

Characterisation of the immune response after vaccination and/or infection

We develop methods for characterising the cellular and humoral immune response in order to provide direct support to vaccine authorisation and product testing activities. These methods allow us to characterise the immune response after infection and/or vaccination. The SARS-CoV-2 pandemic has led us to focus on the immune response against beta-coronaviruses in particular. In addition to determining the titres of neutralising and non-neutralising antibodies, we are interested in the qualitative characterisation of the antibody response by means of epitope mapping and the determination of the stability of antigen/antibody complexes by means of surface plasmon resonance (SPR). Furthermore, we deal with the kinetics of the immune response; how long it lasts; its breadth, in particular with regard to newly emerging variants of the pathogen; and its ability to be restimulated by measures such as booster vaccinations. Another essential aspect of our work consists of studies on the safety of vaccines. Our focus for this research is on the identification and characterisation of possible antibody-dependent enhancement (ADE) antibodies and mechanisms that can intensify the course of the disease (vaccine-associated enhanced disease, VAED).

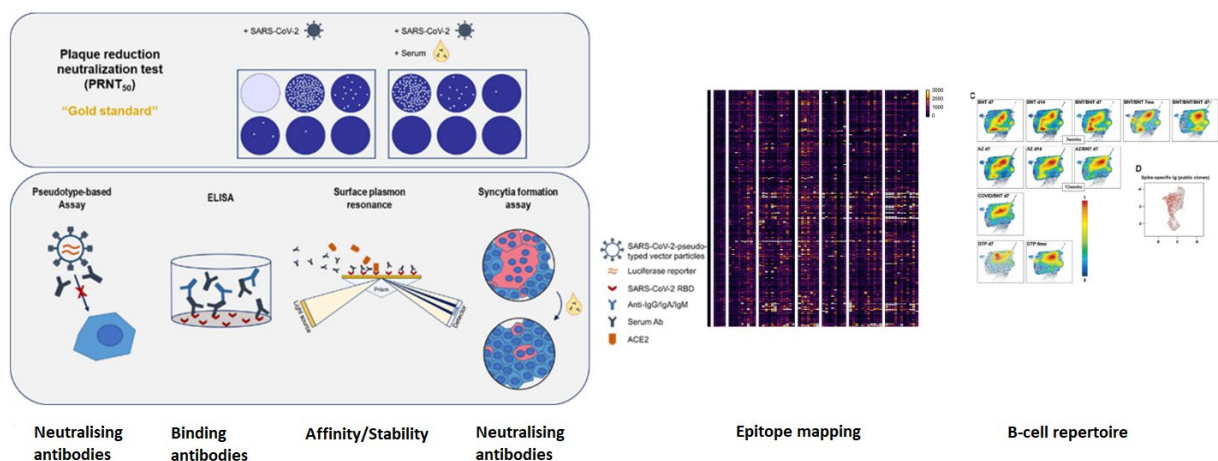


Fig.1 Overview of different experimental approaches to characterising the immune response after vaccination and/or infection. Source: Paul-Ehrlich-Institut

Development of a customisable vaccine platform for preventive and therapeutic vaccinations

We are developing a novel vaccine platform based on a cell permeability-mediating peptide that we identified. Vaccine platforms offer the advantage of being able to be quickly adapted to novel pathogens, which can significantly shorten the development process and possibly the authorisation process as well. The approach we have chosen is suitable for triggering a robust cellular and humoral immune response. The approach is based on hepatitis B virus capsids, which have been modified in such a way that they are cell-permeable due to the incorporation of the cell-permeable peptide motif and can continue to be flexibly loaded with the desired antigens via an adapter.

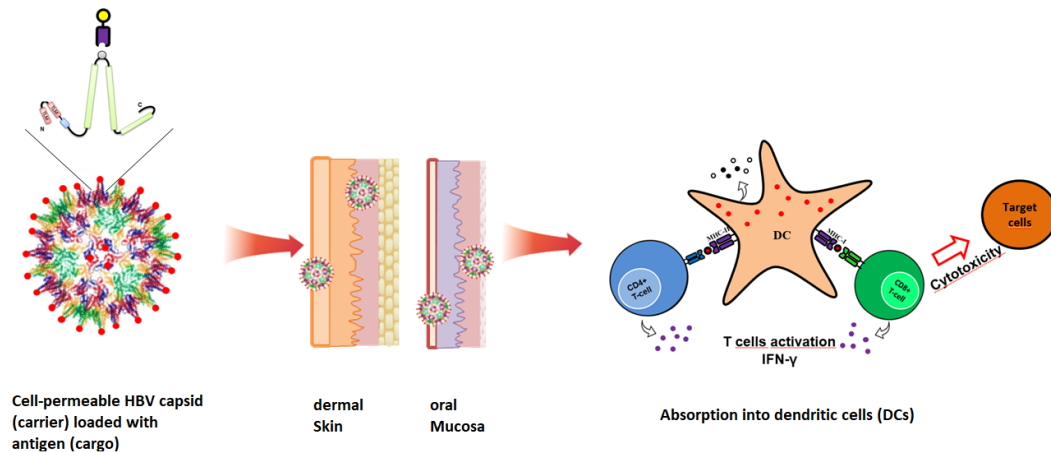


Fig. 2 Vaccine platform based on cell-permeable capsids, which act as antigen carriers and can be flexibly loaded with different antigens via an adapter. The highly ordered antigen structure on the surface promotes a robust antibody response. The membrane permeability allows penetration into antigen-presenting cells and thus a robust T-cell response. Source: Paul-Ehrlich-Institut

This leads to virus-like particles (VLPs), which carry the respective antigen in a highly ordered form on their surface and thereby present it to the immune system. This particularly promotes the triggering of a humoral immune response (antibody response). Due to cell permeability, these antigen-laden carrier particles can efficiently penetrate antigen-presenting cells (APCs), where the antigen can be processed into peptides by immunoproteasomes. Those peptides are then presented on the cell surface in order to stimulate the cellular immune response, in particular the CD8+ T cells. These antigen-specific T cells can then recognise and destroy target cells that produce the antigen or inhibit viral replication by releasing interferons. This process provides an essential basis for the rapid elimination of infectious agents, but also offers the possibility of eliminating chronically infected cells. This platform can also be used for therapeutic vaccines because the elimination of chronically infected cells is possible. We are working in particular on the development of a therapeutic vaccine against chronic infection with the hepatitis B virus (HBV), which currently affects about 300 million people worldwide and kills about one million people every year.