immunoSEQ® T-MAP™ | COVID

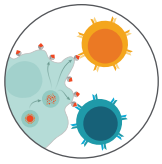
Assessing & monitoring T-cell responses to SARS-CoV-2 with immunoSEQ® T-MAP™ COVID

The COVID-19 pandemic has affected millions of people worldwide, igniting an extraordinary effort from the scientific community to understand the biological foundation of COVID-19 pathophysiology. This research has established a critical role for T cells in the immune response against SARS-CoV-2. Adaptive's immunoSEQ T-MAP COVID offering is a high-throughput approach to accurately, quantitatively, and reproducibly measure the T-cell immune response in COVID-19 clinical trial, vaccine and drug development research.

- Researchers can search our SARS-CoV-2-specific TCR database to determine if their samples show SARS-CoV-2 specific TCRs, the antigens to which these TCR responded, and deeper insights about their samples.
- Another feature provides a simple positive or negative result that can help determine past SARS-CoV-2-specific T-cell response in research samples.

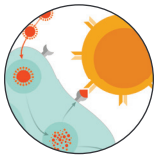
ROLE OF T CELLS IN COVID-19

T cells circulate in the blood and can quickly expand in response to pathogens like SARS-CoV-2 helping to clear the virus, often before symptoms occur. This T-cell response is an essential component of the human immune response to viruses like SARS-CoV-2.



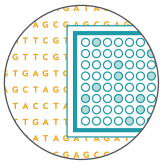
COMPREHENSIVE TOOL TO PROPEL YOUR COVID-19 RESEARCH

immunoSEQ T-MAP COVID allows researchers to comprehensively and quantitatively measure and monitor the T-cell immune response to SARS-CoV-2, allowing differentiation from other diseases.[1]



ASSESSING T-CELL RESPONSE IN COMPARISON TO OTHER METHODS

Preliminary data suggests T-cell based assays may better detect an immune response to COVID-19 when compared to tests that detect antibody responses.



APPLICATIONS OF IMMUNOSEQ TECHNOLOGY IN VACCINE RESEARCH

The immunoSEQ Assay is a validated, accurate, & standarized assay for measuring and monitoring the adaptive immune response, which can be leveraged with COVID-19-specific data to assess vaccine efficacy and durability.

Role of T cells in COVID-19

T cells are the adaptive immune system's first responders to any virus, circulating in the blood to detect and quickly multiply to help clear the virus, and also support the development of antibodies by B cells. This central role for T cells makes them a desirable target for assessing the immune response to viruses and specifically SARS-CoV-2 infection.

The combination of global scientific focus and the number of people infected with the SARS-CoV-2 virus in such a short period of time has led to an understanding of the variability of individual responses on a greater scale. In the setting of COVID-19, we are seeing:

- T-cell responses arise earlier than antibodies and last through clearance into convalescence.[2]
- T cells play a critical role in supporting the development of antibodies by B cells and can serve as the first signs of an immune response to SARS-CoV-2 infection.[3]
- The majority of COVID-19 patients generate a T-cell response comprised of both CD8+ T cells, or "killer" T cells which destroy virus-infected cells, and CD4+ "helper" T cells, which help other immune cells, including B cells which produce antibodies.[4]
- CD8+ & CD4+ T cells were observed in convalescent patients with mild and severe COVID-19 disease.[5]

Figure 1.

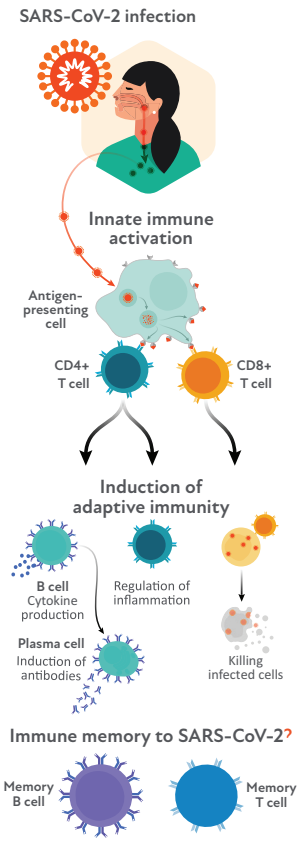


Figure 2.

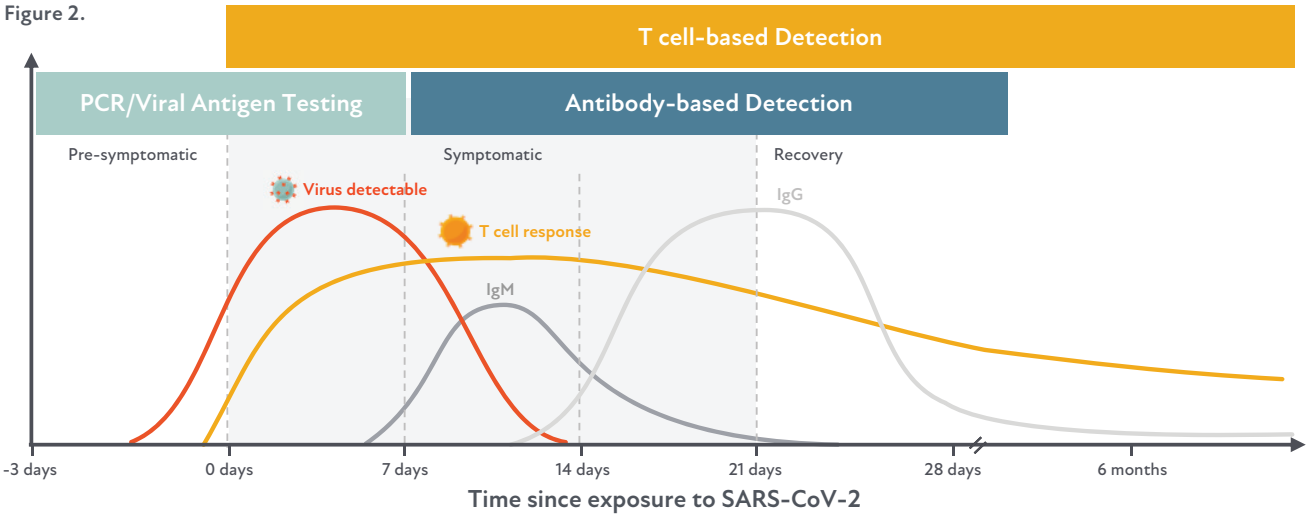


Figure 1. CD8+ T cells directly target infected cells via perforin/granzymes, FAS ligand/TRAIL pathways, or secretion of proinflammatory mediators. CD4+ T cells activate B cells that recognize the antigen. Plasma cells secrete antibodies to target the SARS-CoV-2 virus. Adapted from Gutierrez, et al. Elsevier Current Trends, 2020.[6]

Figure 2. Timeline of the adaptive immune response. T-cell responses, which occur prior to antibody responses, are detected within approximately one week of the onset of COVID-19 symptoms. Antibody responses wane over time, while memory T cells may be detectable months or years after infection. Based on data from Gallais, et al., 2020, Peng, et al. 2020, Snyder et al., 2020, Subbarao, et al., 2020, Channappanavar, et al., 2014, and Zuo, et al., 2020.[1,7,8,9,10,11]

Assessing T-cell response in comparison to other assessment methods

Historically, researchers measured the immune response primarily based on antibody levels. However, as we learn more about the role of T cells, researchers and vaccine developers are recognizing the need to measure the T-cell response in addition to the antibody response to both infection and vaccines.

Antibody tests, or serological tests, detect the antibodies that are produced against the SARS-CoV-2 virus.[12] Antibody production can vary across patients with COVID-19, so these tests may be less reliable.[12,13] Studies indicate that although antibody responses are detectable for months post-exposure, these responses wane over time.[14]

Measuring T cells typically involves using functional assays that require live cells, and such techniques are expensive, bespoke, low throughput and are not suitable to support large clinical studies. For example, ELISpot, an assay that detects proteins secreted by specific immune cells, has historically been used in vaccine research to measure immune responses.[15] However, the ELISpot technology is not capable of quantitatively tracking the longitudinal clonal expansion or contraction of specific T-cell clones, has a limited detection range to measure immune responses from specific cell types, and involves several hands-on steps to culture live cells.[15]

In contrast, Adaptive's immunoSEQ T-MAP COVID is the first molecular T-cell monitoring tool for SARS-CoV-2, is a high-throughput approach to accurately, quantitatively, and reproducibly measure the T-cell immune response. The assay can be performed on whole blood and the analyte, genomic DNA, is highly stable, making specimen handling ideal for applications requiring scale.

	Antibody-based Assays	ELISpot Assay	immunoSEQ T-MAP COVID
What it detects	Antibodies against SARS CoV-2	Proteins secreted by immune cells	T-cell response
Sample type	Blood	Fresh Cells	Flexible sample input including FFPE
How many targets are detectable	1-2	2-3	>100s of viral targets recognized by complete T-cell repertoire
Quantitative assessment?	×	×	✓
Longitudinal assessment?	×	×	✓

Table 1. Methods to detect an immune response in vaccine development. Commonly used assays to detect an immune response to a vaccine are antibody-based assays and ELISpot assay.[15,16] These assays have limited numbers of targets that they can assess and they cannot provide quantitative or longitudinal assessments. The immunoSEQ T-MAP COVID offering provides a highthroughput approach to quantitatively measure T-cell immune responses over time and across a range of flexible sample types.