COVID-19 Drug Repurposing

The new coronavirus disease (COVID-19) has become a pandemic threat to public health. This is a respiratory disease that causes fever, fatigue, dry cough, muscle aches, shortness of breath and pneumonia in some cases. In severe cases, it can cause the respiratory syndrome of ARDSA, a kind of severe lung inflammation, so that a large amount of fluid accumulates around and inside the lungs, which may cause septic shock due to a sharp drop in blood pressure, and body organs will also Failure due to lack of oxygen. The incubation period of this coronavirus is approximately 1 to 14 days, at the same time, Symptoms and severity vary from patient to patient. Elderly people, children under 6 years old, and patients with a history of asthma, diabetes, or heart disease are more susceptible to the effects of this disease which makes the immune system compromised.

COVID-19 Drug Reuse

Because this disease presents a pandemic trend, its severity has caused the international community to take containment measures and conduct collaborative research to solve the knowledge gap in order to determine the treatment of COVID-19. In order to contain this epidemic, many researchers and companies are currently developing new therapies and vaccines against COVID-19. However, this process usually requires at least ten years of work and approximately 300-600 million dollars in funding. In order to quickly control this global epidemic, treatments must be developed immediately. Since the traditional drug development process is cumbersome and expensive, the reuse of known drug molecules against COVID-19 has become a strategy for rapid development of effective treatments.

Ways to Reuse COVID-19 Drugs

The method of drug reuse is based on the network. This method uses and integrates the clinical data of COVID-19, and associates protein structure with drug-targeted gene information, so as to find reusable drugs that can treat COVID-19. It mainly consists of two parts, as shown in Figure 1, (a) Build a disease-gene-drug network, (b) evaluate reusable drugs.

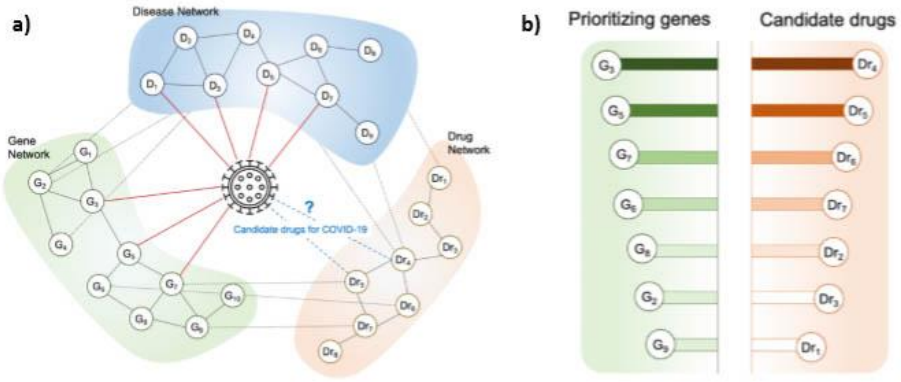

Figure 1 Schematic description for the proposed method (Yonghyun Nam, *et al.* 2020)

Ways to Achieve (a)

- Ligand preparation

  Select antiviral drugs among contemporary drugs for molecular docking research, so as to screen and confirm effective antiviral drugs specifically for COVID-19. PubChem database can be used to extract the chemical structure of 3D molecules.
- Preparation of protein structure

  The current COVID-19 main protease has a co-crystal structure. Use the protein preparation wizard in the Maestro panel to prepare the protein structure.
- Molecular docking

  Molecular docking is a structure-based drug design method that is used to identify the essential amino acid interactions between the selected protein and the generated ligand

with a low energy conformation. The docking ligand can be visualized through Maestro interface.

Ways to Achieve (b)

Currently, no therapeutic drugs for coronavirus have been developed, which means that from the perspective of machine learning, there is no fact that can be used as labeled data. SSL can process a small amount of labeled data and perform prediction by propagating the labeled information to the three-tier node along with the edge. In addition, it is assumed that all drug information related to COVID-19 is unknown, which means that the edge connection between COVID-19 and all drugs is not included in the drug network. The drugs that are being used in clinical practice are used as standards to evaluate reusable drugs.

In this way, we can reuse drugs for current targets, thereby reducing the time and money costs of development, and developing effective drugs against COVID-19 in the fastest way.

References

- Yonghyun Nam, *et al*. Network reinforcement driven drug repurposing for COVID-19 by exploiting disease-gene-drug associations. *arXiv*. 2020.
- BhumiShah, *et al*. *In silico* studies on therapeutic agents for COVID-19: Drug repurposing approach. *Life Science* 252(2020), 117652.