COVID-19
HERD IMMUNITY

Penyusun: Kelompok 1
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Introduction

- Coronavirus disease 2019 (COVID-19) is caused by SARS-Cov-2 (Severe Acute Respiratory Syndrome), which has now spread throught the countries of the world and causes a pandemic.
- When the coronavirus that causes COVID-19 first began to spread, virtually nobody was immune.
- The Virus encountered no resistance, it moved rapidly within the community, and eventually spread throughout the world.

Hub staff report. Covid-19 And The Long Road to Herd Immunity (Internet). Hub JHU EDU. 2020.

How to stop Covid-19?

- About a third of the world is in lockdown as a public health measure to control the spread of SARS-Cov-2, the virus that causes Covid-19.[1]
- The key pont for getting out of lockdown seems to be rested on improved testing and tracking contacts,[2] the use of permission to return to work based on imunity status,[3] new or renewed therapies, and vaccination.[4,5]

1. Altmann, et al. What policy makers need to know about COVID-19 protective immunity. The Lancet. 2020.
2. Studdert DM, Hall MA. Disease control, civil liberties, and mass testing—calibrating restrictions during the COVID-19 pandemic. *N Engl J Med.* 2020.
3. Martinez MA. Compounds with therapeutic potential against novel respiratory 2019 coronavirus. *Antimicrob Agents Chemother.* 2020
4. Amanat F, Krammer F. SARS-CoV-2 vaccines: status report. *Immunity.* 2020
5. Thanh Le T, et al. The COVID-19 vaccine development landscape. *Nat Rev Drug Discov.* 2020

How to stop Covid-19?

- Herd immunity merupakan suatu usaha proteksi yang secara tidak langsung diperoleh dari imunitas individu masing-masing kepada individu yang kebal pada suatu populasi untuk melawan penyebaran pathogen spesifik.
- As yet no effective treatment or vaccine has been found, one way to stop the spread of the virus would require a significant percentage of the population to acquire immunity, a state that epidemiologists refer to as herd immunity.
- Herd immunity is a protection effort that is indirectly obtained from the immunity of each individual in a population to fight the spread of specific pathogens and then can protect susceptible individual.

Hub staff report. Covid-19 And The Long Road to Herd Immunity (Internet). Hub JHU EDU. 2020.

Herd Immunity?

- Herd immunity ia an epidemiological concept that explain the state of a population that is sufficiently immune to a disease so that infection will not spread within the group.
- In other words, people can not get the disease, either because of large vaccinations or a natural immunity, that the people who are vulnerable are proteced.

Katz GM. Here's Why Herd Immunity Won't Save Us From The COVID-19 Pandemic (Internet). Science Alert. 2020 Maret 30.

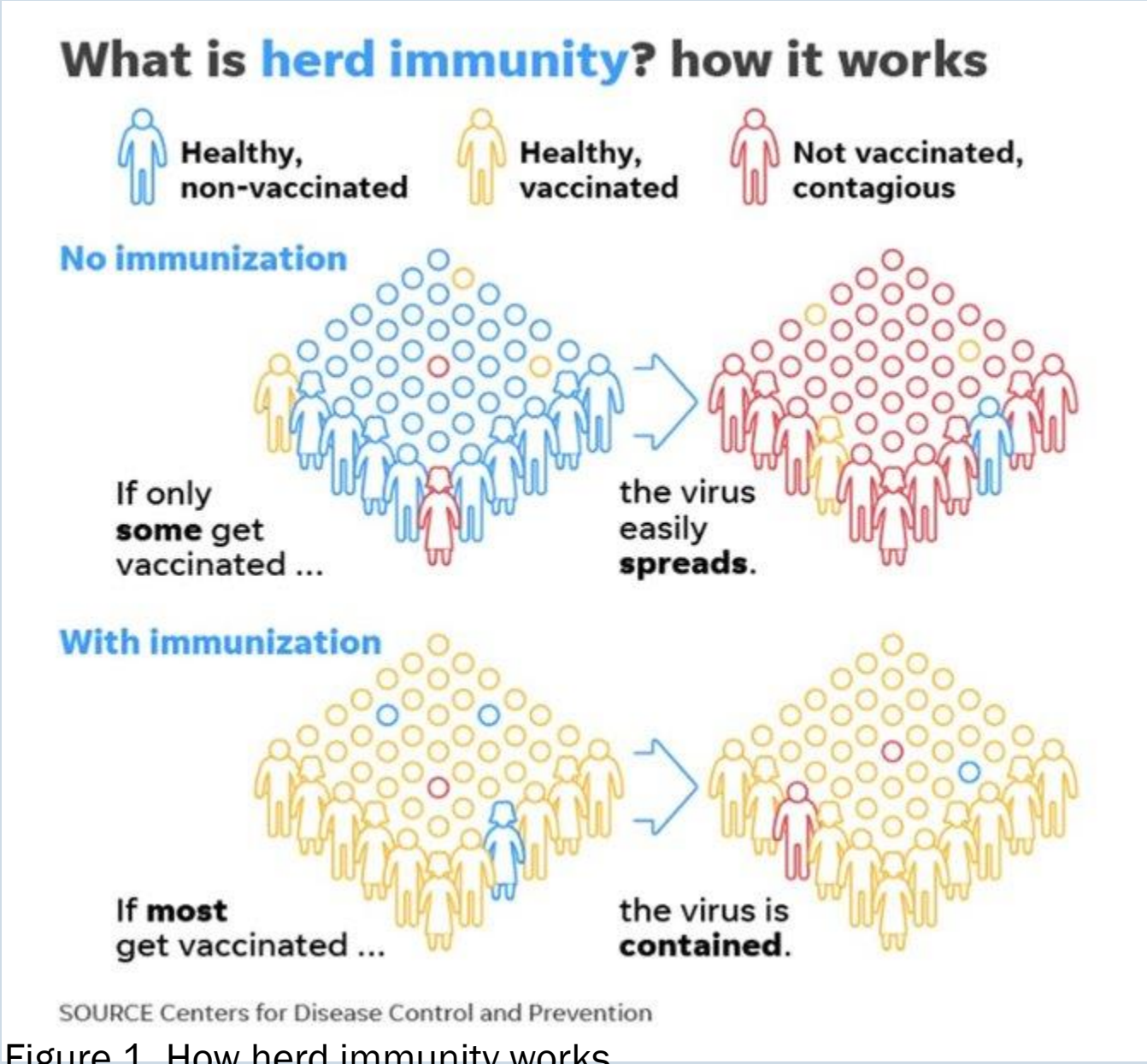

Figure 1. How herd immunity works

History and Concept

- Although nearly a century ago, the term "herd immunity" was not widely used until the last few decades, its use has been popularized by increased use of vaccines, discussion of disease eradication, and analysis of the costs and benefits of vaccination programs.
- The most important milestones: recognition by Smith in 1970 and Dietz in 1975 on **a simple threshold theory** – that
  - if immunity (that is, successful vaccination) is delivered randomly and if members of the population are randomly mixed, such that on average each individual contacts the initial individual in a manner sufficient to transmit the infection, the incidence of infection will decrease if the proportion of immunity exceeds*(R_0-1) / R_0, atau 1 –(1/R_0)*

R_0: : basic reproduction rate, number of secondary cases produced by infected individuals

Fine P, Eames K, Heymann DL. Herd Immunity: A Rough Guide. Clinical Infectious Disease. 2011

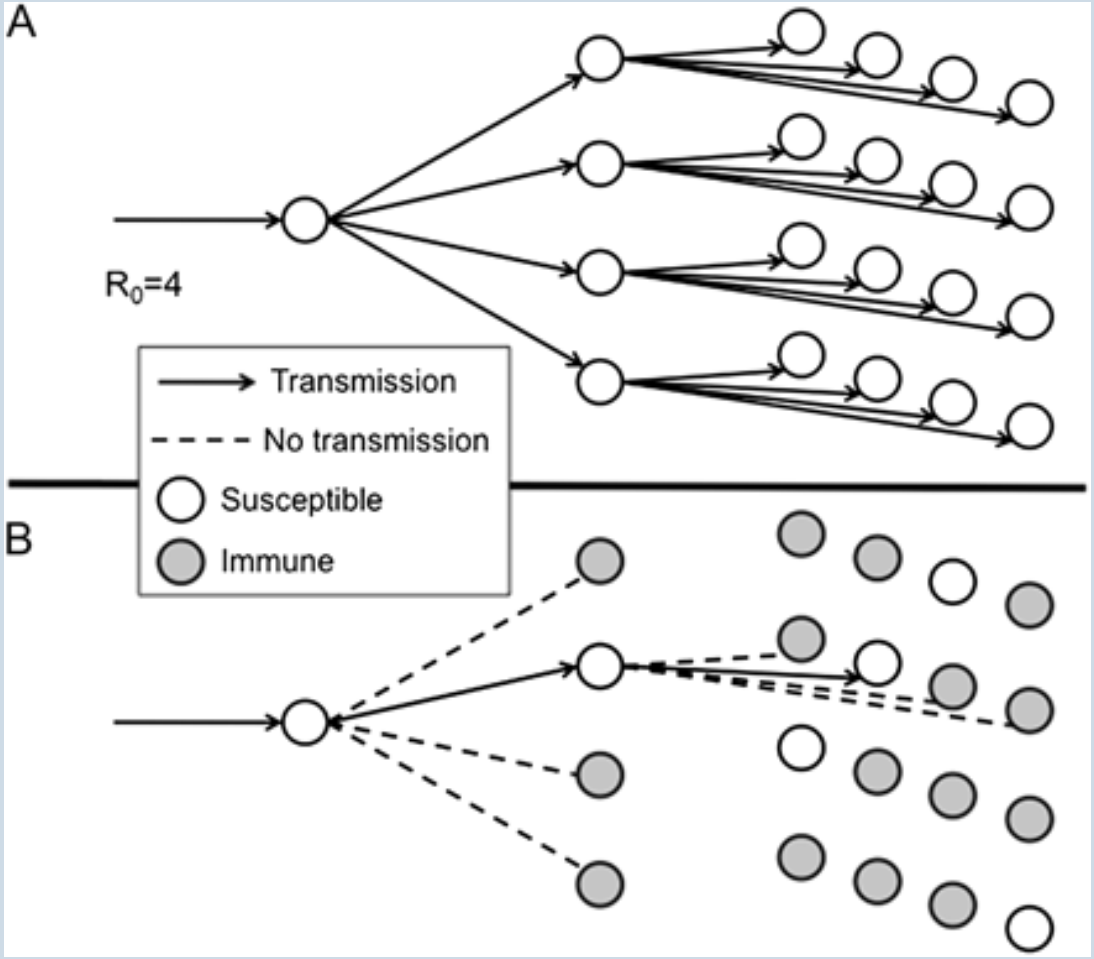

Diagram 1. Describe the transmission with basic reproductive rate R_0 = 4.

- In Figure A, the transmission is more than 3 generations after being entered into a truly vulnerable population (1 case will lead to 4 cases and then 16 cases).
- In Figure B, the expected transmission if (R0 -1) / R0 or 1- (1 / R0) = ¾ of the immune population. In this situation, all but 1 contact is immune, and each case only leads to 1 successful transmission of infection. It can be concluded that the events that occur are constant from time to time. If the proportion of more resistant is greater, the incidence will decrease. On this basis, (R0-1) / R0 is known as "herd immunity threshold."

Fine P, Eames K, Heymann DL. Herd Immunity: A Rough Guide. Clinical Infectious Disease. 2011

Table 1. R_0 of some diseases

R_0 of Some Diseases

Infectious disease	Host	R_0
Measles	Humans (UK)	12-18
Pertussis (whooping cough)	Humans (UK)	12-18
Chickenpox (varicella)	Humans (UK)	10-12
Rubella	Humans (UK)	5-7
Smallpox	Humans	3.5-7
Feline immunodeficiency virus (FIV) Domestic	Cats	1.1-1.5
Rabies	Dogs (Kenya)	2.44
Phocine distemper	Seals	2-3
Tuberculosis	Cattle	2.6
Influenza (Pandemic)	Humans	2-4
Foot-and-mouth disease	Livestock farms (UK)	3.5-4.5
Mumps	Humans	4-12
Poliomyelitis (polio)	Humans	5
HIV/AIDS	Hetro	2-5
HIV	Male homosexuals UK	4
HIV	Female prostitutes in Kenya	11
Malaria	Humans	≈ 100
SARS	Human	2-5
IBR	Cattle (UK)	7
TB	Cattle	2.6

Herd Immunity for COVID-19, is it possible?

- If a vaccine has not been discovered, **some infectious diseases** may make many people to form immunity due to infection (and can make immune to the disease for a **long time**). However, this disease can still circulate on individuals who have weak immune systems.
- This is seen in several diseases (such as measles, mumps, polio, and chickenpox) before the vaccine has not been discovered
- Another virus infectious diseases like flu can **mutate over time**, therefore the antibodies from previous infections that only provide **protection for a short period** of time
- If SARS-CoV2-virus that causes COVID-19 like the another corona virus. The infected individuals may be protected only for months to years later but not for a long period of time

Hub staff report. Covid-19 and The Long Road to Herd Immunity (Internet). Hub JHU EDU. 2020.

How many people must 'immune' to covid-19?

- The calculation depends on several variabels, including basic reproduction numbers (R0) that currently believed to be around 1 to 4 for SARS-CoV-2
- Based on estimation R0 the population immunity must be at least 60% based on population that must have protective immunity, either from a natural infection or vaccination
- This percentage increases if R0 is underestimated

Altmann, et al. What policy makers need to know about COVID-19 protective immunity. The Lancet. 2020.

Estimates of R_0 in some countries

Table 1 Estimates of SARS-CoV-2 effective reproduction number (Rt) of 32 study countries (as of 13 March 2020,7), and the minimum proportion (Pcrit, as% of population) needed to have recovered from COVID-19 with subsequent immunity, to halt the epidemic in that population.

Study countries	Population infected by COVID-19	Estimates of effective reproduction number (R_t) (95% CI), ($n = 32$)	Minimum proportion (%) of total population required to recover from COVID-19 to confer immunity (P_{crit})
R_t >4			
Bahrain	210	6.64 (5.20, 8.61)	85.0
Slovenia	141	6.38 (4.91, 8.38)	84.3
Qatar	320	5.38 (4.59, 6.34)	81.4
Spain	5232	5.17 (4.98, 5.37)	80.7
Denmark	804	5.08 (4.60, 5.62)	80.3
Finland	155	4.52 (3.72, 5.56)	77.9
R_t (2–4)			
Austria	504	3.97 (3.56, 4.42)	74.8
Norway	996	3.74 (3.47, 4.04)	73.3
Portugal	112	3.68 (2.86, 4.75)	72.8
Czech Republic	141	3.57 (2.88, 4.45)	72.0
Sweden	814	3.44 (3.20, 3.71)	70.9
The United States	2294	3.29 (3.15, 3.43)	69.6

ProMED-mail. COVID-19 update (39): global, more countries, stability, mitigation impact. WHO, 2020

How much people should be‘imunne’?

- To reach heard immunity for Covid-19, 70% or more of the population should be immune.[1]
- Without vaccine, there would be more than 200 million American get infected before we can reach this treshold. [1]
- If the current pace of the COVID-19 pandemic continues in the United States, more than half a million American would be dead of Covid-19. [1]

- There are some ways to reach that treshold.[2]
  - *Worst case*—if people **do not perform physical distancing** or other ways to slow the spread of SARS-CoV-2—the virus can infect many people in a few months. This would **overwhelm hospitals capacity** and lead to high death rates.

1. Dowdy, D. Early Herd Immunity against COVID-19: A Dangerous Misconception. JHU EDU. 2020.

2. Hub staff report. Covid-19 and The Long Road to Herd Immunity (Internet). Hub JHU EDU. 2020.

How much people should be‘imunne’?

- *The best case, if **current levels of infection is maintained —or even reduced**— until a vaccine becomes available. This will need **responsibility of the entire** population, with continued **physical distancing for an extended period**, likely a year or longer, before a highly effective vaccine can be developed, tested, mass produced, and administered.*
- *The most likely case is, infection **rates rise and fall over time**. We may **relax** social distancing measures when numbers of infections fall, and **reimplemented** when numbers increase again. **Prolonged effort** will be required to prevent major outbreaks until a vaccine is developed.*

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- Until we have a vaccine, anyone talking about herd immunity as a preventative strategy for COVID-19 is simply wrong.
- Fortunately, there are other ways of preventing infections from spreading, which all boil down to avoiding people who are sick.

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Gideon Meyerowitz-Katz, epidemiologist