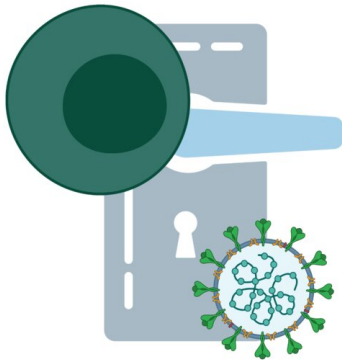


# Artificial intelligence model predicts which key of the immune system opens the locks of coronavirus

22 April 2021



Credit: Jani Huuhtanen, Biorender.com

With an artificial intelligence (AI) method developed by researchers at Aalto University and University of Helsinki, researchers can now link immune cells to their targets and for example uncouple which white blood cells recognize SARS-CoV-2. The developed tool has broad applications in understanding the function of immune system in infections, autoimmune disorders, and cancer.

The human immune [defense](#) is based on the ability of [white blood cells](#) to accurately identify disease-causing pathogens and to initiate a defense reaction against them. The immune defense is able to recall the pathogens it has encountered previously, on which, for example, the effectiveness of vaccines is based. Thus, the immune defense the most accurate patient record system that carries a history of all pathogens an individual has faced. This information however has previously been difficult to obtain from patient samples.

The learning immune system can be roughly divided into two parts, of which [B cells](#) are responsible for producing antibodies against pathogens, while T cells are responsible for destroying their targets. The measurement of antibodies by traditional laboratory methods is relatively simple, which is why antibodies already have several uses in healthcare.

"Although it is known that the role of T cells in the defense response against for example viruses and cancer is essential, identifying the targets of T cells has been difficult despite extensive research," says Satu Mustjoki, Professor of Translational Hematology from the University of Helsinki.

## AI helps to identify new key-lock pairs

T cells identify their targets in a key and a lock principle, where the key is the T cell receptor on the surface of the T cell and the key is the protein presented on the surface of an infected cell. An individual is estimated to carry more different T cell keys than there are stars in the Milky Way, making the mapping of T cell targets with laboratory techniques cumbersome.

Researchers at Aalto University and the University of Helsinki have therefore studied previously profiled key-lock pairs and were able to create an AI model that can predict targets for previously unmapped T cells.

"The AI model we created is flexible and is applicable to every possible pathogen—as long as we have enough experimentally produced key-lock pairs. For example, we were quickly able to apply our model to coronavirus SARS-CoV-2 when a sufficient number of such pairs were available," explains Emmi Jokinen, a Ph.D. student at Aalto University.

The results of the study help us to understand how a T cell applies different parts of its key to identify its locks. The researchers studied which T cells recognize common viruses such as influenza-, HI-, and hepatitis B -virus. The researchers also used their tool to analyze the role of T-cells recognizing hepatitis B, which had lost their killing ability after the progression of hepatitis to hepatic cell cancer.

The study has been published in the scientific journal *PLOS Computational Biology*.

### **A new life for published data with novel AI models**

Tools generated by AI are cost-effective research topics.

"With the help of these tools, we are able to make better use of the already published vast patient cohorts and gain additional understanding of them," says Harri Lähdesmäki, Professor of Computational Biology and Machine Learning at Aalto University.

Using the [artificial intelligence](#) tool, the researchers have figured out, among other things, how the intensity of the defense reaction relates to its target in different disease states, which would not have been possible without this study.

"For example, in addition to COVID19 infection, we have investigated the role of the defense system in the development of various [autoimmune disorders](#) and explained why some cancer patients benefit from new drugs and some do not," says M.D. Jani Huuhtanen, a Ph.D. student at the University of Helsinki.

**More information:** Emmi Jokinen et al. Predicting recognition between T cell receptors and epitopes with TCRGP, *PLOS Computational Biology* (2021). [DOI: 10.1371/journal.pcbi.1008814](https://doi.org/10.1371/journal.pcbi.1008814)

Provided by Aalto University

APA citation: Artificial intelligence model predicts which key of the immune system opens the locks of coronavirus (2021, April 22) retrieved 31 October 2022 from <https://medicalxpress.com/news/2021-04-artificial-intelligence-key-immune-coronavirus.html>

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