expected to save more lives than using two doses since the first vaccine injection in extensive

https://doi.org/10.30595/medisains.v19i2.11661

©(2021) by the Medisains Journal. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. More information is available at <u>Attribution-NonCommercial 4.0 International</u>.

coverage provides a greater level of protection in the population than complete vaccination. Although first-dose campaigns can speed up group immunity and require far fewer resources than 2-dose campaigns, it is worth being careful that additional data and single-dose trials are needed to establish efficacy. If the efficacy of a single dose < 82%, then the difference between a single-dose strategy and a 2-dose strategy becomes smaller-the same rate in mortality rates from both strategies when single-dose efficacy was 52%. Vaccines with low efficacy may increase the risk of resistance to the new variant.<sup>6,7</sup> May be a political, commercial, and social role in shifting priorities during vaccination campaigns.<sup>8</sup> The overestimation that vaccines provide lasting immunity and prevent fatal infections or symptoms, pandemic fatigue, or overconfidence in vaccination campaigns triggers risky behaviors that cause cases to surge toward the peak of pandemics in the absence of effective mitigation. The effect of vaccine benefits on public health begins to decrease when there is a high and rapid rate of COVID-19 transmission, looser mitigation measures, lower immunity levels before the emergence of the more contagious SARS-CoV-2 variant.

Risk is an approach to maximizing the vaccine's effects, but not at the expense of vaccination speed. The ideal projection is two direct strategies: a hybrid distribution that combines active outreach to priority groups with passive distribution to the general public and a single-dose distribution to as many populations as possible, a previous plan to keep a second dose as a backup.

The indecision of the COVID-19 vaccine has become an emerging problem in some countries. According to the latest estimates from the survey, some developing countries such as India report a higher willingness to vaccinate. However, other countries such as Serbia, Croatia, France, Lebanon, and Paraguay are lower in the 10th acceptance spectrum.9 In Indonesia, about 65% of respondents said they were willing to accept the COVID-19 vaccine is provided by the Government, while eight percent of them refused. The remaining 27% expressed doubts about the Government's plan to distribute the COVID-19 vaccine are several issues that contribute to the indecision of the COVID-19 vaccine. In many countries, vaccines have been bought or developed so quickly that it raises concerns that trials are being accelerated and regulatory standards are loosened. Another concern is that pandemics led to the use of the first mRNA vaccine. The novelty of the approach alone has sparked some doubts. Many people have little faith in manufacturing companies. There is also an ongoing disinformation campaign against the COVID-19 vaccine on various social media platforms. For developing countries, concerns about the composition of vaccines and their acceptance of religious and ethnic groups are widely present.

The safety of vaccines is also in question. The critical role of AstraZeneca Oxford's vaccine was effectively undermined when scientists began reporting cases of thrombosis.<sup>10</sup> rials for the vector-based vaccine Adenovirus 26, produced by Johnson & Johnson, were also delayed when one of the participants developed an unexplained. This puts underdeveloped countries at significant risk because the most viable and cost-effective options are no longer available. According to a recent survey, certain factors are presented as predictors of receiving the COVID-19 vaccination. The most important predictor was the vaccination of participants against Covid-19. The acceptance of more health workers as part of the team working in the COVID-19 unit is vital. The income factors of people affected by the economic crisis are more receptive to the idea of vaccination. Interestingly, age is not a vital factorof.<sup>11</sup>

The fulfillment of the proper vaccination needs in each population needed to achieve herd immunity to stop the spread of the virus will vary, depending on the variant of the virus in circulation, as well as the heterogeneous level of that population, also depending on the density and mobility of the population. In addition, the duration of protection provided by natural immunity and vaccine-induced immunity is not well established, and different vaccines can provide different durations and degrees of humoral (B cell) and cellular (T cell) immunity.12,13 It is also unknown how long and effective immunity is given by mixed vaccines and third dose boosters in different populations, including different ethnicities. Finally, children who still have not been routinely vaccinated because most COVID-19 vaccines have not been licensed for this subgroup, especially elementary school children, meaning they will remain largely vulnerable populations where the group's immunity levels are uncertain. Therefore, the exact level of population immunity to 'end' pandemics in every country and globally is difficult to determine.<sup>14</sup>

Effective herd immunity has complicated consequences in SARS-CoV-2 infection. There are various factors and several obstacles that must be solved to achieve them. Group immunity in many regions and geographical locations is difficult to achieve simultaneously due to large population numbers and social differences. Based mathematics shows that 50-66% of the population needs to be immunized naturally or artificially, and this percentage is not easily achieved. Another problem that science must establish is the duration of this herd immunity. It is still unknown for SARS-CoV2 infection how long immune memory lasts. An efficient immune response cannot be performed in all individuals, and relapsing cases have been widely reported. An effective vaccine is likely to control current outbreaks and induce group immunity to prevent future outbreaks, but also strengthening the immune system is a way to alleviate the health care system. In addition, community tactics in the face of lockout need to be thoroughly elaborated so that the economic impact must be minimized and the formation of solid herd immunity in this infection will be optimal.<sup>15</sup> The results showed that antiviral antibodies in patients recovering against SARS-CoV-2 did not decrease within four months of diagnosis. We estimate that the risk of death from infection is 0.3% and that 44% of people infected with SARS-CoV-2 are not diagnosed with qPCR.<sup>16</sup>

#### STRATEGIES AND SCENARIOS

Therefore, dealing with this pandemic needs to be done correctly and well. There are at least four strategies there are scenarios that can be done, among others: Without vaccines (scenario 1), the spread of COVID-19 can be suppressed in areas by maintaining strict social distance measures and levels of face mask use. However, loosening social distance restrictions to pre-pandemic levels without changing the current use of face masks will lead to a new COVID-19 outbreak, resulting in 0.8-4 million infections and 15,000-100,000 deaths over 16 months. In these circumstances, introducing a vaccine (scenario 2) would partially offset this negative impact, albeit with relatively low vaccine effectiveness and coverage. However, if face masks are reduced by up to 50% (scenario 3), a vaccine that is only 50% effective (weak vaccine) will require 55-94% coverage to suppress the epidemic. Vaccines that are 80% effective (moderate vaccines) require only 32-57% coverage to suppress epidemics.

Conversely, if the use of masks is stopped completely (scenario 4), a weak vaccine will not suppress the epidemic, and further significant outbreaks will occur. A moderate vaccine with 48-78% coverage or a firm (100% effective) vaccine with 33-58% coverage would be needed to suppress the epidemic. Delaying the rollout of vaccinations for 1-2 months will not substantially change the epidemic trend if current non-pharmaceutical interventions are maintained. A moderate vaccine with 48-78% coverage or a firm (100% effective) vaccine with 33-58% coverage would be needed to suppress the epidemic. Delaying the rollout of vaccinations for 1-2 months will not substantially change the epidemic trend if current non-pharmaceutical interventions are maintained. A moderate vaccine with 48-78% coverage or a firm (100% effective) vaccine with 33-58% coverage would be needed to suppress the epidemic. Delaying the rollout of vaccinations for 1-2 months will not substantially change the epidemic trend if current non-pharmaceutical interventions are maintained.

#### REFERENCES

 WHO. The Sinovac COVID-19 vaccine: What you need to know. Published 2021. https://www.who.int/news-room/featurestories/detail/the-sinovac-covid-19-vaccine-whatyou-need-toknow?\_\_cf\_chl\_captcha\_tk\_=pmd\_K6pbXEF0E G0gTihp0xhm\_QkYBbDb.ADuc30HwioVbPc-1630634328-0-gqNtZGzNAyWjcnBszQnI

- Santoso A, Pranata R, Wibowo A, Al-Farabi MJ, Huang I, Antariksa B. Cardiac injury is associated with mortality and critically ill pneumonia in COVID-19: A meta-analysis. *Am J Emerg Med.* 2021;44:352-357. doi:10.1016/j.ajem.2020.04.052
- Our World In Data. Statistics and Research Coronavirus (COVID-19) Vaccinations. https://ourworldindata.org/covid-vaccinations
- 4. Zhao S, Lin Q, Ran J, Musa SS, Yang G. Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID- 19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information. Prelim Estim basic Reprod number Nov coronavirus China, from 2019 to 2020 A datadriven Anal early phase outbreak. 2020;(January):214-217.
- Lopez Bernal J, Andrews N, Gower C, et al. Effectiveness of Covid-19 Vaccines against the B.1.617.2 (Delta) Variant. *N Engl J Med.* Published online July 2021. doi:10.1056/NEJMoa2108891
- Pfizer-BioNTech. Vaccines and Related Biological Products Advisory Committee Meeting FDA Briefing Document Pfizer-BioNTech COVID-19 Vaccine Sponsor : Pfizer and BioNTech. Published online 2020.
- 7. Livingston EH. Necessity of 2 Doses of the Pfizer and Moderna COVID-19 Vaccines. *JAMA*. 2021;325(9):898. doi:10.1001/jama.2021.1375
- UK science advisers: publish evidence behind COVID vaccine changes. Nature. 2021;589(7841):169-170. doi:10.1038/d41586-021-00045-8
- Sheikh AB, Pal S, Javed N, Shekhar R. COVID-19 Vaccination in Developing Nations: Challenges and Opportunities for Innovation. *Infect Dis Rep.* 2021;13(2):429-436. doi:10.3390/idr13020041
- Ong D. Scientists Discover Cause Of Blood Clots From AstraZeneca COVID-19 Vaccine.https://www.ibtimes.com/scientistsdiscover-cause-blood-clots-astrazeneca-covid-19vaccine-3166638#:~:text=A group of German scientists led by Professor,cases of cerebral blood clots reported in Germany.
- 11. Dror AA, Eisenbach N, Taiber S, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. *Eur J Epidemiol.* 2020;35(8):775-779. doi:10.1007/s10654-020-00671-y
- 12. Jeyanathan M, Afkhami S, Smaill F, Miller MS, Lichty BD, Xing Z. Immunological considerations for COVID-19 vaccine strategies. *Nat Rev Immunol.* 2020;20(10):615-632. doi:10.1038/s41577-020-00434-6
- 13. Dai L, Gao GF. Viral targets for vaccines against COVID-19. *Nat Rev Immunol*. 2021;21(2):73-82. doi:10.1038/s41577-020-00480-0
- Kwok KO, McNeil EB, Tsoi MTF, Wei VWI, Wong SYS, Tang JWT. Will achieving herd immunity be a road to success to end the COVID-19 pandemic? J Infect. Published online June 2021. doi:10.1016/j.jinf.2021.06.007

- 15. Neagu M. The bumpy road to achieve herd immunity in COVID-19. J Immunoass Immunochem. 2020;41(6):928-945. doi:10.1080/15321819.2020.1833919
- 16. Gudbjartsson DF, Norddahl GL, Melsted P, et al. Humoral Immune Response to SARS-CoV-2 in Iceland. *N Engl J Med.* 2020;383(18):1724-1734. doi:10.1056/NEJMoa2026116