1 Can common coronavirus compete with novel coronavirus?

2 Short title: Coronavirus competition

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Abstract

The novel coronavirus, SARS-CoV-2, caused lethal human respiratory infections, and there is a big problem to control the disease. The application of other viruses to compete with the novel coronavirus was proposed in this paper. On the viewpoint of receptor competition, resource competition, and cross immunity, an attempt should be made to select a natural virus, such as the common coronavirus causing the common cold in human, or transform a virus with biotechnology in order to resist the novel coronavirus. Similar scenarios were suggested to deal with other viruses like human immunodeficiency virus. Microecological communities of viruses could form an independent research area to dig the deeper biological and medical significance. The present study provided the information to further the theoretical implication and medical application of the study of virus interactions.

Abstract word count = 131

Keywords = SARS-CoV-2, biological competition, virus interaction, viral community

The novel coronavirus, SARS-CoV-2, caused serious illness [1-3]. Research into preventing and treating the diseases caused by this virus is ongoing. The microbial microecological method, e.g., viral competition, could be considered as one of the proposals. Biological competition between the viruses causing the respiratory tract infections has been reported [4-6]. During the respiratory tract infections, immunity responses to a virus could inhibit the competing viruses, reducing the infections by the later [5-6]. Coronaviruses are also causing pathogens of animal and human respiratory infections [7], and since the novel coronavirus is discovered only recently, its competition with other viruses remains unknown. The theoretical proposal of biological competition between the novel coronavirus and other viruses, as well as the issues of virus community, were herein provided, with the aim to promote experimental studies of the related topics.

Proposition based on the biological competition to deal with the novel coronavirus

Viruses in the human body use resources of cells and are resisted by the immune system; There may be multiple viruses coexisting in the human body, and a complex interspecies relationship between them affects their fates (Figure 1a). Can common coronavirus compete with the novel coronavirus? After a long time of evolution and adaptation, the common coronavirus has adapted well to the environments of the human body. The novel coronavirus has just contacted with humans and should not be well adapted to the human physical environments. If the

vital organs of the human body are ensured to function normally, the common coronavirus defeating the novel coronavirus in the human body environments is possible.

An attempt should be made to select a virus in nature or transform a virus with biotechnology in order to resist the novel coronavirus. If the novel coronavirus belongs to any variants or relatives of human cold viruses, theoretically, to choose the virus or transmute the virus should built on the following conditions. First, the virus that is selected or transformed must have an equal or even stronger infectivity. By doing so, it can compete against the novel coronavirus for the receptors or the other reproductive and survival resources in the human body. Second, virulence of the virus that is selected or transformed must be lower than the novel coronavirus. Third, the competitor can be inhibited by the drugs, or can be controlled by the human immune system under a certain condition.

The virus that causes a cold or influenza might satisfy the conditions above and become the competing virus. For example, the common coronavirus, such as human coronavirus OC43 and human coronavirus 229E, are the candidates. To select these viruses are based on the evidence inadequate but worth considering. The common coronavirus and the novel coronavirus belong to the same group and are infectious, but the virulence of them is different in degrees. In that case, to a certain degree, it can be supposed that these two viruses have an equal or similar infecting effect on humans. That is, the molecule groups to infect the humans can be integrated into the same or similar receptor in the human body. And the part that is mutated may

69 be the toxophoric groups. Thus, it is probable that the patient is injected with, takes, or
70 inhales a common coronavirus of a thick degree that is enough to have it competing
71 against the novel coronavirus for the human receptor and the other resources in need
72 of the virus growth (Figure 1b). If the common coronavirus defeats the novel
73 coronavirus ultimately, only the common cold is treated in the end. In addition, the
74 symptoms developed by the illness caused by the novel coronavirus like those of
75 respiratory infections developed by the common coronavirus. If the patient is injected
76 into the common coronavirus, then before the novel coronavirus activates the human
77 immunity, the injected virus can pathologically improve on the same or similar immunity
78 to inhabit the further reproduction of the novel coronavirus. Moreover, further
79 investigation and statistics must be done to research the relationship between the
80 novel coronavirus and the cold virus.

81 However, there exist some problems with this proposition in which the cold or
82 influenza virus is used to resist the novel coronavirus. Are those evidences well
83 established to support the biological competition? If the cold or influenza virus is kept
84 in balance with the novel coronavirus, can the artificial conditions help the cold or
85 influenza virus gravitate towards the winning? Is the patient whose physical condition
86 is worsened by the cold or influenza virus more susceptible to the novel coronavirus?
87 For the individual case, is it the cold or influenza virus fatal to the patient? For many
88 cases, can the common cold or influenza virus reproduce under the human immune
89 system or not? Despite of it, the proposition is worth considering, especially before the
90 specific treatment is not found and the novel virus mutates variously and speedily.

91

92 **To deal with other infectious viruses**

93 For those viruses that are difficult to deal with such as hepatitis virus and
94 human immunodeficiency virus (HIV), it can also be tried to select a virus in nature or
95 transform a virus with biotechnology to resist the pathogenic virus. Many studies have
96 been done to the pathogenic virus of these infectious diseases whose biological
97 information has been known. Attention must be paid to the mechanism that is related
98 to infecting effects and virulence effects in order to find the treatment. At present, most
99 of the research is based on vaccines of these diseases, the prevention of infecting, the
100 killing of the disease pathogen, etc. Although a dim hope is in sight, much difficulty is
101 still at hand.

102 If the biological competition is taken into consideration to deal with these
103 infectious diseases, except looking for a virus in nature, it is viable to transform a virus
104 by the biotechnological method. Take HIV for instance, the following methods can be
105 used. Scientists can clone nucleic acid sequences which have a relevant infecting
106 effect to HIV, plant them into the neutral virus such as the cold or influenza virus. This
107 new virus, which has the infecting effects of HIV but only the virulence of the cold or
108 influenza virus and thus can be cured by the known drugs, can be made to compete
109 against HIV. In another method, scientists can clone nucleic acid sequences, which
110 contribute to the cure by the known drugs, of some viruses which can be cured by the
111 known drugs and plant them into HIV. This new virus, which has the infecting effects
112 of HIV but can be cured by the known drugs, can be made to compete against HIV. Of

course, scientists can also create a HIV varietas, the living vaccine, which has the infectivity but not severe enough to cause a disease.

The study on microecological communities of viruses

In the case of a new virus infect a person, if other viruses co-exist in the infected person, their interaction, whether synergy or antagonism, might be important to the health of the person. In the condition of antagonism in different viruses in a patient, when the novel coronavirus infects the elderly, adults, and children with the same infection rate, adult people may have the highest mortality rate (especially the mortality rate is standardized by dividing by the mortality rate of the control group which have the same physiological conditions, except for being infected by the novel coronavirus) because adult people's stronger immunity results in lower levels of other viruses before infection, which makes novel coronaviruses less suppressed by other viruses; similarly, a general cold might not be bad news for patients infected by the novel coronavirus, because the microecological balance of viruses might inhibit the novel coronavirus. But when the immune system recognizes the virus, the situation is reversed — adult people's stronger immunity protecting against new viruses more effectively [8]. Thus, the microecological balance of viruses to some extent help immunity system fight new viruses, especially before effective specific immune mechanisms are established. If so, it is paid more attention to use antiviral drugs because antiviral drugs might affect microecological balance of viruses if the antiviral drugs cannot inhibit the novel coronavirus (Figure 1c, 1d, 1e).

Interactions between viruses within hosts had previously reported, such as the negative correlation between HIV and hepatitis virus [9-10], antagonism of influenza viruses [5-6], cooperation and communication among viruses [11], and evolution of viruses under competition environments [12]. To deeply explore the mechanism insight and medical application of relationship between viruses, the study of ecological communities of viruses could be classified as a special field including several research contents as followed.

1) Interaction between viruses in hosts. For an example, competition for resources between viruses is crucial for reproduction and survival. This extends to the competition between physiological mechanisms and biomolecular structures. Moreover, cooperation and mutual benefit between viruses are also possible, including the exchange of genetic material.

2) Virus biodiversity in hosts. How to calculate virus biodiversity and the relationship between virus biodiversity and the health of hosts are worth studying. The data of virus biodiversity in the patients during the processes of infection, latent, treatment, and healing has clinical significances.

3) The study of beneficial viruses. Not every virus is harmful to the human body. Is there a beneficial virus in an individual? If so, is this benefit based on the production of useful substances to the human body or the maintenance of the ecological balance of the virus to suppress harmful viruses? In addition, do the usefulness and harmfulness of viruses change in different environments? The answers to these questions are helpful to health care and industrial development.

4) Other scientific issues about communities of viruses. It is believed that with the development of the related techniques, the research contents of virus ecological community will become more and more abundant. For instances, omics researches of the virus community, such as meta-genome and meta-transcriptome, will be analyzed; the exchange of virus species and/or genetic materials of virus between different hosts during contacting processes is also an interesting issue.

5) Ethical and legal issues about communities of viruses. Like other biological disciplines, the study of viral communities also requires ethical and legal restrictions. Especially, because the virus research process may bring serious infectious diseases, it is necessary to evaluate the safety risk of related research on virus communities. At the same time, legislation should be adopted to regulate the cultivation of multiple viruses.

Conclusion

Two or more viruses coexisting in the human body may compete for similar resources and trigger similar immune responses. If the common coronavirus (or other low-risk viruses) and the novel coronavirus have such an antagonistic relationship, artificial introduction of the common coronavirus into patients will effectively suppress the novel coronavirus. Similar scenarios will be suggested to deal with other viruses like HIV. Viral competition can be considered as a supplement to existing virus-controlling measurements, such as antiviral drugs and immune factors, so the study of this field deserves development.

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180 **Conflict of Interest**

181 The authors declare that they have no conflict of interest.

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a

b

Heavier illness

No illness

c

No illness

No illness

d

Illness

The heaviest illness

e

Illness

The heaviest illness

Figure 1 Schematic diagram of virus competition in the patient

It is assumed that all viruses compete for resources and one piece of resource meets

one virus. The immune system can resist at most one virus of Virus A. The immune system can resist at most 4 viruses of Virus B. Virus C is harmless to the human body and does not cause immune system reactions. When the number of viruses exceeds the resistance of the immune system, the person will get sick.

- a, Competition of different viruses without treatments — the control
- b, Adding the common coronavirus (Virus B)
- c, Killing the novel coronavirus (Virus A) by antiviral drugs
- d, Killing the common coronavirus (Virus B) by antiviral drugs
- e, Killing other competing viruses (Virus C) by antiviral drugs