DISCUSSION PAPER SERIES

COVID-19 感染に関する統計分析と政策提言
その 1
**Statistical analysis of COVID-19 transmission
at initial stage**

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Statistical analysis of COVID-19 transmission at initial stage

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The infection transmission, as fundamental evidence for the prevention and control responses of COVID-19, should be studied with interdisciplinary approaches including pathology and statistics. Since February 2020, our research team has been conducting statistical analyses of infection characteristics and the effectiveness of responses in 102 countries and regions based on infection data published by the WHO and national CDCs through statistical and policy engineering methods.

Most studies have looked at the timing and scale of transmission of infection from an infectious medical perspective as a basis for response. However, transmission patterns are closely linked to complex human behavior, and it is often difficult to find more coherent patterns of transmission even when focusing on specific regions. In our study, we attempted to observe some common features in the spread of COVI-19 from a statistical perspective, based on open data, through cross-regional comparisons of large samples.
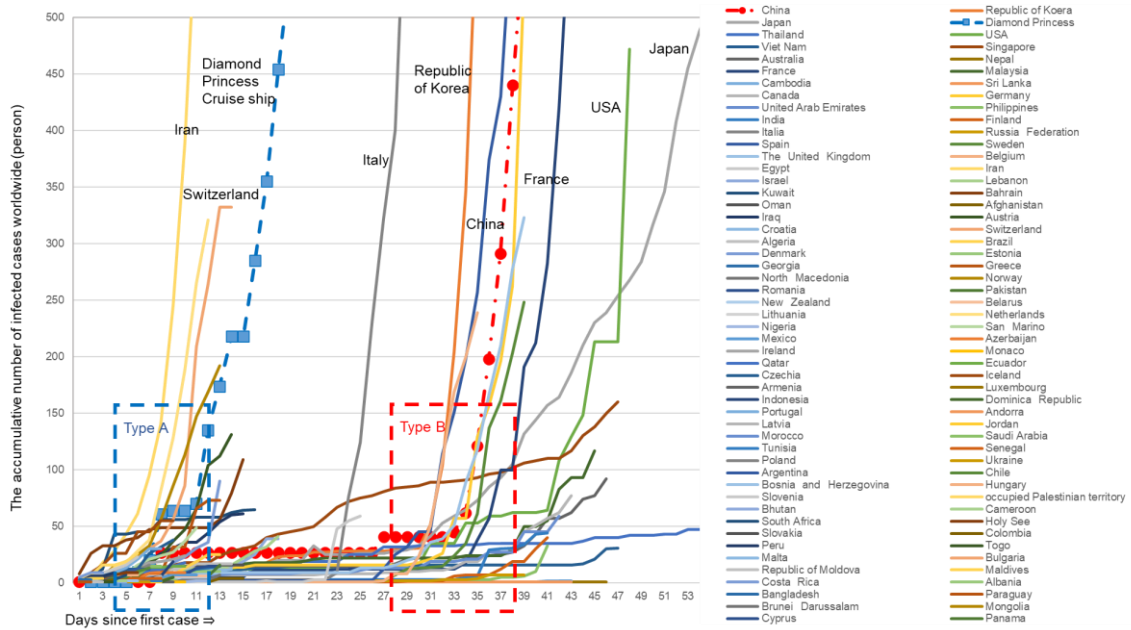
Figure 1. Type A and B of COVID-19 transmission at initial stage
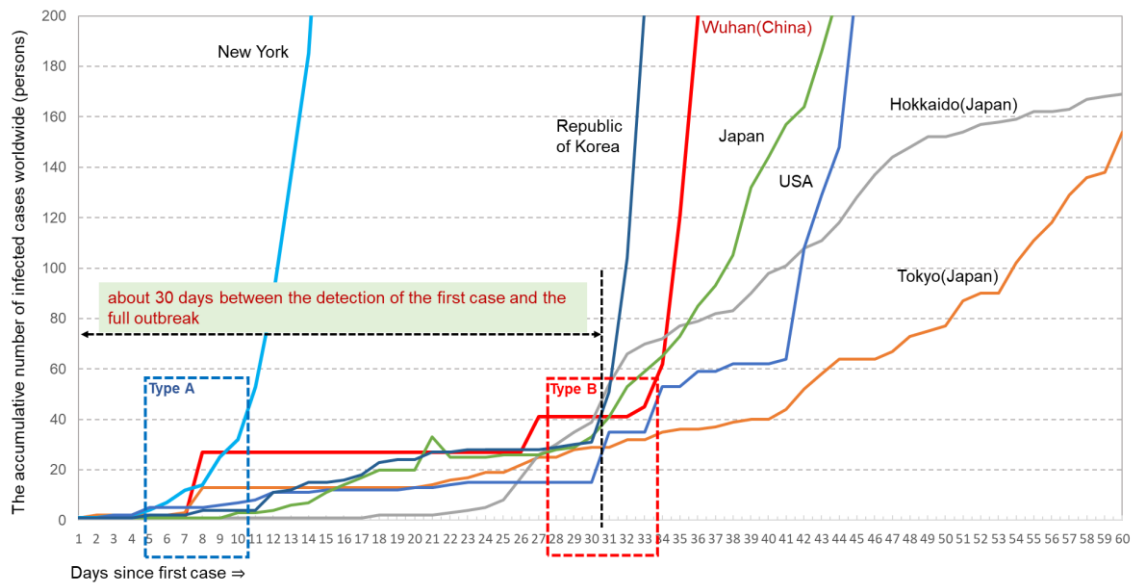Data Source: WHO (2021)[1], compiled by the authors (ZHOU, 2020)[5].

Figure 2. Collective Latency Periods for in specific regions
Data Source: WHO (2021)[1], Tokyo Metropolitan Infectious Disease Surveillance Center (2021)[2], Hokkaido Government (2021)[3], New York Government (2021) [4], compiled by the authors.

Figures 1 and 2 respectively show the daily cumulative number of infections in various countries around the world, including the Diamond Princess cruise ship docked in Yokohama Port, Japan, in February 2020, after the first case of infection was announced

(ZHOU, 2020) [5]. As shown in Figure 1 and 2, the initial stage of a large-scale outbreak can be divided into two groups, corresponding to A and B type. Type A is cruise ship type, which is featured with high density and rapid outbreak of infection, such as Diamond Princess, New York, Iran, and Switzerland. The high density refers to the so-called "3 dense" environment, which means confined space, dense place, and close distance. Type B is more widely found in urban transmission, such as Wuhan, China, the United States, Japan, South Korea, etc. The statistical analysis results show that from the discovery of the first infected person to the large-scale infection outbreak, Type A is about 7 days (one week), half of the 14 days which is the maximum incubation period suggested by WHO. And Type B is about 30 days (four weeks), about twice the 14 days incubation period. We define Type B period as Collective Latency Period (CLP) and Type A period as Collective Latency Period in Dense environment (CLP-d).

The medical incubation period for infected individual is 1-14 days according to the WHO standard; here we suggest, based on the results of the statistical analysis above, that CLP and CLP-d could be introduced into the response considerations. CLP and CLP-d are concluded based on statistical analysis and the above findings demonstrate that there is a distinct commonality in the data on outbreaks across countries and regions.

Based on this finding, it is extremely important to take resolute and decisive responses to deal with the spread of COVID-19 within one month after the first infection is found. Furthermore, the longest latency time from the first case of infection to a large-scale outbreak is about four weeks, so it is suggested that the quarantine time should be changed from two weeks, which is now commonly implemented, to four weeks, and two weeks of isolation plus two weeks of observation are safer. Among them, the quarantine and observation methods for the second two weeks can be handled in different ways according to the situation of various countries and regions.

The results of statistical analysis show that the two transmission types at initial stage of COVID-19, which could be used for considering more effective responses. Although the transmission mechanism through populations is not clear currently, it should be analyzed with interdisciplinary approaches such as medical science, behavior science and even sociology. COVID-19 has further verified that human beings are a community of shared interests and risks. Whether it is prevention and control of viruses or protection of global industrial chains, mutual cooperation and support are needed to minimize the losses.

Reference:

1) WHO (2021) COVID-19 Weekly Epidemiological Update, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/, accessed on January 11, 2021

2) Tokyo Metropolitan Infectious Disease Surveillance Center (2021) https://stopcovid19.metro.tokyo.lg.jp/, accessed on January 11, 2021

3) Hokkaido Government Site (2021) http://www.pref.hokkaido.lg.jp/hf/kth/kak/hasseijoukyou.htm, accessed on January 11, 2021

4) New York Government Site (2021) https://www1.nyc.gov/site/doh/covid/covid-19-main.page, accessed on January 11, 2021

5) **ZHOU Weisheng (2020) , Statistical Results Show the Timeliness and Effectiveness of China's Measures against COVID-19,** Science and Technology Daily, 2020.04.30 http://stdaily.com/English/ChinaNews/2020-04/30/content_932701.shtml https://www.prnewswire.com/news-releases/statistical-results-show-the-timeliness-and-effectiveness-of-chinas-measures-against-covid-19-301050350.html