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Handbook SARS-CoV-2

Key Aspects of COVID-19 & Comprehensive Overview of Related Research Reagents

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antibodies-online has proudly supported over 500+ COVID-19 R&D projects in diagnostics, drug discovery and basic research across more than 25+ countries. The SARS CoV-2 Handbook is a compilation of key COVID-19 resources assembled to advance the effort against the pandemic.

Part one of the Handbook touches on the basic biology of the SARS-CoV-2 function and the involved virus and host proteins. Part two examines the factors contributing to the development of COVID-19. And Part three provides background regarding antibodies and immunoassays necessary for the study and diagnostics of SARS-CoV-2 and COVID-19. Version 1.2 of the Handbook focuses on the B.1.1.529 / omicron variant with emphasis on neutralizing antibodiy binding efficiency. It gives you direct access to the antibodies and proteins used by our community of scientists to drive the world's leading COVID-19 work.

We hope you find this Handbook useful. We appreciate the trust you have placed with our team to deliver the most relevant and highest quality products. And, we look forward to working together with you to advance scientific discovery.

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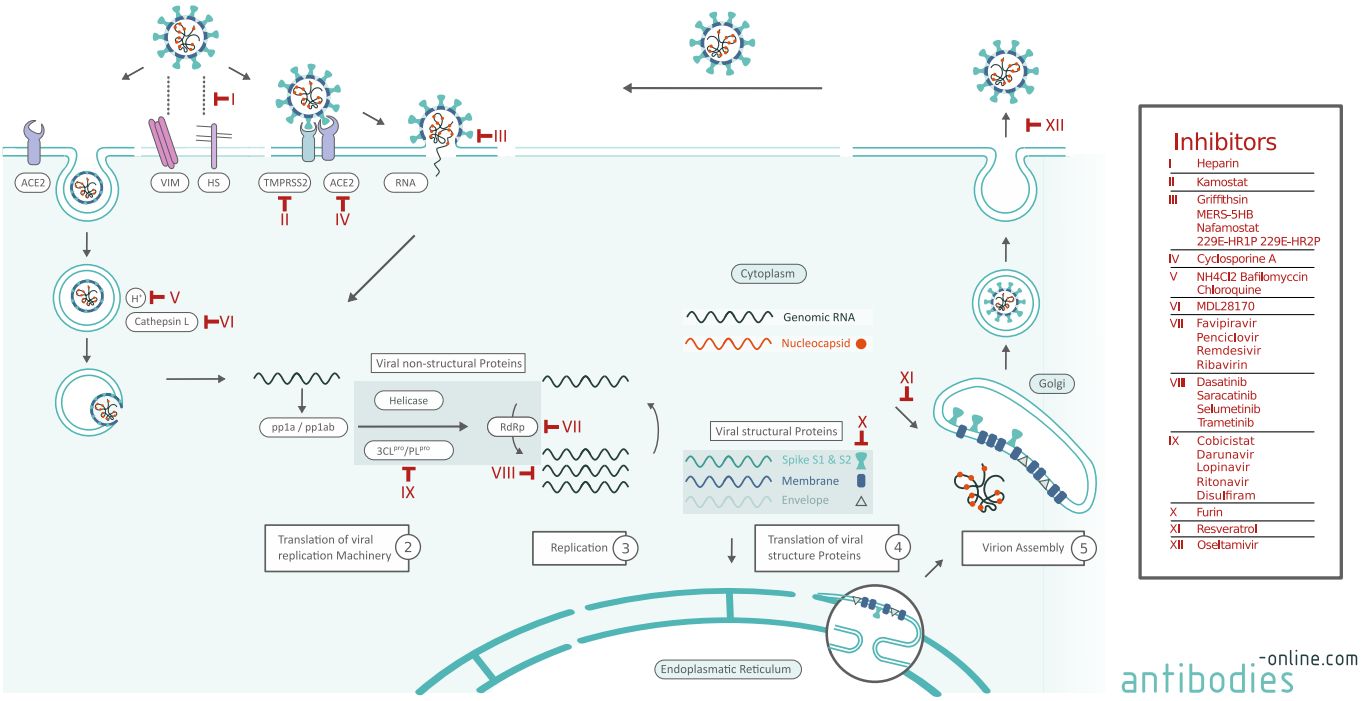
1. SARS-CoV-2

SARS-CoV-2 Life Cycle: Stages and Inhibition Targets



Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) belongs to the enveloped positive-sense RNA viruses. This virus is characterized by club-like spikes on the surface, and a unique replication strategy. Cell entry of coronaviruses depends on binding of the viral spike (S) proteins to cellular receptors and on S protein priming by host cell proteases. Unravelling which cellular factors are used by SARS-CoV-2 for entry might provide insights into viral transmission and reveal therapeutic targets.

In the following the replication cycle of SARS-CoV-2 is explained together with possible inhibitors and their respective targets. This compilation is based on current literature however we make no claim to accuracy.

Virus Entry

SARS-CoV-2 can hijack the cell in two ways, either via endosomes or via plasma membrane fusion. (In both ways) Spike proteins (S1, S2) of SARS-CoV-2 mediate attachment to the membrane of a host cell and engage angiotensin-converting enzyme 2 (ACE2) as the entry receptor. Inhibitors like Griffithsin (Inhibitor III) bind to the spike glycoprotein, thus preventing viral entry. Cell surface vimentin (VIM) acts as a critical co-receptor and is essential for successful ACE-2 binding. Binding of heparan sulfate (HS) to the receptor binding domain (RBD) enhances binding to ACE2 as well. Viral adhesion may be inhibited by by exogenous heparin. Heparin competes with HS for binding of the SARS-CoV-2 S protein.

When virions are taken up into endosomes, cathepsin L activates the spike protein. The pH dependent cysteine protease can be blocked by lysosomotropic agents, like bafilomycin A1 or ammonium chloride (Inhibitor Classes IV,V). Alternatively, the spike protein can be cleaved between the S1 and S2 domains by the cellular serine protease TMPRSS2 in close proximity to the ACE2 receptor, which initiates fusion of the viral membrane with the plasma membrane (Inhibitor II: Camostat). 1 The plasma membrane fusion entry is less likely to trigger host cell antiviral immunity and therefore more efficient for viral replication.

Translation of Viral Replication Machinery and Replication

After the viral RNA is released into the host cell, polyproteins are translated. The coronavirus genomic RNA encodes nonstructural proteins (NSPs) that have a critical role in viral

RNA synthesis, and structural proteins which are important for virion assembly. First, polyproteins pp1a and pp1ab, are translated which are cleaved by the Papain-like protease (PLpro, Nsp3) and 3C-like protease (3CLpro, Nsp5) (Inhibitor VIII) to form functional NSPs such as Helicase or the RNA replicase–transcriptase complex (RdRp). RdRp especially can be inhibited by virostatica like Favipiravir or Penciclovir (Inhibitor VI); the replication of viral RNA in general by kinase signaling pathway inhibitors like Saracatinib (Inhibitor VII). The expression level of N protein can be decreased by resveratrol (Inhibitor X).

One of the first translated proteins is the host shutoff factor Nsp1. This viral protein interferes with translation and causes accelerated degradation of host mRNA, thus suppressing the host's innate immune response.

Translation of Viral Structure Proteins and Virion Assembly

RdRp (Nsp12) is responsible for replication of structural protein RNA. Structural proteins S, Envelope (E), Membrane (M) are translated by ribosomes that are bound to the endoplasmic reticulum (ER). The ER forms double membrane vesicles (DMVs) in which the viral RNA is replicated and shielded from the host's innate immune system. Nsp3 creates pores through which viral RNA leaves the DMVs for virion assembly. The nucleocapsid proteins (N) remain in the cytoplasm and are assembled from genomic RNA. They fuse with the virion precursor which is then transported from the ER through the Golgi Apparatus to the cell surface via small vesicles.

Release of Virus

Virions are then released from the infected cell through exocytosis and search another host cell. Oseltamivir inhibits cleavage of sialic acids by neuroamidase from the cell receptors thus preventing release of newly formed virions from the cell surface (Inhibitor XI). One feature that sets SARS-CoV-2 apart from other coranaviruses like e.g. SARS-CoV-2 is a second cleavage site in the S protein. Furin cleavage at the S1/S2 site probably takes place when virions are released through the Golgi apparatus or lysosomes. It primes the S protein for a second cut at the S2' site by TMPRSS2. Certain mutations within this site are also hallmarks of SARS-CoV-2 variants of concern alpha (B.1.1.7), beta (B.1.351), delta (B.1.617.2) and omicron (B.1.1.529).

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Virus Entry

Product	Cat. No.	Clonality	Application	Validations
anti-ACE2 antibody (Angiotensin I Converting Enzyme 2)	ABIN1169449	Monoclonal	FACS, ELISA, WB	(2) (3)
anti-ACE2 antibody (Angiotensin I Converting Enzyme 2)	ABIN1169446	Polyclonal	ELISA, WB	(1) (1)
anti-ACE2 antibody (Angiotensin I Converting Enzyme 2) (AA 18-740)	ABIN6964048	Monoclonal	ELISA, FACS	(3)
anti-TMPRSS2 antibody (Transmembrane Protease, serine 2) (AA 254-490)	ABIN1871674	Polyclonal	ICC, IHC, WB	(3)
Transmembrane Protease, serine 2 (TMPRSS2) (AA 1-492) protein (GST tag)	ABIN4369881		AP, AA, ELISA, WB	(1)
Heparan sulfate (HS) ELISA Kit	ABIN6962574		ELISA	(1)
anti-Vimentin antibody (VIM) (C-Term)	ABIN3187471	Polyclonal	ELISA, IF, IHC, WB	(2)
SARS-CoV-2 Inhibitor Screening Kit	ABIN6952717		ELISA, ScA	(1) (3)

Translation of Viral Replication Machinery and Replication

Product	Cat. No.	Clonality	Source	Validations
anti-SARS-CoV-2 Membrane Protein antibody (SARS-CoV-2 M)	ABIN6952906	Polyclonal		(2)
anti-SARS-CoV-2 Envelope antibody (SARS-CoV-2 E) (N-Term)	ABIN1031551	Polyclonal	Rabbit	(8) (8)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N) (AA 1-419) (Fc Tag)	ABIN6952664	Chimeric	HEK-293 Cells	

Translation of Viral Structure Proteins and Virion Assembly

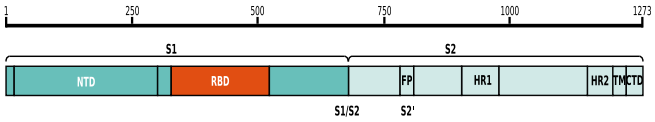
Product	Cat. No.	Clonality	Source	Validations
SARS-CoV-2 Spike (Trimer) protein (rho-1D4 tag)	ABIN6952670		HEK-293 Cells	(2)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	ABIN6952546	Monoclonal	Human	(8) (5)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	ABIN6952547	Chimeric	Rabbit	(7) (3)

SARS-CoV-2 Structural and Non-Structural Proteins

antibodies-online provides a large selection of recombinant proteins for SARS-CoV-2 research and assay development including membrane protein, nucleocapsid protein, spike protein, S protein mutations, envelope protein, and non-structural proteins.

SARS-CoV-2 Spike (S1, S2) Protein

SARS-CoV-2 uses its spike glycoprotein (S), a main target for neutralization antibody, to bind its receptor, and mediate membrane fusion and virus entry. Each monomer of trimeric, unglycoslyated S protein is about 142 kDa, and contains two subunits, S1 and S2, mediating attachment and membrane fusion, respectively. Below you can find a schematic representation of SARS-CoV-2 Spike protein: NTD, N-terminal domain. FP, fusion peptide. HR1, heptad repeat 1. HR2, heptad repeat 2. TM, transmembrane domain.



SARS-CoV-2 Nucleocapsid (N) Protein

The nucleocapsid protein is an important structural protein for the coronaviruses. It is highly abundant in the viruses. Its function involves entering the host cell, binding to the viral RNA genome, and forms the ribonucleoprotein core. N protein contains two distinct RNA-binding domains (NTD and CTD) linked by a poorly structured linkage region containing a serine/arginine-rich (SR-rich) domain.

SARS-CoV-2 Membrane (M) Protein

The coronavirus membrane (M) protein is the key player in virion assembly. One of its functions is to mediate the incorporation of the spikes into the viral envelope. When expressed alone, it accumulates in the Golgi complex in homomultimeric complexes.

SARS-CoV-2 Envelope (E) Protein

E protein of SARS-CoV-2 is a 75 amino acids long protein existing in both monomeric and homo-pentameric form. Approximately 20 copies of the protein have been found in the viral particle and previous mutagenesis-based studies demonstrated its pivotal role in the onset and development of the viral infection.

SARS-CoV-2 Non-structural Proteins (NSP)

The SARS-CoV-2 genome encodes 16 non-structural proteins (Nsp1-16), four structural proteins, and nine putative accessory factors. NSPs include the various enzymes and transcription factors the virus uses to replicate itself, such as viral protease, RNA replicase and proteins to control the host.

The role of recombinant Proteins in SARS-CoV-2 Research

Recombinant SARS-CoV-2 proteins are indispensable as antigens for antibody development, as capture antigens or as standards in assays. They can be used as a positive control in antigen-detecting ELISAs to accurately separate true positive results from potentially false results or as capture antigens for immunoglobin ELISAs. The trimeric, full length SARS-CoV-2 Spike protein for example is suitable for assay development and highly useful when studying neutralizing antibodies. In addition SARS-CoV-2 proteins are needed for drug discovery and drug repurposing studies. In the process of drug discovery, functional studies with active proteins are vital to verify the inhibitory effects of the tested substance. NSPs as well as the S and N proteins are in the spotlight as potential targets; their functions and interaction with the host cell are crucial for virus propagation and therefore highly relevant for inhibition strategies. SARS-CoV-2 N protein has been shown to affect the complement system whereas the SARS-CoV-2 NSPSs are responsible for virus replication.

Post-translational modifications (PTMs), like glycosylation, modify proteins as last step of maturation to promote protein folding and improve stability. The glycosylation pattern of the SARS-CoV-2 spike protein is important for the identification of immunogens for vaccine design, especially regarding steric hindrance. The spike glycoprotein exists as a homotrimeric fusion protein. Each of the trimers contains 66 glycosylation sites for host-derived N-linked glycans. In the predominant state of the trimer, one of the RBDs is in an “up” position whereas the other two are in a “down” position. Interaction of S-protein and ACE2 only takes place with one RBD in the “up” position.

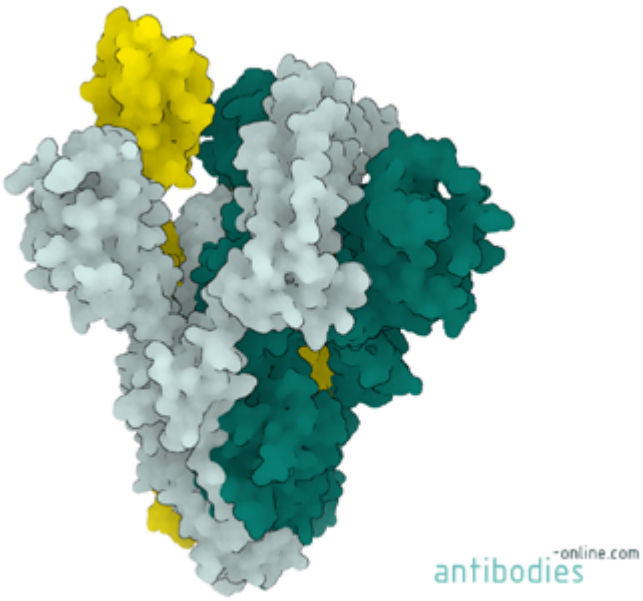
SARS-CoV-2 utilizes high mannose as well as complex-type glycans structure on their spike proteins. This leads to a complex surface structures, a challenge for finding interactors and in the generation of neutralizing antibodies (Nabs). The Full length SARS-CoV-2 Spike protein (ABIN6952670) is, like our other active SARS-CoV-2 proteins produced in

HEK293-cells. The expression in cultures human cells assures the correct glycosylation pattern and the conformation with of the homotrimeric fusion protein in its active „up“ state. The Full length SARS-CoV-2 Spike protein therefore is highly useful when studying neutralizing antibodies.

In a recent Glycobiology article Shajahan et al. performed site-specific quantitative N-linked and O-linked glycan profiling on recombinant SARS-CoV-2 S protein subunit S1 and SARS-CoV-2 S protein subunit S2 through glycoproteomics using high resolution LC-MS/MS. The spike protein is comprised of two protein subunits (S1 and S2), which together possess 22 potential N-glycosylation sites. The group identified 2 unexpected O-glycosylation sites at the receptor binding domain (RBD) of subunit S1.

The N-glycans on the S protein play important roles in proper protein folding and priming by host proteases. Since glycans can shield the amino acid residues and other epitopes from cells and antibody recognition, glycosylation can enable the coronavirus to evade both the innate and adaptive immune responses. The group used recombinant SARS-CoV-2 S1 Protein and SARS-CoV-2 S2 Protein expressed in HEK293 cells and observed partial N-glycan occupancy on 17 out of 22 N-glycosylation sites. High mannose-type $Man_5GlcNAc_2$ sugar chains were implemented as predominant structure across all sites.

Thr323 and Ser325 were identified as O-glycosylation sites on the S1 subunit of SARS-CoV-2 spike protein through high resolution mass spectrometry glycoproteomic profiling. The residues Thr323 and Ser325 are located at the RBD of the S1 subunit of SARS-CoV-2, and thus the O-glycosylation at this location could play a critical role in viral binding with hACE2 receptors.



Prefusion SARS-CoV-2 spike protein trimer with a single RBD in the „up“ position (yellow; PDB 6VSB)

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Trimeric SARS-CoV-2 Spike Proteins

Product	Source	Cat. No.	Validations
SARS-CoV-2 Spike (Trimer) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6952670	(2)
SARS-CoV-2 Spike (Trimer) protein (His tag)	HEK-293 Cells	ABIN6953172	
SARS-CoV-2 Spike (Super Stable Trimer) protein (His tag,AVI tag,Biotin)	HEK-293 Cells	ABIN6953303	(4)
SARS-CoV-2 Spike (Super Stable Trimer) protein (His tag)	HEK-293 Cells	ABIN6953299	(4)
SARS-CoV-2 Spike (Super Stable Trimer) protein (His tag)	HEK-293 Cells	ABIN6953302	(2) (5)
SARS-CoV-2 Spike (D614G), (Trimer) protein (His tag)	HEK-293 Cells	ABIN6953171	
SARS-CoV-2 Spike (D614G), (Super Stable Trimer) protein (His tag,AVI tag,Biotin)	HEK-293 Cells	ABIN6953300	(4)
SARS-CoV-2 Spike (D614G), (Super Stable Trimer) protein (His tag)	HEK-293 Cells	ABIN6953301	(4)

SARS-CoV-2 Spike (S1, S2) Proteins

Product	Source	Cat. No.	Validations
SARS-CoV-2 Spike (Trimer) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6952670	(2)
SARS-CoV-2 Spike (Super Stable Trimer) protein (His tag)	HEK-293 Cells	ABIN6953302	(2) (5)
SARS-CoV-2 Spike (Super Stable Trimer) protein (His tag,AVI tag,Biotin)	HEK-293 Cells	ABIN6953300	(4)
SARS-CoV-2 Spike S2 protein (His tag)	HEK-293 Cells	ABIN6952319	(1)
SARS-CoV-2 Spike S1 protein (His tag)	HEK-293 Cells	ABIN6952318	(1)
SARS-CoV-2 Spike S1 protein (His tag)	HEK-293 Cells	ABIN6952427	(4) (5)
SARS-CoV-2 Spike S1 (RBD) protein (His-SUMOstar Tag)	Yeast	ABIN6953166	(5)
SARS-CoV-2 Spike S1 (RBD) protein (His tag,MYC tag)	Mammalian Cells	ABIN6953168	(5)

SARS-CoV-2 N, M, E Proteins

Product	Source	Cat. No.	Validations
SARS-CoV-2 Nucleocapsid (SARS-CoV-2 N) protein (His tag)	HEK-293 Cells	ABIN6952454	(2) (1)
SARS-Coronavirus Membrane Protein (SARS-CoV M) Protein	Escherichia coli (E. coli)	ABIN1111939	
SARS-CoV-2 Envelope (SARS-CoV-2 E) protein (His tag,GST tag)	Escherichia coli (E. coli)	ABIN6952705	(1)

SARS-CoV-2 Non-structural Proteins (NSP)

Product	Source	Cat. No.	Validations
SARS-CoV-2 Host Translation Inhibitor Nsp1 (NSP1) protein (His tag)	Escherichia coli (E. coli)	ABIN6952638	(1)
SARS-CoV-2 Host Translation Inhibitor Nsp1 (NSP1) protein (His tag)	Insect Cells	ABIN6952564	
SARS-CoV-2 Non-Structural Protein 2 (NSP2) protein (His tag)	Insect Cells	ABIN6952565	
SARS-CoV-2 Non-Structural Protein 4 (NSP4) protein (rho-1D4 tag)	Insect Cells	ABIN6952566	
SARS-CoV-2 3C-Like Proteinase (NSP5) (3CL-PRO, M-Pro) (AA 1-306) protein (His-Avi Tag)	Escherichia coli (E. coli)	ABIN6952903	
SARS-CoV-2 3C-Like Proteinase (NSP5) (3CL-PRO, M-Pro) protein (His tag)	Insect Cells	ABIN6952691	
SARS-CoV-2 Non-Structural Protein 6 (NSP6) protein (rho-1D4 tag)	Insect Cells	ABIN6952568	
SARS-CoV-2 Non-Structural Protein 7 (NSP7) protein (His tag)	Escherichia coli (E. coli)	ABIN6952707	(1)
SARS-CoV-2 Non-Structural Protein 7 (NSP7) protein (His tag)	Insect Cells	ABIN6952692	
SARS-CoV-2 Non-Structural Protein 8 (NSP8) protein (His tag)	Insect Cells	ABIN6952693	
SARS-CoV-2 Non-Structural Protein 10 (NSP10) protein (His tag)	Insect Cells	ABIN6952572	
SARS-CoV-2 Helicase (NSP13) (HEL) protein (His tag)	Insect Cells	ABIN6952696	
SARS-CoV-2 Guanine-N7 Methyltransferase (NSP14) (ExoN) protein (His tag)	Insect Cells	ABIN6952575	
SARS-CoV-2 2′-O-Ribose Methyltransferase (NSP16) protein (His tag)	Escherichia coli (E. coli)	ABIN6953311	
SARS-CoV-2 2′-O-Ribose Methyltransferase (NSP16) protein (His tag)	Insect Cells	ABIN6952577	

SARS-CoV-2 Mutations

A rising level of immunity in the population increases the selection pressure on SARS-CoV-2 and more variants of the virus are discovered. Viral variants that can partially escape the body's defenses spread more rapidly. Antibodies used for vaccination also run the risk of poorer detection, thus they need to be screened for efficacy when new variants emerge.

The UK lineage B.1.1.7 / alpha emerged in September 2020, with N501Y, P681H amongst other mutations. Higher transmissibility of this variant of concern let to rapid growth in the UK and internationally. A similar suite of deletions to B.1.1.7 shows B.1.525 / eta, however combined with E484K, Q677H and F888L mutations. The B.1.526 / iota variant first identified in New York. The lineage is characterized by E484K spike mutation, which may help the virus evade antibodies, and the S477N mutation, which may help the virus bind more tightly to human cells. E484K mutation has been found also in variants B.1.351 / beta and P.1 / gamma identified in South Africa and Brazil respectively. Studies by multiple laboratories have shown that the E484K change — situated in the receptor binding domain (RBD), a protein of the S protein recognized by the host cell — weakens the potency of antibodies that can usually disable the virus.

International lineage A.23.1 is characterized by F157L, V367F, Q613H and P681R mutation. Q613H is predicted to be functionally equivalent to the D614G mutation that arose early in 2020. The proline-arginine substitution near this cleavage site at position 681 makes the sequence less acidic. This causes furin to recognize and cut more effectively, stimulating more spike proteins to enter human cells.

In the same time frame B.1.617.2 / delta was first detected in India and spread worldwide. The lineage is characterized by L452R, T478K and P681R. The T478K mutation in the RBD was first described in this variant and is near the E484K mutation. T478K also facilitates antibody escape.

Lineage B.1.621 was first detected in Colombia in January 2021. Until September 2021 the lineage has been reported in various countries across the globe. The lineage combines E484K, N501Y, D614G and P681H mutations of different lineages of concern among others.

B.1.1.529 / omicron appeared first in November 2021. Early sequences are predominantly from South Africa, though also detected in Botswana and Hong Kong. Omicron is primarily of concern due to the large number of mutations it has in the Spike gene. The number of mutations is unique for SARS-CoV-2 variants, they are concentrated in the receptor binding domain and N-terminal domain, and thus may play key roles in ACE2 binding and antibody recognition. A particular cluster of mutations at the S1-S2 furin cleavage site (H655Y, N679K, P681H) are associated with increased transmissibility. Similar to delta variant, T478K facilitates antibody escape. The combination of mutations Q498R and N501Y in in-vitro evolution studies significantly increased the binding affinity to ACE2. There are also two mutations in Nucleocapsid, N:R203K and N:G204R. This mutation pattern is already known from alpha and gamma variants, it is linked to increased subgenomic RNA expression and increased viral loads. The following page shows a tabular comparison of amino acid changes in the S and N proteins of SARS-CoV-2 variants of concern.

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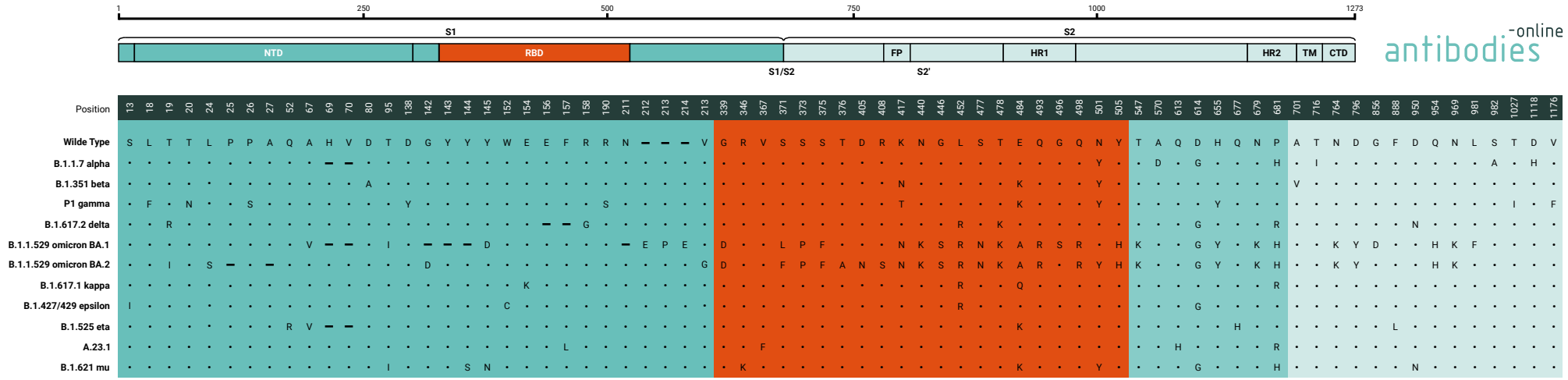
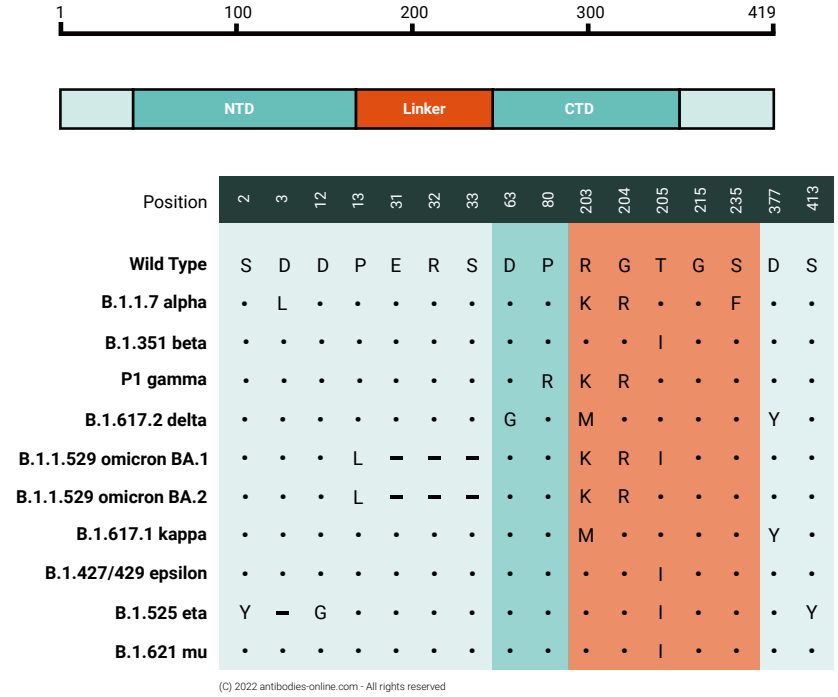


Amino acid changes in the S proteins of different SARS-CoV-2 variants of concern and variants of interest. The RBD domain is highlighted orange.



Amino acid changes in the N proteins of different SARS-CoV-2 variants of concern and variants of interest. The linker region is highlighted in orange.

B.1.1.7 / Alpha Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.1.7 lineage) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6963742
SARS-CoV-2 Nucleocapsid (SARS-CoV-2 N) (D3L), (G204R), (R203K), (S235F) protein (His tag)	HEK-293 Cells	ABIN6971314

Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953169	
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953170	
anti-SARS-CoV-2 Spike S1 antibody	Chimeric	AM122	IgG1	Human	ABIN6953206	(5)

B.1.351 / Beta Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.351 lineage) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6963740

Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953169	
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953170	
anti-SARS-CoV-2 Spike S1 antibody	Chimeric	AM122	IgG1	Human	ABIN6953206	(5)

P.1 / Gamma Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (P.1 lineage) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6964443

Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953169	
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953170	

B.1.617.2 / Delta Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.617.2 - delta) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6999328
SARS-CoV-2 Spike (B.1.617.2 - delta plus), (RBD) (Active) protein (His tag)	HEK-293 Cells	ABIN7013114

Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953169	
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953170	

B.1.617.1 / Kappa Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.617.1 - kappa), (RBD) protein (His tag)	HEK-293 Cells	ABIN6992290
SARS-CoV-2 Spike (B.1.617.1 - kappa) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6976302

Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953169	
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1	Mouse	ABIN6953170	

B.1.429 / Epsilon Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.429 lineage) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6972926

Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)
anti-SARS-CoV-2 Spike S1 antibody	Chimeric	AM122	IgG1	Human	ABIN6953206	(5)

B.1.525 / Eta Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.525 lineage) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6972924

CR3022 antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)

B.1.621 / Mu Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (B.1.621 - mu) protein (rho-1D4 tag)	HEK-293 Cells	ABIN7013133

Wuhan Strain

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike (Trimer) protein (rho-1D4 tag)	HEK-293 Cells	ABIN6952670

B.1.1.529 / Omicron Lineage

Proteins

Product	Source	Cat. No.
SARS-CoV-2 Spike S1 (B.1.1.529 - Omicron) protein (His tag)	HEK-293 Cells	ABIN7041437
SARS-CoV-2 Spike (BA.2 - Omicron) protein (His tag)	HEK-293 Cells	ABIN7072153
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (Trimer) protein (His-Avi Tag,Biotin)	HEK-293 Cells	ABIN7041445
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (Trimer) protein (His tag)	HEK-293 Cells	ABIN7041439
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (RBD) protein (His-Avi Tag,Biotin)	HEK-293 Cells	ABIN7041442
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (RBD) protein (His tag)	HEK-293 Cells	ABIN7041436
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (NTD) protein (His tag)	HEK-293 Cells	ABIN7041440
SARS-CoV-2 Spike (B.1.1.529 - Omicron) protein (rho-1D4 tag)	HEK-293 Cells	ABIN7072154
SARS-CoV-2 Spike (B.1.1.529 - Omicron) protein (His tag)	HEK-293 Cells	ABIN7072155
SARS-CoV-2 Nucleocapsid (SARS-CoV-2 N) (BA.2 - Omicron) protein (His tag)	HEK-293 Cells	ABIN7041441

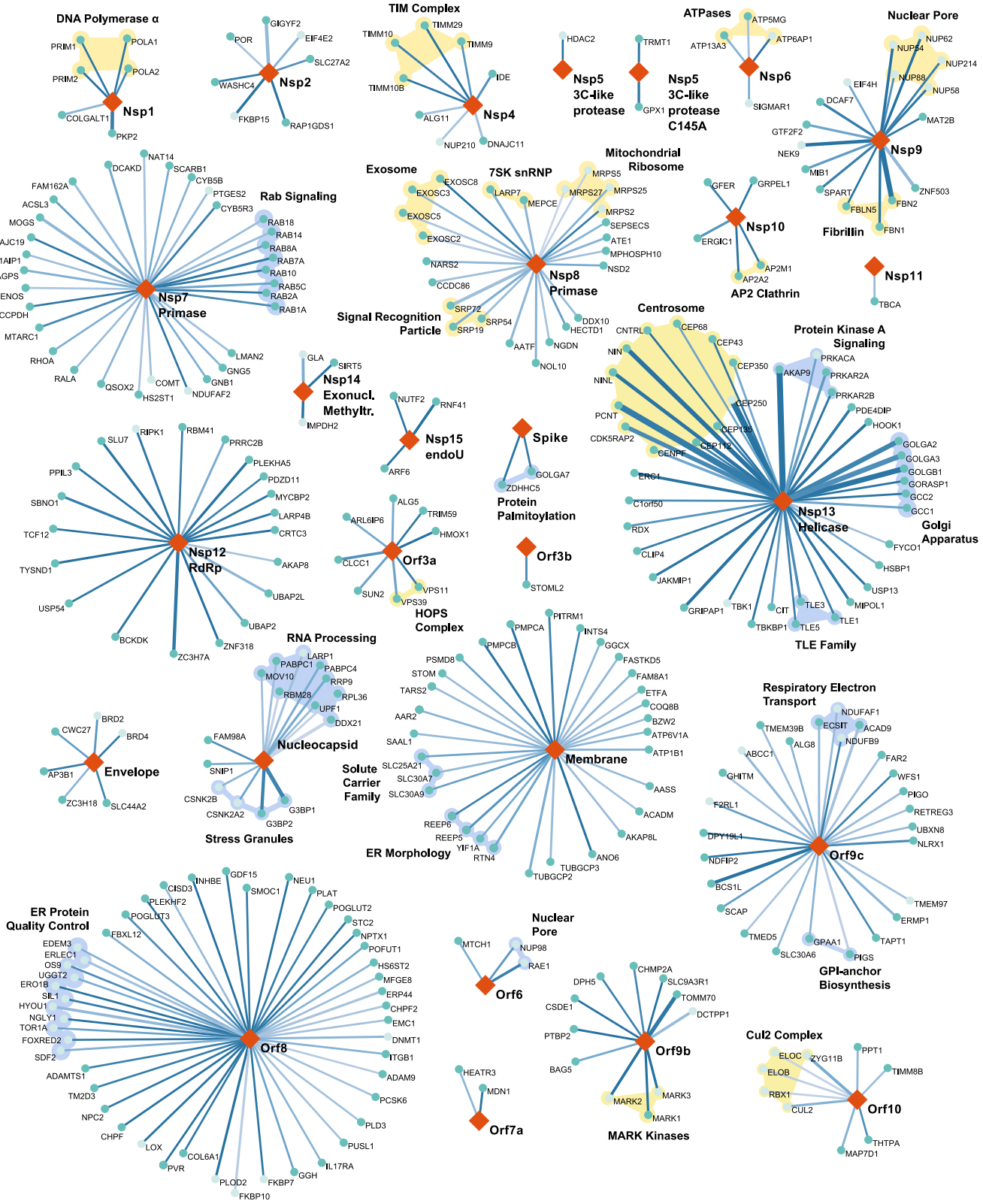
Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (9)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)
anti-SARS-CoV-2 Spike antibody AA 319-541	Monoclonal	MM117	IgG1	Mouse	ABIN7042145	(3)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		IgG1		ABIN6953169	(1)
anti-SARS-Coronavirus Nucleocapsid Protein (SARS-CoV N) antibody	Polyclonal		IgG	Rabbit	ABIN6952544	(21) (10)

SARS-CoV-2 Spike Proteins - Furin Cleavage Site

Product	Source	Cat. No.
SARS-CoV-2 Spike (P.1 - gamma) (Active) protein (His tag)	Baculovirus infected Insect Cells	ABIN7041646
SARS-CoV-2 Spike (BA.2 - Omicron) protein (His tag)	Baculovirus infected Insect Cells	ABIN7041649
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (Trimer) protein (His-Avi Tag,Biotin)	Baculovirus infected Insect Cells	ABIN7041648
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (Trimer) protein (His tag)	Baculovirus infected Insect Cells	ABIN7041645
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (RBD) protein (His-Avi Tag,Biotin)	Baculovirus infected Insect Cells	ABIN7041650
SARS-CoV-2 Spike (B.1.1.529 - Omicron), (RBD) protein (His tag)	Baculovirus infected Insect Cells	ABIN7041644
SARS-CoV-2 Nucleocapsid (SARS-CoV-2 N) (BA.2 - Omicron) protein (His tag)	Baculovirus infected Insect Cells	ABIN7041441

SARS-CoV-2 Protein Interactome



SARS-CoV-2 Protein Interactome: 332 high-confidence interactions between 26 SARS-CoV-2 proteins (orange) and human proteins (circles; drug targets: grey; protein complexes: yellow; proteins in the same biological process: blue).

The 30 kb SARS-CoV-2 genome encodes 16 non-structural proteins (Nsp1-16), four structural proteins (spike, envelope, nucleocapsid, membrane), and nine putative accessory factors. Many of these proteins and polypeptides have a number or interaction partners in particular in lung cells, the virus' primary infection site. These interactions with the host cell determine the virus' ability to infect the cell, reproduce its genome and trigger the production and release of new virus particles. In addition, several virus proteins appear to have interaction partners affecting innate immune pathways such as the interferon signaling pathway, NF-κB inflammatory response, type I interferon production, and IRF-3 activation.

At least some of the members of the third group of SARS-CoV-2 proteins, the nine accessory factors (Orf3a-10), have been implicated in driving progression of COVID-19. Orf3a induces apoptosis and is thought to activate NF-kB and the NLRP3 inflammasome involved in pyroptosis, a highly inflammatory form of apoptosis. The type I interferon (IFN) antagonists Orf6 and Orf9b inhibit the IFN alpha and beta signaling, two key players of the antiviral innate immune response.

Some of these regulatory functions are shared with other pathogenic human viruses. Therefore, a deeper understanding of these mechanisms may lead to the identification of targets and development of novel therapeutics relevant for future virus pandemics.

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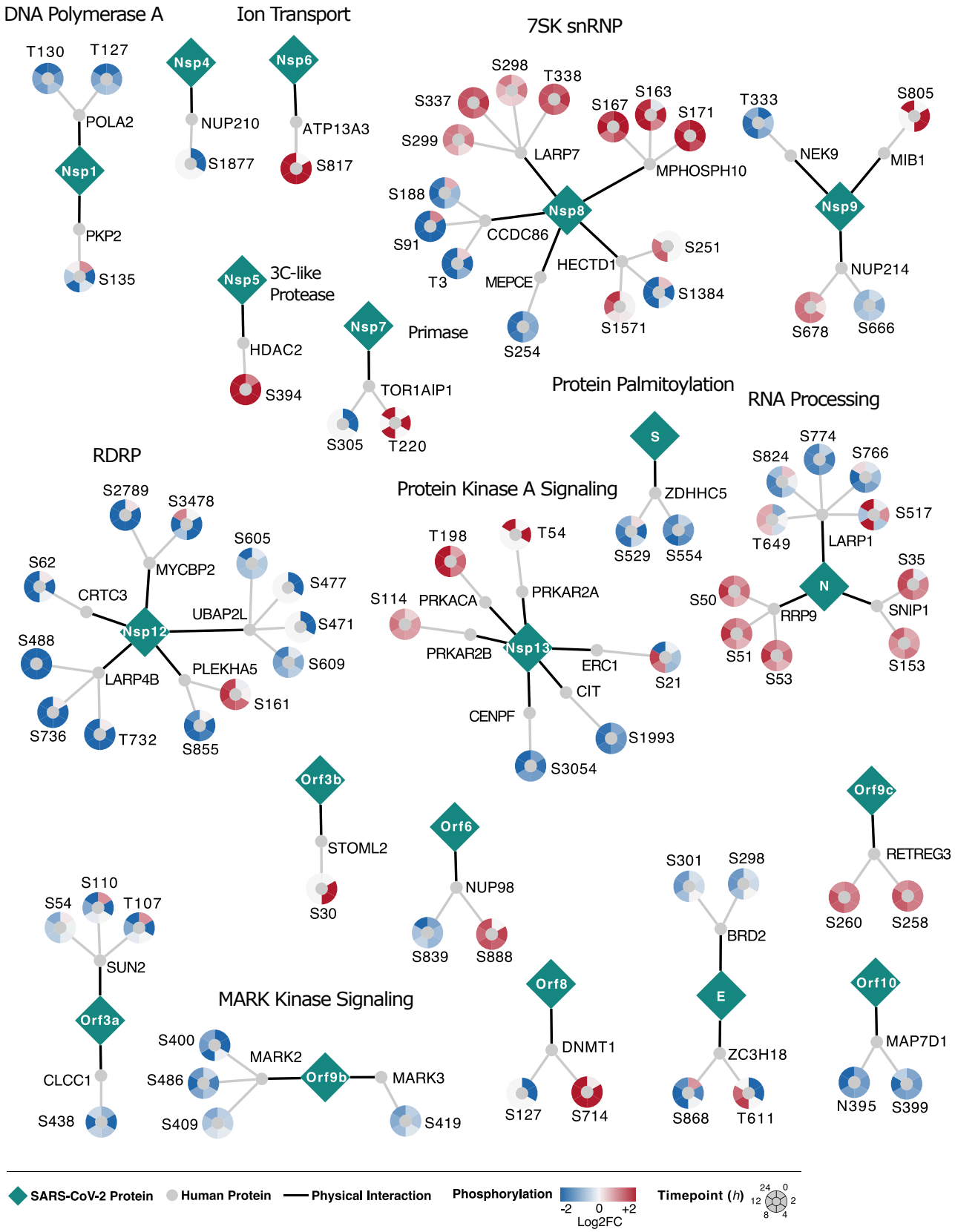
Global Phosphorylation Landscape of SARS-CoV-2 Infection



Phosphorylation of SARS-CoV-2 Interacting Proteins

During a COVID-19 infection both, host and viral proteins, undergo major changes in phosphorylation. The virus tries to alter activities of e.g. kinases in order to influence cellular signaling to its benefits. The map below is based on the SARS-CoV-2 virus-host protein-protein interaction map of Gordon et al. and shows 40 human proteins which are significantly differentially phosphorylated across infection at least two time points. Viral proteins are shown as green diamonds. Interacting human proteins are shown as gray or respectively dark grey circles. PHs emanate from human proteins, colored by change compared with uninfected control samples (red, increase; blue, decrease) at each time point (0, 2, 4, 8, 12, and 24 h after infection) in a clockwise fashion.

The SARS-CoV-2 N protein is known to interact with several RNA-processing proteins that are differentially phosphorylated during infection, including LARP1 and RRP9. Here LARP1 phosphorylation decreases on several sites, which is known to consequently increase LARP1 affinity for 3' untranslated regions (UTRs) of mRNAs encoding ribosomal proteins, driving inhibition of human protein synthesis. In addition, Nsp8 interacts with LARP7 and MEPCE which are important regulators of RNA polymerase II-mediated transcription elongation as part of the 7SK small nuclear ribonucleoprotein particle (snRNP) complex. Their phosphorylation may influence positive transcription elongation factor b (PTEFb [CDK9]) and transcriptional regulation of the virus.

10 of the 40 interacting proteins are kinases, a decrease in activity for MARK2 and PRKACA were observed while CK2 shows increased activity. The changes in kinase activity offer insights into the biology of viral infection and possible attack points to fight an infection. Therefore kinases are predestined as drug targets and further research may lead to development of novel therapeutics relevant for future virus pandemics.

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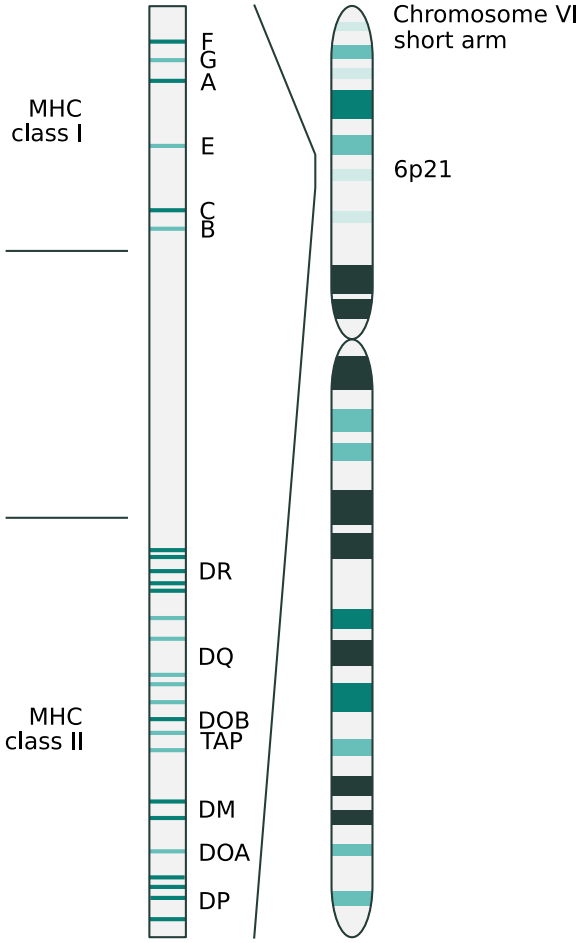
2. Immune Response and COVID-19

Human Leukocyte Antigen (HLA) in Adaptive Immune Response

The Major Histocompatibility Complex (MHC) comprises a number of genes that occur in many species. The encoded proteins help the immune system to tell the body's own proteins apart from those of pathogens such as viruses, bacteria, and protozoans. In humans, MHC proteins are encoded by the Human Leukocyte Antigen (HLA), a group of more than 200 genes located closely together on the short arm of chromosome 6. Class I HLAs present peptides from inside the cell whereas class II HLAs present antigens from outside of the cell to T-lymphocytes. A third cluster of HLAs (class III HLAs), situated between class I and class II HLAs, encodes components of the complement system and is not involved in the adaptive immune response.

Classical class I and class II Human Leukocyte Antigen (HLA) are leading candidates for infectious disease susceptibility. Many observations point to a major role for classical HLA loci in determining susceptibility to viral infections1. One study shows that individuals with the allele HLA-B*46:01 have the fewest predicted binding peptides for SARS-CoV-2, suggesting they may be particularly vulnerable to COVID-19, as they were previously shown to be for SARS. A different allele, HLA-B*15:03, showed the greatest capacity to present highly conserved SARS-CoV-2 peptides that are shared among common human coronaviruses, suggesting it could enable cross-protective T-cell based immunity. These observations point towards a potential influence of different HLA composition - the haplotype - in the present SARS-CoV-2 pandemic. Association of various HLA haplotypes with SARS-CoV-2 infection and the course of COVID-19 could



Human Leukocyte Antigen

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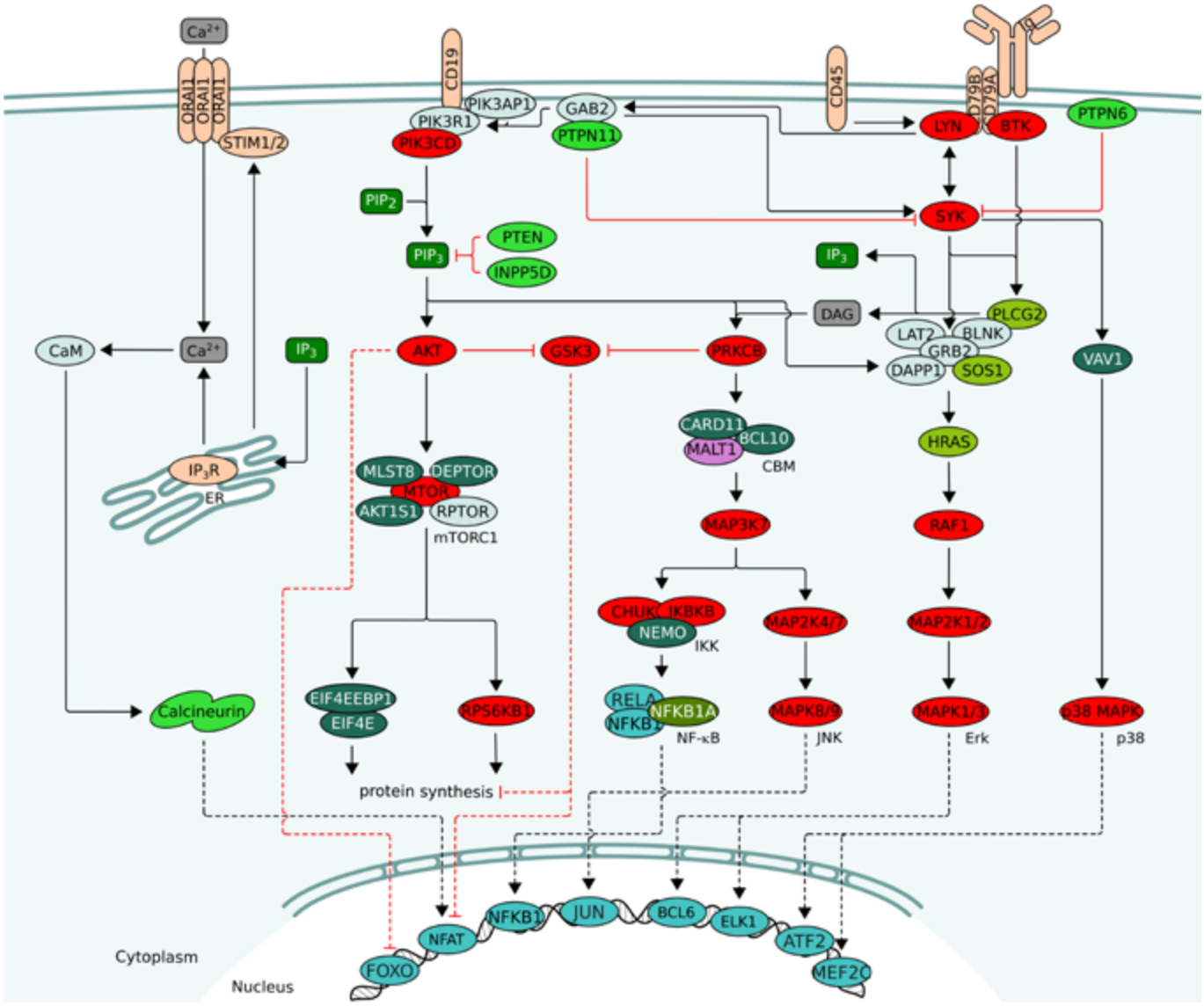
B Cell Immunity



BCR Signaling

B cell receptor (BCR) signaling is essential for B cell survival and development and antibody production under physiological and pathological conditions. Antigen-driven priming signaling is important for the initiation of B cell activation and differentiation into antibody-secreting cells. On the other hand, tonic BCR signaling is required for B cell survival and development whereas chronic signaling is essential for the proliferation of B cell lymphoma cells.

Stimulation of the BCR by antigen engagement initiates receptor clustering leading to phosphorylation of CD79 and CD19 by tyrosine protein kinase Lyn (LYN). The Protein kinase Syk (SYK) binds to phospho-tyrosine residues within the CD79 ITAM domain and is activated. Adaptor proteins such as BLNK, BCAP (PIK3AP1), LAB (LAT2), and GRB2 associate with phospho-tyrosines outside the ITAM on CD79. BLNK and BCAP are also phosphorylated by SYK. Phosphoryated BCAP and CD19 attract the regulatory subunit p85 which results in the activation of catalytic p110 PI3Kδ (PIK3CD). Conversion of phosphatidylinositol 4,5-bisphosphate (PIP_2) to Phosphatidylinositol (3,4,5)-trisphosphate (PIP_3) by the activated kinase then attracts PH domain containing proteins such as AKT, BTK, PLCγ2 (PLCG2), and Vav (VAV1) to the plasma membrane. Phoshporylated BLNK act as a scaffold for membrane-associated kinases BTK and PLCγ2 (PLCG2), thus facilitating their activation. This catalyzes activation of downstream NF-κB and JNK signaling through the CBM signalosome and activation of ERK signaling. In addition, Vav (VAV1) activation leads to p38 signaling and cytoskeletal rearrangement and AKT signaling leading to activation of mTORC1 and inhibition of FoxO.

BCR antigen engagement also leads the activation to Ca^{2+} dependent pathways. Activated phospholipase C-γ (PLCG2) hydrolyzes phosphatidylinositol 4,5-bisphosphate (IP2) to the second messenger 1,4,5-trisphosphate (IP3). This leads to Inositol 1,4,5-trisphosphate receptor (IP3R) mediated release of Ca^{2+} from the endoplasmic reticulum (ER). Upon depletion of the ER Ca^{2+} store additional Ca^{2+} enters the cell through the CRAC Channel (ORAI1), further increasing the concentration of cytoplasmic Ca^{2+} which is bound by Calmodulin (CaM). Ca^{2+} dependent signaling causes dephosphorylation nuclear factor of activated T cells (NFAT) by Calcineurin and subsequently translocation into the nucleus and activation of NFAT promotors.

In the course of the COVID-19 pandemic and the search for therapeutic approaches, the BCR signaling pathway is increasingly being scrutinized. Epitopes of BCR as well as TCR change in the course of a COVID-19 infection and remain persistent even after the infection has subsided. Several loci are unique to COVID-19 infection indicating their SARS-CoV-2 specificity. Further understanding of B cell mechanisms has potential clinical utility in COVID-19 immunotherapies.

Click here to see the online version of this article and antibodies, proteins as well as ELISA kits of important actors

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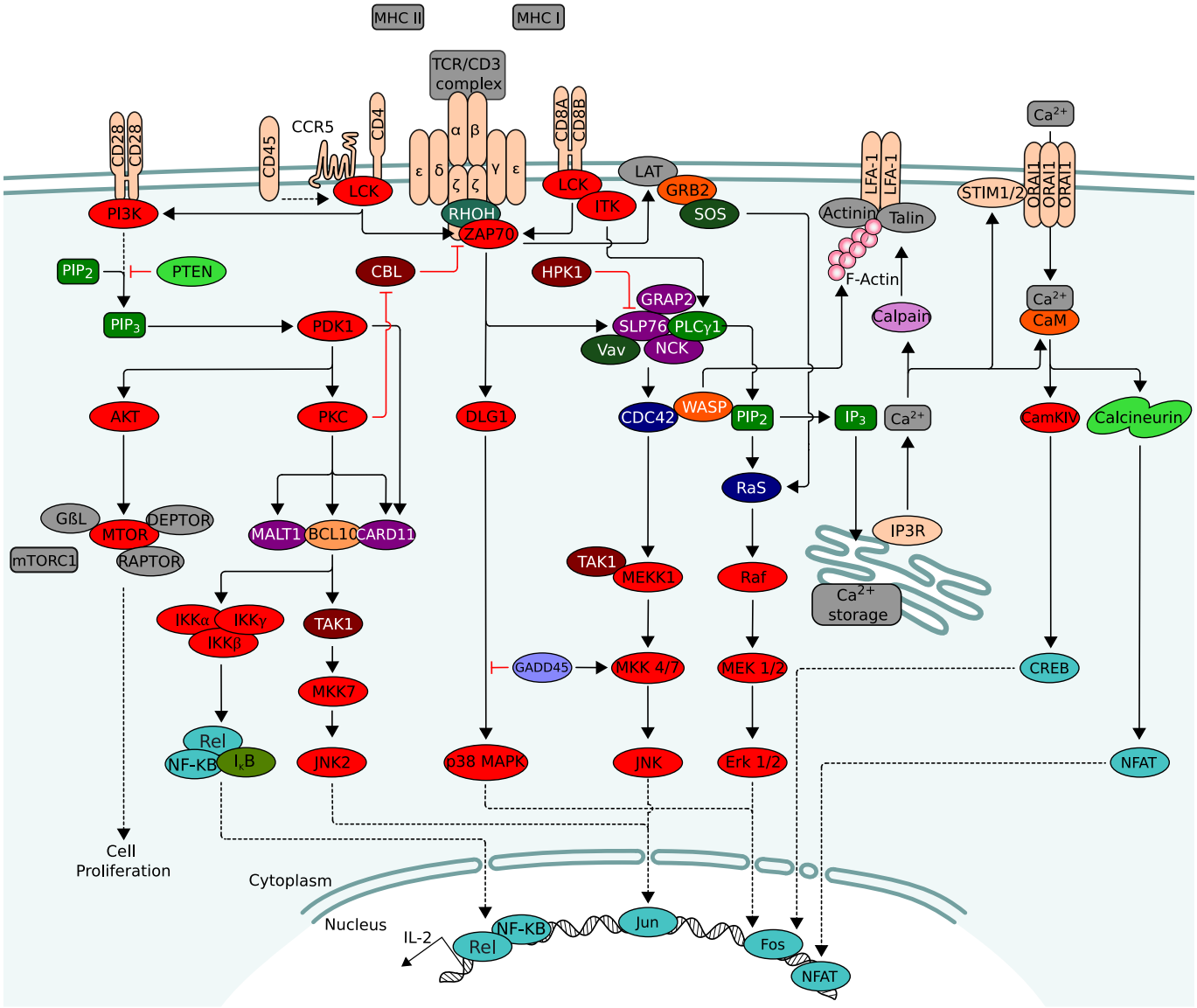
T Cell Immunity



The T-Cell Receptor (TCR) is a protein complex on the surface of cells responsible for the recognition of antigens on the surface of antigen presenting cells (APC). Cell surface glycoproteins CD4 and CD8 serve as coreceptors with the TCR primarily for the interaction with the major histocompatibility complex class II (MHC II) loaded with peptides derived from cytosolic proteins and MHC I with extracellular protein peptides respectively. Activation of the TCR induces a number of signaling cascades, ultimately leading to the transcription of several gene products essential for T cells differentiation, proliferation and secretion of a number of cytokines.

CD45 regulated activation of Src-family kinases LCK and FYN leads to phosphorylation of TCR immunoreceptor tyrosine-based activation motifs (ITAMs) in CD3, creating a docking site for ZAP-70. Phosphorylation and activation is modulated by CD45. ZAP-70 binds to the CD3 zeta chain, which positions the protein kinase to phosphorylate the transmembrane protein linker of activated T cells (LAT). Signaling proteins like SLP-76 can now dock to LAT and are also phosphorylated by ZAP-70. SLP-76 promotes recruitment of Vav, the adaptor proteins NCK and GRAP2, and an inducible T cell kinase (Itk).

Further recruitment of other protein upon LAT and SLP-76 phosphorylation leads to calcium mobilization, Ras Activation and cytoskeletal reorganization. Phosphorylation of phospholipase C γ1 (PLCγ1) by the Itk results in the hydrolysis of phosphatidylinositol 4,5-bisphosphate (PIP2) to produce the second messenger inositol trisphosphate (IP^3) and diacylglycerol (DAG). DAG activates PKC4 and the MAPK/Erk pathways cascade which leads to activation of transcription factor NF-κB and ATF2 activation and relocation into nucleus.

IP_3 promotes release of Ca^{2+} from the ER, which triggers entry of extracellular Ca^{2+} into cells through calcium release-activated Ca^{2+} (CRAC) channels. Calcium-bound calmodulin (Ca2+/CaM) activates the phosphatase calcineurin. Transcription factor NFAT gets activated and promotes IL-2 gene transcription.

TCR signaling is regulated on several levels to diversify the cell response. Extracellular signals are recognized by additional cell surface receptors like CD28 or LFA-1 and modulate cellular response further. Besides, tight negative regulation is essential to prevent hyperactivation of the pathway and the associated immune response.

T cell response is a crucial part of the adaptive immune response. While antibody production by B cells is the focus to prevent infection with SARS-CoV-2, the causative agent for COVID-19, an adaptive T cell response is likely equally important, in particular considering variants of concern such as the recently emerging B.1.1.7, B.1.351, P.1 lineages. Virus-specific effector CD8+ cells resulting from an infection or vaccination can kill infected cells and form memory CD8+ cells for a later infection. Furthermore, T cells hold great promise in adoptive T cell (ATC) cancer immunotherapy using engineered chimeric antigen receptors (CARs) and are at the core of potential cancer vaccines based on tumor-derived neoantigens.

Click here to see the online version of this article along side with antibodies, proteins and ELISA kits for important actors

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SARS-CoV-2 Neutralizing Antibodies

A part of antibodies produced during an immune response are neutralizing antibodies. NAbs can inhibit the infectivity binding specifically to surface structures, thus preventing the interaction with its host cells. NAbs are used for passive immunization and also play a role in active immunization by vaccination.

Antibodies achieve neutralization of viral pathogens through different mechanisms: opsonization of virions or infected cells, complement and membrane attack complex (MAC) activation, antibody-dependent cytotoxicity, or binding to virion or their targets to block the initial interaction of the virus with the host cell. Most nAbs targeting SARS-CoV-2 target the virus' S protein, in particular the RBD.

Host Cell Entry via ACE2 Receptor

The SARS-CoV-2 S Protein is essential for the virions' contact to the host cell via the angiotensin-converting enzyme 2 (ACE2) receptor. ACE2 contact points are situated between amino acids K417 and Y505 of the S Protein Receptor Binding Domain (RBD). Neutralizing antibodies targeting the RBD disrupt this interaction and can thus impede SARS-CoV-2 interaction.

Available SARS-CoV-2 Neutralizing Antibodies based on Clone CR3022

The recombinant human clone CR3022 was originally isolated from a convalescent SARS patient from Singapore. The clone was demonstrated to be effective in neutralization assays for different SARS-CoV strains in synergy with other RBD-targeting antibodies. Its epitope does not overlap with the ACE2 binding site, thus leaving it accessible for other neutralizing antibodies. Since the outbreak of COVID-19, CR3022 has been demonstrated to bind the SARS-CoV-2 S protein RBD in a similar fashion.

Crystallization assays of CR3022 bound to its SARS-CoV-2 target have provided important insights into possible attack points for therapeutics against this virus. One of the many advantages of recombinant antibodies with human IgG-structures like the Spike Protein Antibody (ABIN6952546) is that they can be used as standards in the development of assays for the detection of human IgGs against SARS-CoV2.

CR3022 binds to epitope residues in the RBD that are not mutated in the variants of concern like B.1.617.2 / delta and B.1.1.529 / omicron and in the variants of note B.1.621, B.1.617.1, B.1.429, B.1.525 and A.23.1. Therefore, the mutant substitutions do not have a significant impact on the binding of CR3022 to its target.

	Wuhan Strain	Delta B.1.617.2	Omicron B.1.1.529
CR3022 ABIN6952546	++	+	+
MM43 ABIN7036075	++	++	-
MM117 ABIN7042145	+	+	++

Binding preferences of the neutralizing antibodies CR3022, MM43,and MM117 for S proteins from the SARS-CoV-2 Wuhan strain and B.1.617.2/ delta and B.1.1.529/ omicron.
See experimental data on page 51: Neutralizing Antibodies in Assay Development

SARS-CoV-2 S Protein RBD Specific Sybodies

In addition to traditional immunoglobulin antibodies, sybodies are an alternative platform to achieve specific binding. These small (12-15kDa) single chain synthetic nanobodies bind with affinities similar to those of Ig antibodies are well suited to bind in particular to hidden epitopes. A popular SARS-CoV-2 target for sybodies is the S protein RBD. Due to their smaller size they are thought to be less sensitive to the position of the RBD in the prefusion S protein trimer. In context with SARS-CoV-2 neutralization, sybodies with different can bind to different, non-overlapping epitopes and exhibit synergistic neutralizing effects.

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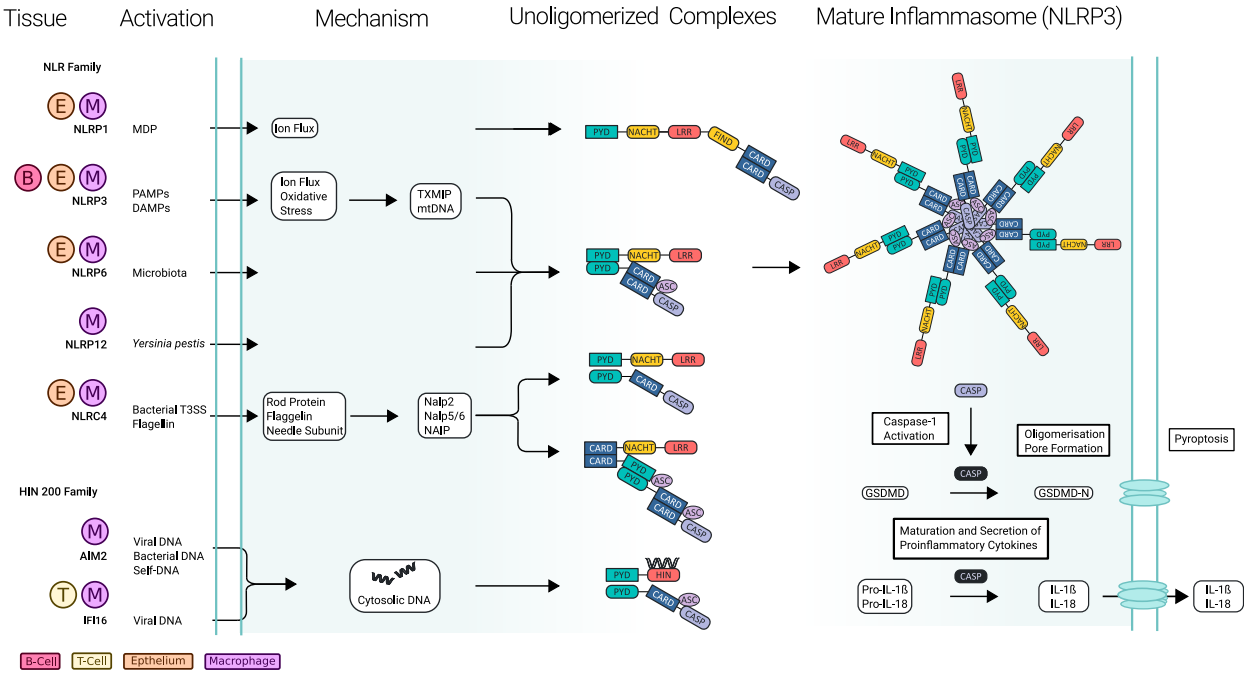
SARS-CoV-2 Neutralizing Antibodies

Product	Clonality	Clone	Isotype	Source	Cat. No.	Validations
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	CR3022	IgG1 kappa	Human	ABIN6952546	(8) (5)
SARS-CoV-2 Spike S1 antibody RBD	Recombinant	CR3022	IgA1 kappa	Human	ABIN6953047	
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Recombinant	CR3022	IgM kappa	Rabbit	ABIN6953042	(7) (3)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	CR3022	IgG kappa	Rabbit	ABIN6952547	(7) (3)
SARS-CoV-2 Spike S1 antibody RBD	Recombinant	CR3022	IgG2b kappa	Mouse	ABIN6953044	
anti-SARS-CoV-2 Spike antibody AA 16-685	Monoclonal	MM43	IgG1	Mouse	ABIN7036075	(2)
anti-SARS-CoV-2 Spike antibody AA 319-541	Monoclonal	MM117	IgG1	Mouse	ABIN7042145	(3)

SARS-CoV-2 S Protein RBD Specific Sybodies

Product	Clonality	Clone	Fragment	Isotype	Source	Cat. No.
SARS-CoV-2 Spike antibody RBD	Chimeric	Sb#45	Sybody	IgG1-Fc Fusion	Human	ABIN7072722
SARS-CoV-2 Spike antibody RBD	Chimeric	Sb#42	Sybody	IgG1-Fc Fusion	Human	ABIN7072719
SARS-CoV-2 Spike antibody RBD	Chimeric	Sb#16	Sybody	IgG1-Fc Fusion	Human	ABIN7072716
SARS-CoV-2 Spike antibody RBD	Chimeric	Sb#14	Sybody	IgG1-Fc Fusion	Human	ABIN7072713

Inflammasome



Inflammasome - Pathway

Inflammasomes are multiprotein complexes located in the cytosol. Typically, they consist of a sensor protein, an adaptor protein containing an caspase recruitment domain, and a pro-inflammatory caspase. In case of the NLRP3 inflammasome, presently the best characterized inflammasome, the respective proteins are NLRP3, ASC/PYCARD, and CASP1. The caspase promotes maturation of pro-inflammatory cytokines IL-1beta and IL-18 and Gasdermin D through proteolytic cleavage. Processing of IL-1beta, IL-18, and Gasdermin D drive pyroptosis, a highly inflammatory form of apoptosis. Subsequently to cleavage, the N-terminal part of Gasdermin D (GSDMD-N) localizes to the plasma membrane and forms pores through which IL-1beta and IL-18 are released. In addition, due to osmotic pressure the cells swells and ultimately bursts.

The formation of inflammasomes is triggered upon recognition of inflammatory stimuli by cytosolic pattern recognition receptors (PRRs). NOD-like receptors (NLRs) were the first class of these sensors to be discovered. More recently, AIM2-like receptors (ALRs) and RIG-I-like receptors (RLRs) have been added to this list. Assembly of different inflammasomes is in response to specific inflammatory ligands sensed by the respective receptors. These inflammatory ligands are molecular patterns that associated with pathogens (PAMPs) - such as bacteria, bacterial components (e.g. LPS , toxins, type III secretion systems components), and viruses - or with cellular damage (DAMPs) – such as nucleic acids, heat shock proteins, or markers for oxidative stress.

As part of the innate immune system, the primary role of the inflammasome is likely the protection against invading pathogens. It is also involved in the initiation of the adaptive immune response through stimulation of the macrophages and regulation of Th17 cell differentiation. The NLRP3 inflammasome in particular has been implicated in metabolic disorders, allergic responses to environmental stimuli, and more recently in driving the cytokine storm in COVID-19.

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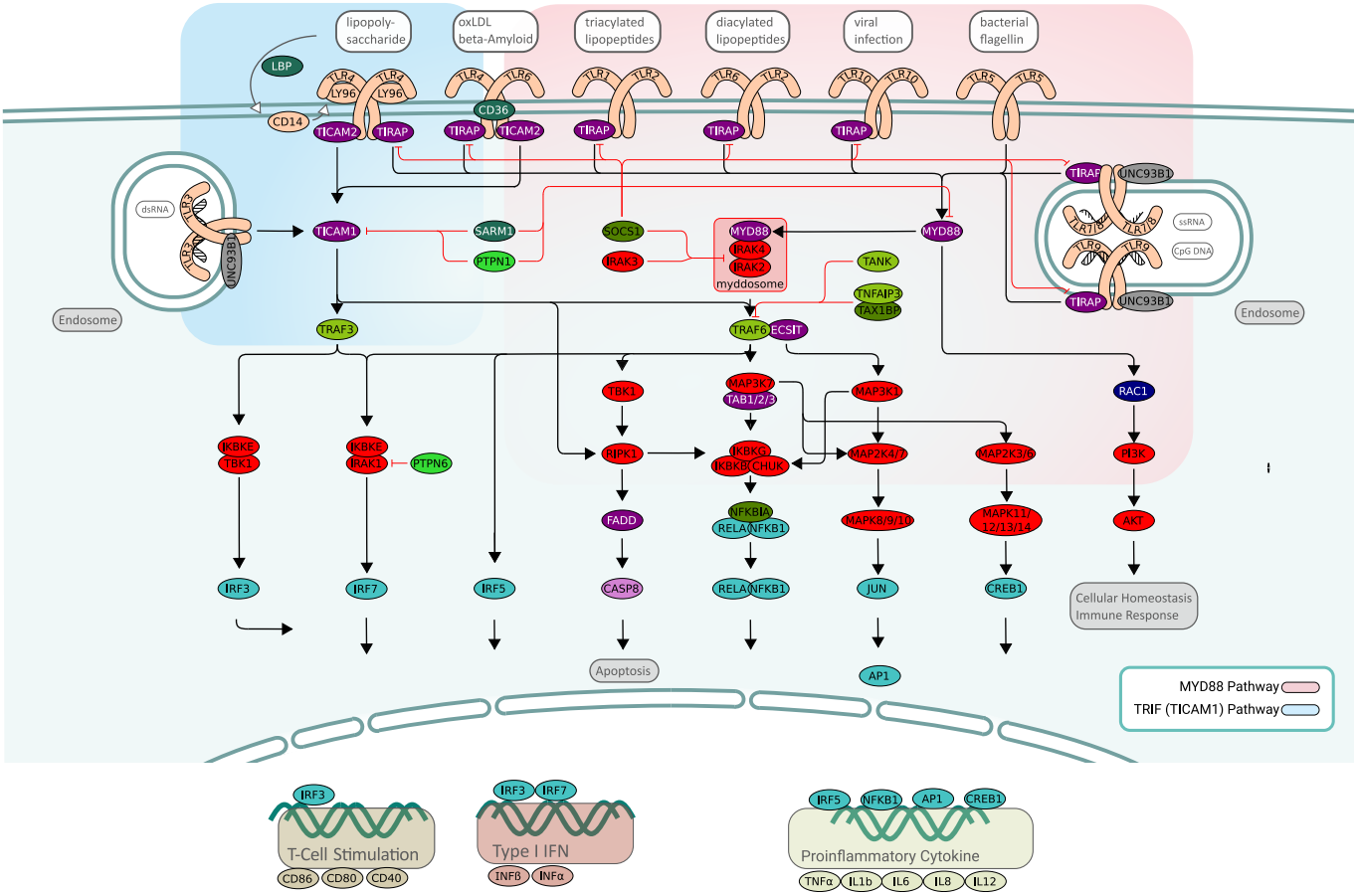
Selected Inflammasome Antibodies & ELISA Kits

Product	Reactivity	Validations	Cat. No.
anti-IL1B antibody (Interleukin 1, beta)	Human	(2) (6)	ABIN969215
anti-NLRP3 antibody (NLR Family, Pyrin Domain Containing 3) (AA 1-93)	Human, Mouse	(60) (5)	ABIN1169100
IL1B ELISA Kit (Interleukin 1, beta)	Rat	(81) (6)	ABIN6574167
anti-HMGB1 antibody (High Mobility Group Box 1)	Human, Mouse, Rat	(1)	ABIN1169270
anti-GSDMD antibody (Gasdermin D)	Human		ABIN2142907
HMGB1 ELISA Kit (High Mobility Group Box 1)	Human	(49) (6)	ABIN6574155
anti-IL 18 antibody (Interleukin 18) (AA 1-157)	Mouse	(3) (2)	ABIN964783
Lipopolysaccharides (LPS) ELISA Kit	Various Species	(21) (3) (1)	ABIN6574100

TLR Signaling



As part of the innate immune system the Toll-like receptor (TLR) signaling pathway contributes to the first line of defense against microbial pathogens. The innate immune system was historically considered nonspecific in response to different invading pathogens, targeting a wide array of pathogenic organisms, including viruses, bacteria, and fungi. This paradigm substantially shifted with the discovery of the Toll receptor in Drosophila.

To date, 10 members of the family have been identified in human and 13 in mouse. Homologs have also been discovered in plants, illustrating the high-degree of conservation in this receptor class.

Different TLRs recognize specific pathogen-associated molecular patterns (PAMPs). The chemical nature of these PAMPs is highly diverse; e.g. lipopolysaccharide (LPS) of gram-negative bacteria are recognized by TLR4 while TLR5 recognizes the bacterial protein flagellin. Ligands for TLR3, 7, 8, and 9 are nucleic acids, and TLR2 is specific for lipoproteins.

Binding of a TLR ligand to the N-terminal ectodomain of a TLR prompts the formation of TLR homo- or heterodimers.

Following dimerization, TLR signals are transduced via a cytoplasmic C-terminal Toll IL-1 receptor (TIR) domain to a set of adapter proteins.

Downstream, TLR signaling engages two distinct pathways in which either TRIF (TICAM2) or MyD88 are the key component. Both pathways culminate in the induction of inflammatory cytokines (TNF, IL-6, IL-12), type I interferons (IFN-alpha, IFN-beta), or apoptosis. Furthermore, TLR signaling induces dendritic cell maturation and contributes consequently to the adaptive immune response.

TLR7 and TLR8 in particular are relevant in context with SARS-CoV-2 infections because they specifically recognize viral ssRNA such as the SARS-CoV-2 genome. Therefore, some SARS-CoV-2 vaccines include TLR7/8 agonists to boost the immune response. SARS-CoV-2 effectively evades the host response by manipulating the immune answer at several points. Cytokine as well as intererfon signaling ist disturbed.

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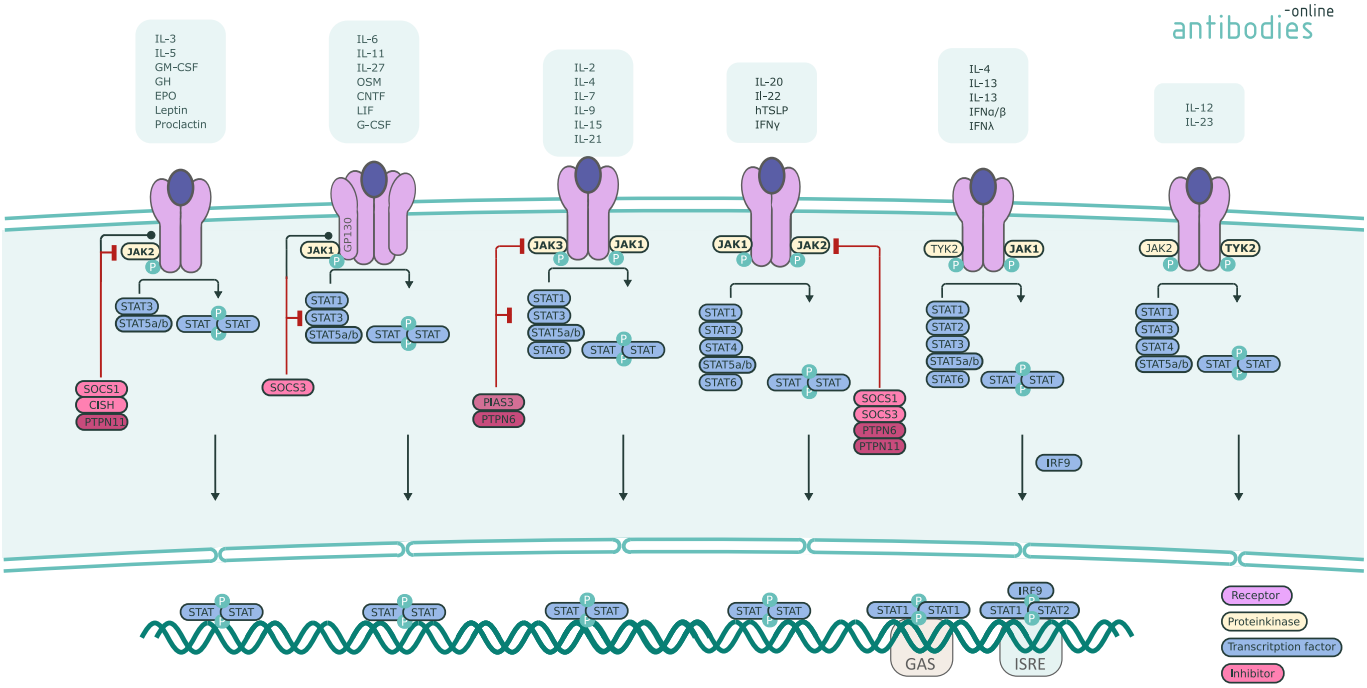
Selected TLR Signaling Antibodies & ELISA Kits

Product	Reactivity	Validations	Cat. No.
anti-IRF3 antibody (Interferon Regulatory Factor 3)	Human	(2) (6)	ABIN1513098
anti-IRF5 antibody (Interferon Regulatory Factor 5) (C-Term)	Human	(3)	ABIN184812
anti-Interleukin 6 antibody (IL6)	Human	(56) (3)	ABIN1383944
anti-Interleukin 6 antibody (IL6)	Mouse	(3)	ABIN964780
anti-MAP2K3 antibody (Mitogen-Activated Protein Kinase Kinase 3) (AA 1-138)	Human	(9)	ABIN5542528
anti-MYD88 antibody (Myeloid Differentiation Primary Response Gene (88)) (Internal Region)	Human	(5)	ABIN185362
anti-TLR4 antibody (Toll-Like Receptor 4)	Human, Mouse, Rat	(3) (3)	ABIN6269449
anti-TICAM1 antibody (Toll-Like Receptor Adaptor Molecule 1) (C-Term)	Human	(1) (2)	ABIN2855929
anti-TICAM2 antibody (Toll-Like Receptor Adaptor Molecule 2) (AA 150-200)	Cow, Human, Monkey, Mouse, Opossum, Rat	(2)	ABIN960372

JAK-STAT Signaling



JAK-STAT signaling in vertebrates relies on a network of protein kinases and transcription factors to integrate signals from various receptor systems. The multitude of stimuli include cytokines, growth factors, and hormones, binding of which ultimately effect processes such as immune response regulation and cell growth, survival, and differentiation.

The highly conserved pathway involves essentially three levels of processing of the incoming information depending on the function of the respective components:
Binding of the ligand to the receptor triggers conformational changes of the receptor molecule(s). This steric change of the receptor brings two Janus Kinases (JAK) bound to the receptor or receptor subunits into close proximity, thus enabling trans-phosphorylation. The activated JAKs phosphorylate subsequently additional targets. The major phosphorylation targets are Signal Transducer and Activator of Transcription (STAT). These transcription factors are inactive in the cytoplasm until phosphorylation by JAKs. Once the conserved tyrosine toward the C-terminus of the STAT has been phosphorylated, it can act as dimerization interface in conjunction with SH2 domains of another STAT. These activated STAT dimers are then translocated to the nucleus and bind to specific DNA motifs to activate target gene transcription.

Besides, negative regulation of these processes takes place on multiple levels: Suppressors of Cytokine Signaling (SOCS) gene transcription is stimulated by activated STATs. SOCS inactivate signaling through binding to the phosphorylated JAKs or receptors or facilitate JAK ubiquitination. Protein Inhibitor of Activated STATs (PIAS) bind to activated STATs and prevent them from binding DNA. Protein Tyrosine Phosphatase (PTP) reverse the activity of JAKs.

The JAK-STAT signaling pathway transduces downstream of multiple cytokines critical to the pathogenesis of immune-mediated disease. It has been suggested that patients with mutations in STAT1 and STAT2 are often more likely to develop infections from bacteria and viruses. Since many cytokines function through the STAT3 transcription factor, STAT3 plays a significant role in maintaining skin immunity. In addition, because patients with JAK3 gene mutations have no functional T cells, B cells or NK cells, they would more likely to develop skin infections. Mutations of the STAT5 protein, which can signal with JAK3, has been shown to result in autoimmune disorders. Also, STAT4 mutations have been associated with rheumatoid arthritis, and STAT6 mutations are linked to asthma.

Current research on this pathway has been focusing on the inflammatory and neoplastic diseases and related drugs. One example of a JAK inhibitor drug is Ruxolitinib, which is used as a JAK2 inhibitor. JAK1 and JAK3 inhibitor Tofacitinib has been used for psoriasis and rheumatoid arthritis treatment and is under investigation for many other immune-mediated

diseases including systemic lupus erythematosus, inflammatory bowel disease, and rare autoinflammatory diseases with a type 1 interferon signature. It has been reported that therapies which target STAT3 can improve the survival of patients with cancer.

In the course of the COVID-19 pandemic several JAK inhibtors have been approved for treatment of COVID-19 induced cytokine storm, an excessive inflammatory reaction in which cytokines are rapidly produced in large amount in response to an infection.

The prototypical JAK-STAT signaling pathway is rather linear. There is however considerable crosstalk with other signaling cascades like MAPK pathways, PI3K signaling and JAK independent STAT phosphorylation through receptor tyrosine kinase (RTKs).

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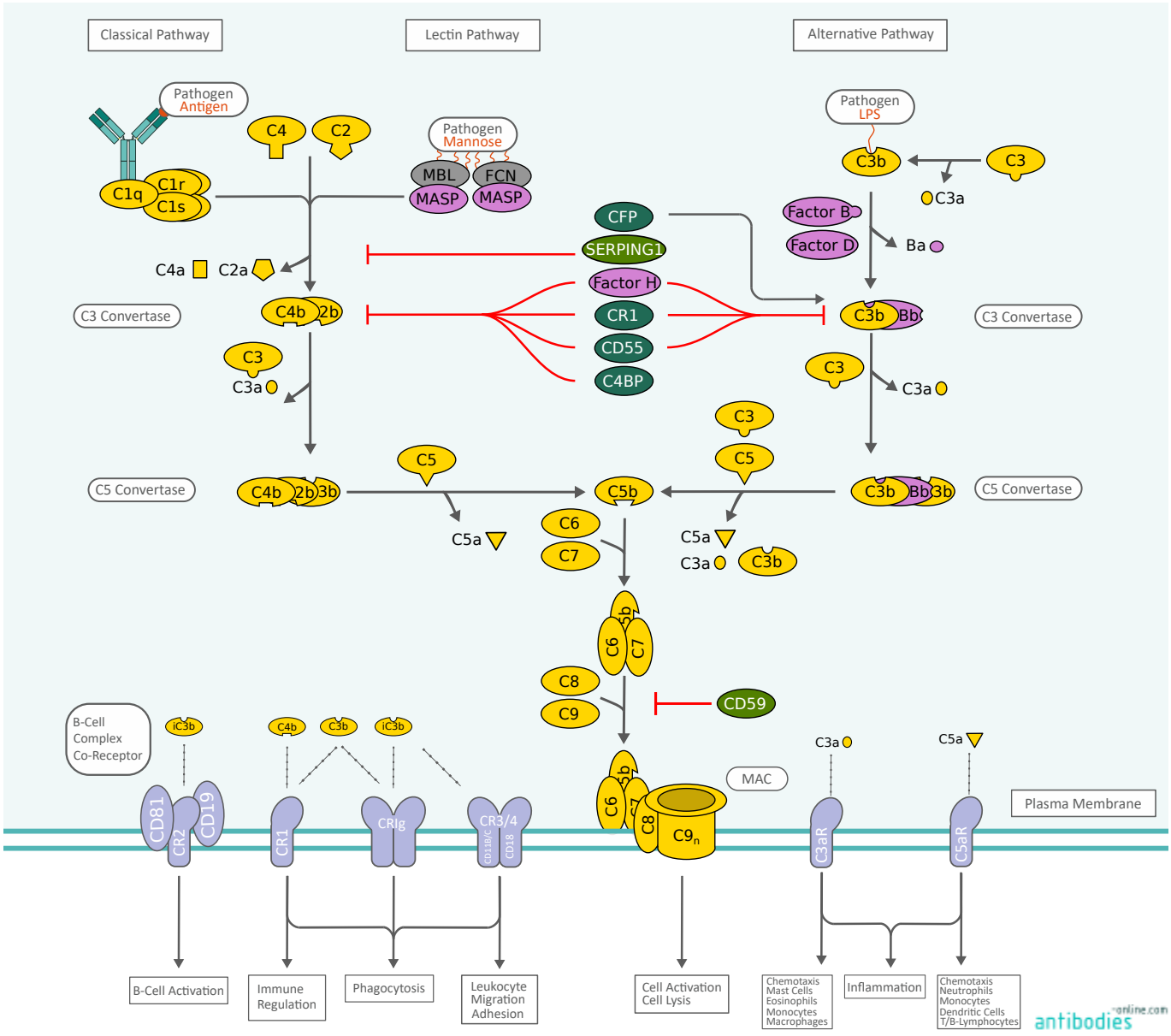
Complement System



The complement system is part of the innate immune system and plays an important role in the host defense, inflammation, tissue regeneration and other physiological processes.

Complement activation results in opsonization of pathogens and their removal by phagocytes. It also causes chemotactic attraction of phagocytes and macrophages. Furthermore, the complement system forms the terminal membrane attack complex (MAC), a membrane channel causing osmotic lysis of the respective pathogen. While complement is not adaptable it does complement the adaptive immune system and it is also involved in B and T cell response regulation.

Activation of complement unfolds along three different complement activation pathways depending on the nature of the pathogen: The classical pathway, the lectin pathway, and the alternative pathway. All three converge into the common terminal pathway that leads to the formation of the MAC. In addition, anaphylatoxins C3a and C5a elicit a plethora of physiological responses that range from chemoattraction to apoptosis. The complement system consists of more than 30 proteins that are either present as soluble proteins in the blood or as membrane-associated proteins. Most exist as inactive zymogens that are then sequentially cleaved and activated. The central component in all three pathways is component C3, the most abundant complement protein found

in the blood. Its activation induces the formation of the activation products C3a, C3b, and C5a and ultimately the MAC.

In addition to these three established pathways, it has been shown that factors such as kallikrein, plasmin, thrombin, and factor XIIa activate the complement system independently of the C3 protein.

Innate immune mechanisms including the complement system are the first line of a higher organism's defense against infective agents coming from the external environment. Impairment of these basic mechanisms can cause a diverse spectrum of diseases. The reasons for the complement system malfunctioning may be different. They are often the result of mutations in genes encoding the complement cascade proteins or regulatory proteins.

Deficiencies of the C3 and other complement components, contribute to the emergence of recurrent bacterial, viral and fungal infections. MBL also plays a major protective role in the early stages of infection and in the control of inflammation. Its deficit is one of the most common reasons for human immunodeficiency, observed in microbial infections as well as in autoimmune diseases such as rheumatoid arthritis. On the other hand, the excessive activation of complement proteins is often discovered to be the reason for many diseases. These include e.g. autoimmune diseases, Alzheimer's syndrome, schizophrenia, atypical hemolytic-uremic syndrome, angioedema, macular degeneration, and Crohn's disease.

Complement is responsible for immune inflammatory response in adipose tissues which has been implicated in the development of obesity and can lead to tissue inflammation and eventually insulin resistance. Lack of regulation of the classical complement pathway through the deficiency in C1-inhibitor results in episodic angioedema. C1-inhibitor defiency can be hereditary or acquired, resulting in hereditary or acquired angioedema. Addtionally, deficiency in the C1q protein of the classical complement pathway can lead to development of systemic lupus erythematosus.

Immunotherapies have been developed to detect and destroy cells infected by the HIV virus via classical complement activation utilizing synthetic peptides that target conserved regions in HIV specific proteins and induce an antibody specific immune response through IgG antibodies.

In COVID-19, the SARS-CoV-2 nucleocapsid protein triggers activation of the lectin pathway of the complement system through interaction with mannose binding lectin (MBL)-associated serine protease (MASP). Released soluble N protein dimers interact with MASP-2, further accelerating MASP-2 activation and activation of the complement system. The positive feedback through cell lysis and release of N-protein leads to elevation of pro-inflammatory cytokines, characterized as cytokine storm.
N-protein neutralization is a promising avenue for a COVID-19 therapy, as well as the targeted inhibition of MASP-2. Suppressive effects could also be observed with anti-C5a antibody treatment.

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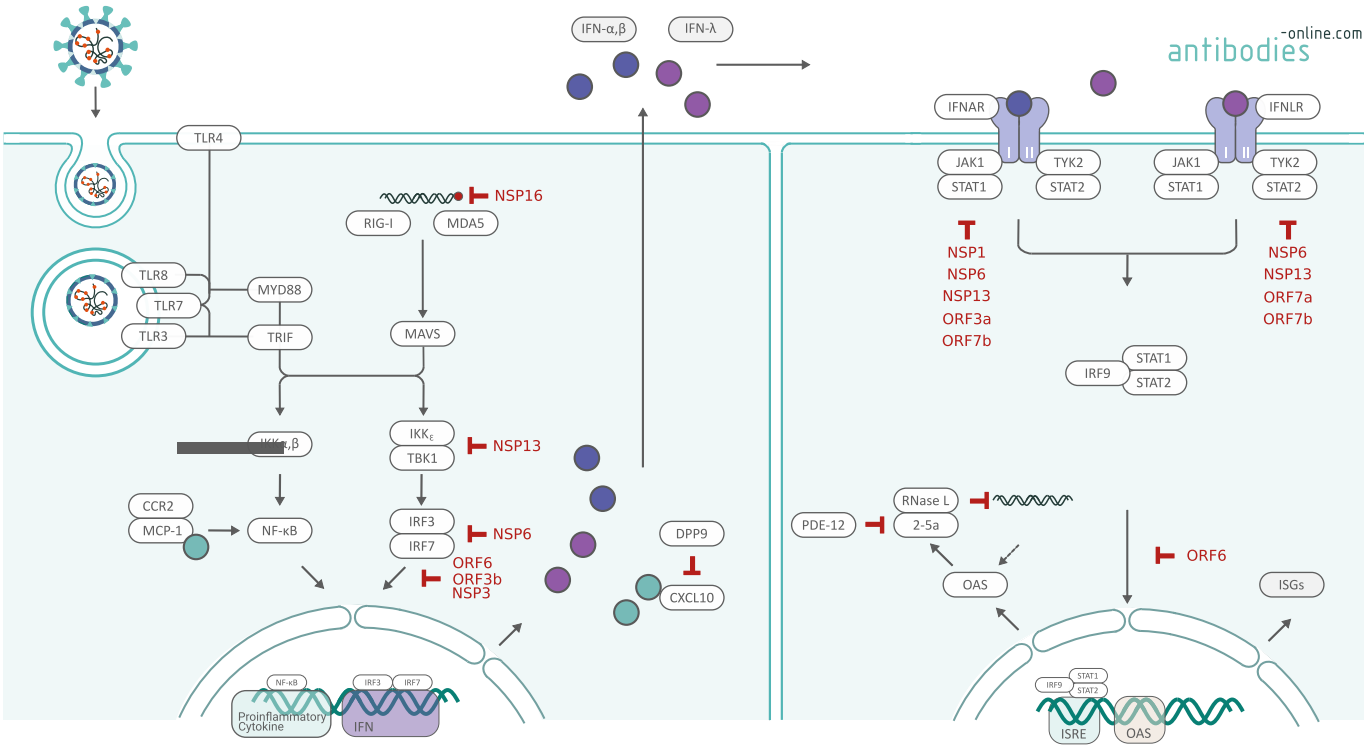
SARS-CoV-2 Interferon Antagonism



Recent studies on SARS-CoV-2 evaluating evasion of immune response reveal several SARS-CoV-2 proteins which manipulate host response in favor of virus proliferation. Compared with other virus-related respiratory diseases, interferon I (IFN-I) and interferon III (IFN-III) signaling is more efficiently suppressed. This ultimatively leads to low interferon-stimulated gene (ISG) responses with impact on viral transmission and pathogenesis.

SARS-CoV-2 antagonize IFN-I Production and Signaling

An unbiased screening of SARS-CoV-2 proteins identified main antagonist to IFN-I response. Several SARS-CoV-2 proteins antagonize IFN-I production via distinct mechanisms: Similar to SARS-CoV, NSP16 of SARS-CoV-2 is able to modify the 5' cap with its 2'-O-methyl-transferase activity, allowing the virus to efficiently evade recognition by melanoma differentiation-associated protein 5 (MDA5). NSP13 binds and blocks TANK binding kinase 1 (TBK1) phosphorylation, Nonstructural protein 6 (NSP6) binds TBK1 to suppress interferon regulatory factor 3 (IRF3) phosphorylation and ORF6 binds importing Karyopherin α 2 (KPNA2) to inhibit IRF3 nuclear translocation. IRF3 nuclear translocation is further inhibited by ORF3b and NSP3, the truncated ORF3b of SARS-CoV-2 suppresses IFN induction more efficiently than that of SARS-CoV, which may contribute to the poor IFN response reported in COVID-19 patients.

Two sets of viral proteins antagonize IFN-I and IFN-III (IL28a/IL28b/IL29) signaling through blocking of signal transducer and activator of transcription 1 (STAT1)/STAT2 phosphorylation or nuclear translocation. NSP1, ORF3a and ORF7b antagonize STAT1 signaling, ORF7a and ORF7b antagonizes STAT2 signaling. NSP6, and NSP13 are key actors in interferon antagonism. They suppress both signaling pathways alongside with IRF3 nuclear translocation. Taken together, SARS-CoV-2 inhibits IFN-I signaling through suppression and inhibition of STAT1 and STAT2 phosphorylation and through blockign of STAT1 nuclear translocation. This ultimatively leads to low expression of ISGs and a limited antiviral response.

Interferon Antagonism as a driver of severe COVID-19

Besides viral proteins suppressing IFN-1 signaling, autoantibodies have been found to hamper the type I interferon antiviral response. Approximately one in ten patients that develop severe COVID-19, produce antibodies that block type I interferons. The proportion of patients possessing these

autoantibodies appears to be positively correlate with age, from slightly less than 10% in those younger than 40 years up to slightly more than 20% in COVID-19 patients older than 80 years.

Type I interferons are involved in the innate immunity against viral infections. The innate immune response is thought to be an important factor of SARS-CoV-2. This is consistent with the observation that genetic defect of the IFN I immune response can underlie severe COVID-19. It is also consistent with the observation that children, that rely more on the innate immune response, are relatively spared from a severe course of the disease.

Potential therapeutic SARS-CoV-2 Targets

Pairo-Castineira used Mendelian randomisation to find potential targets for repurposing of licensed medications. A low expression of Interferon-alpha/beta receptor beta chain (IFNAR2), and high expression of TYK2 and C-C chemokine receptor type 2 (CCR2) is associated with critical illness. TYK2 is a target for JAK inhibitors already in medical use. The receptor CCR2 is able to bind monocyte chemotactic protein 1 (MCP-1). MCP-1 concentrations are associated with more severe disease. Anti-CCR2 monoclonal antibody therapy in treatment of rheumatoid arthritis is safe.

Dipeptidyl peptidase 9 (DPP9) encodes a serine protease with diverse intracellular functions, including cleavage of the key antiviral signalling mediator CXCL10 and key roles in antigen presentation, and inflammasome activation.

Another potential target is therapeutic target is PDE-12. Upon contact with viral dsDNA, OAS1 produces 2‘-5‘A which activates an effector enzyme, RNAse L. RNAse L degrades double-stranded RNA which consequently activates MDA5 leading to interferon production. Endogenous or exogenus phosphodiesterase 12 (PDE-12) activity degrades the host antiviral mediator 2-5A.

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Interferon Antagonism related Antibodies

Product	Clonality	Application	Cat. No.	Validations
anti-TBK1 antibody (TANK-Binding Kinase 1) (AA 514-527)	Polyclonal	ELISA, IHC, WB	ABIN1590112	(2)
anti-STAT2 antibody (Signal Transducer and Activator of Transcription 2, 113kDa) (Tyr1221)	Polyclonal	ELISA, IHC (p), WB	ABIN3187617	(5)
anti-STAT1 antibody (Signal Transducer and Activator of Transcription 1, 91kDa) (pSer727)	Polyclonal	ELISA, ICC, IF, IHC, WB	ABIN6256410	(1) (8)
anti-MAVS antibody (Mitochondrial Antiviral Signaling Protein) (AA 160-450)	Monoclonal	ICC, IP, IHC, WB	ABIN1169132	(3) (1)
anti-IL29 antibody (Interleukin 29) (Internal Region)	Polyclonal	ELISA, WB	ABIN3181015	(1)
anti-IL28A antibody (Interleukin 28A (Interferon, lambda 2)) (AA 1-200)	Monoclonal	ELISA, FACS, ICC, IHC, WB	ABIN5542627	(6)
anti-Interleukin 28 (IL28) (C-Term) antibody	Polyclonal	ELISA, IHC (p), WB	ABIN3181017	(6)
anti-IFNB1 antibody (Interferon, beta 1, Fibroblast)	Polyclonal	IHC, WB	ABIN3022168	(4)
anti-IFNA1 antibody (Interferon, alpha 1)	Monoclonal	FACS, IF, IHC (fro), WB	ABIN6939689	(1)
anti-IFNA1 antibody (Interferon, alpha 1) (C-Term)	Polyclonal	ELISA, WB	ABIN3180993	(1)
anti-IRF9 antibody (Interferon Regulatory Factor 9) (AA 171-393)	Polyclonal	ICC, IF, IHC, IHC (p), WB	ABIN1498905	(3)
anti-IRF3 antibody (Interferon Regulatory Factor 3)	Polyclonal	ChIP, IHC, WB	ABIN6142528	(1) 4)
anti-IRF3 antibody (Interferon Regulatory Factor 3)	Polyclonal	IF, IHC, WB	ABIN1513098	(2) (6)
anti-IFNAR2 antibody (Interferon alpha/beta Receptor 2) (Center)	Polyclonal	ICC, IF, WB	ABIN2856183	(1) (2)
anti-IFNAR1 antibody (Interferon (Alpha, beta and Omega) Receptor 1) (AA 1-436)	Polyclonal	ELISA, IHC (p), WB	ABIN2692327	(3)
anti-DDX58 antibody (DEAD (Asp-Glu-Ala-Asp) Box Polypeptide 58)	Polyclonal	IHC, WB	ABIN3023649	(2) (4)

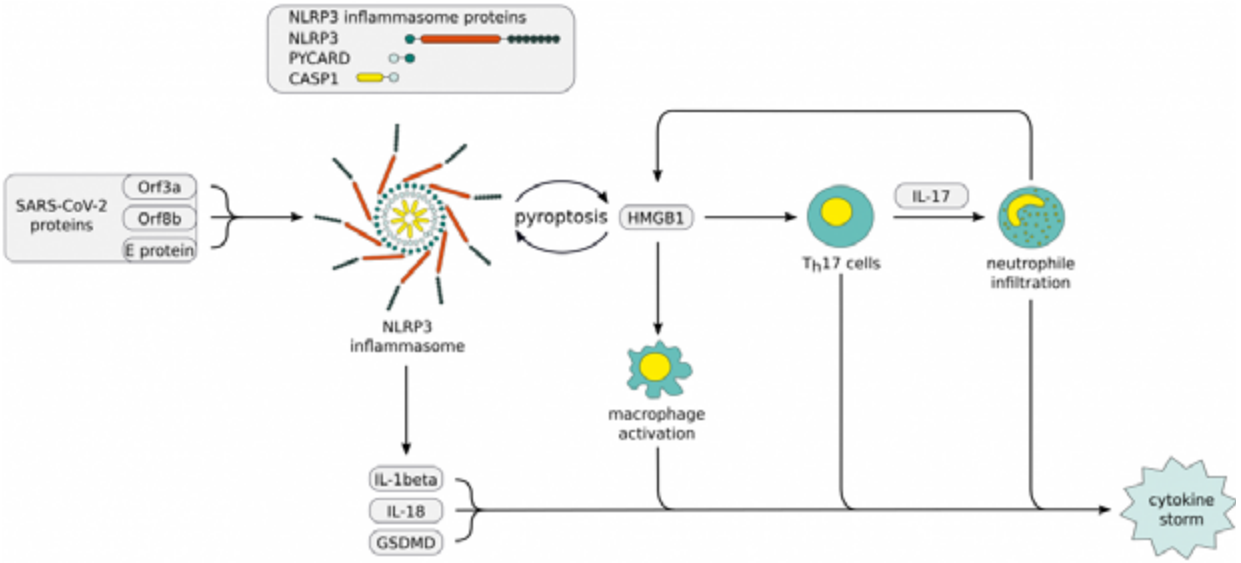
Interferon Antagonism related Antibodies

Product	Clonality	Application	Cat. No.	Validations
anti-TYK2 antibody (Tyrosine Kinase 2)	Monoclonal	ELISA, WB	ABIN969448	(2) (1)
anti-TICAM1 antibody (Toll-Like Receptor Adaptor Molecule 1) (C-Term)	Polyclonal	ICC, IF, WB	ABIN2855929	(1) (2)
anti-TLR8 antibody (Toll-Like Receptor 8)	Polyclonal	IHC, WB	ABIN3022015	(2)
anti-TLR7 antibody (Toll-Like Receptor 7) (AA 900-950)	Polyclonal	FACS, IHC, IHC (p), WB	ABIN604913	(3)
anti-TLR4 antibody (Toll-Like Receptor 4) (AA 420-435)	Polyclonal	ICC, FACS, IF, IHC, WB	ABIN361724	(3) (2)
anti-TLR3 antibody (Toll-Like Receptor 3) (C-Term)	Polyclonal	ELISA, ICC, IHC, IHC (p), WB	ABIN461896	(4)
anti-MYD88 antibody (Myeloid Differentiation Primary Response Gene (88)) (Internal Region)	Polyclonal	ELISA, EIA, IHC, WB	ABIN185362	(5)
anti-Interleukin 28 Receptor, alpha (Interferon, lambda Receptor) (IL28RA) (Internal Region) antibody	Polyclonal	ELISA, WB	ABIN3180976	(1)
anti-IFIH1 antibody (Interferon Induced with Helicase C Domain 1) (N-Term)	Polyclonal	ELISA, IHC, WB	ABIN185002	(3) (1)
anti-IFNG antibody (Interferon gamma) (FITC)	Monoclonal	Func, ICC, FACS, IP, IHC (p), RIA, ELISA, WB	ABIN1981884	(4) (1)
anti-CCR2 antibody (Chemokine (C-C Motif) Receptor 2) (Internal Region)	Polyclonal	ELISA, WB	ABIN3181473	(2)
anti-CCL2 antibody (Chemokine (C-C Motif) Ligand 2)	Monoclonal	ICC, FACS, IHC, ELISA, WB	ABIN969505	(2) (7)
anti-OAS2 antibody (2'-5'-Oligoadenylate Synthetase 2, 69/71kDa) (Internal Region)	Polyclonal	ELISA, IHC (p), WB	ABIN3181072	(4)
anti-OAS3 antibody (2'-5' Oligoadenylate Synthetase 3) (Internal Region)	Polyclonal	ELISA, WB	ABIN1782149	
anti-OAS1 antibody (2',5'-Oligoadenylate Synthetase 1, 40/46kDa) (C-Term)	Polyclonal	IHC, IHC (p), WB	ABIN6748615	(2)

Interferon Antagonism related SARS-CoV-2 Proteins

Product	Source	Cat. No.	Validations
SARS-CoV-2 ORF3a (AA 126-275) protein (His tag)	Escherichia coli (E. coli)	ABIN6952944	
SARS-CoV-2 Non-Structural Protein 6 (NSP6) protein (rho-1D4 tag)	Insect Cells	ABIN6952568	
SARS-CoV-2 Host Translation Inhibitor Nsp1 (NSP1) protein (His tag) collections(1)	Escherichia coli (E. coli)	ABIN6952638	(1)
SARS-CoV-2 Host Translation Inhibitor Nsp1 (NSP1) protein (His tag)	Insect Cells	ABIN6952564	
SARS-CoV-2 Helicase (NSP13) (HEL) protein (His tag)	Insect Cells	ABIN6952696	

COVID-19 Cytokine Storm



In most patients developing severe COVID-19, inflammatory processes do not subside. Instead, a cytokine storm emerges, a hyper-inflammatory response involving the dysregulated activation of a large number of immune and inflammatory cells.

IL-6 levels continue to increase and the levels of IL- 2, IL-7, IL-10, TNF-α, G-CSF, CXCL10, CCL2, and CCL3 are also substantially higher in COVID-19 patients. CD4+ and CD8+ T cell numbers are anti-proportional to the levels of TNF-alpha, IL-6, and IL-10 in COVID-19 patients. Expression of the exhaustion markers PD-1 and HAVCR2 are also increased in these cells. On the other hand, in severe cases of COVID-19 numbers of CD14+ CD16+ inflammatory monocytes are increased in peripheral blood. CD14+ CD16+ monocytes have also been linked to Kawasaki Disease, a rare acute inflammatory disease of the arteries in young children that has been observed in conjunction with COVID-19 recently. These CD14+CD16+ monocytes are also CD11b+, CD14+, CD16+, CD68+, CD80+, CD163+, CD206+ and secrete IL-6, IL-10 and TNF-alpha, thus further contributing to inflammation.

All these factors contribute to the development of a cytokine release syndrome or cytokine storm, an excessive inflammatory reaction in which cytokines are rapidly produced in large amount in response to an infection. Cytokine storm is considered an important contributor to acute respiratory distress syndrome (ARDS) and multiple organ dysfunction syndrome (MODS).

Evidence suggests an increased susceptibility to a severe course of COVID-19 due to life style related low-grade inflammation or genetics. These factors can lead to enhanced exposure to DAMPs and further NLRP3 inflammasome activation. One of the DAMPs downstream of NLRP3 inflammasome activation is HMGB1. It is typically found in elevated serum concentrations during inflammatory events and acts as a central mediator of an excessive inflammatory response in case of viral infections. HMGB1 has been proposed to be one of the main contributors to the cytokine storm through a positive feedback loop involving induction of IL-17 production by Th17 cells and the subsequent neutrophil infiltration, leading to further NLRP3 inflammasome activation.

The SARS-CoV-2 N protein triggers activation of the lectin pathway of the complement system through interaction with mannose binding lectin (MBL)-associated serine protease (MASP). Released soluble N protein dimers interact with MASP-2, further accelerating MASP-2 activation and activation of the complements system. The positive feedback through cell lysis and release of N-protein leads to further increase of pro-inflammatory cytokines and aggravation of the cytokine storm.

In addition to the damaging effect on the alveolar structure, inflammatory cytokines IL-1 and TNF induce increases expression of HA-synthase-2 (HAS2) in CD31+ endothelium, EpCAM+ lung alveolar epithelial cells, and fibroblasts. HAS2 catalyzes polymerization of hyaluronan, a component of the extracellular matrix that can absorb water up to a 1000 times its weight. Accumulation of this liquid jelly in the damaged lungs further limits the gas exchange in the lung, leading to low oxygen saturation of the blood.

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- Ziegler-Heitbrock: „The CD14+ CD16+ blood monocytes: their role in infection and inflammation“, J. Leukoc. Biol. (2007).

Cytokine Storm related Antibodies

Product	Reactivity	Clonality	Application	Validations	Cat. No.
anti-Caspase 1 antibody (CASP1)	Human, Mouse, Rat	Polyclonal	IHC, WB	(2) (1)	ABIN3021171
anti-CD46 antibody (CD46 Molecule, Complement Regulatory Protein)	Cow, Human	Monoclonal	FACS, IP, WB	(8) (1)	ABIN94149
anti-CCL2 antibody (Chemokine (C-C Motif) Ligand 2)	Human, Monkey, Mouse	Monoclonal	ICC, FACS, IHC, ELISA, WB	(2) (7)	ABIN969505
anti-CCL3 antibody (Chemokine (C-C Motif) Ligand 3) (C-Term)	Human	Polyclonal	ELISA		ABIN185352
anti-CCL5 antibody (Chemokine (C-C Motif) Ligand 5)	Human	Monoclonal	ELISA, WB	(1)	ABIN1574139
anti-CXCL10 antibody (Chemokine (C-X-C Motif) Ligand 10)	Human	Monoclonal	IA, IHC (fro), FACS, WB	(3)	ABIN2191895
anti-GSDMD antibody (Gasdermin D) (AA 1-485)	Human	Monoclonal	ELISA, IF, IHC, IHC (p), WB	(2)	ABIN574462
anti-HMGB1 antibody (High Mobility Group Box 1)	Human, Mouse, Rat	Monoclonal	ELISA, WB	(1)	ABIN1169270
anti-IFNA antibody (Interferon alpha)	Human, Mouse, Rat	Polyclonal	WB	(2)	ABIN3020881
anti-IRF3 antibody (Interferon Regulatory Factor 3)	Human	Polyclonal	IF, IHC, WB	(2) (6)	ABIN1513098

Cytokine Storm related ELISA Kits

Product	Method Type	Sample Type	Detection Method	Validations	Cat. No.
IL2 ELISA Kit (Interleukin 2)	Sandwich ELISA	Cell Culture Supernatant, Cell Lysate, Plasma, Serum, Tissue Homogenate	Colorimetric (Pre-coated)	(4) (5)	ABIN6730879
IL17 ELISA Kit (Interleukin 17)	Sandwich ELISA	Cell Culture Supernatant, Cell Lysate, Plasma, Serum, Tissue Homogenate	Colorimetric (Pre-coated)	(6) (5)	ABIN6730906
IL-10 ELISA Kit (Interleukin 10)	Sandwich ELISA	Cell Culture Supernatant, Cell Lysate, Plasma, Serum, Tissue Homogenate	Colorimetric (Pre-coated)	(16) (5)	ABIN6574129
IL1B ELISA Kit (Interleukin 1, beta)	Sandwich ELISA	Cell Culture Supernatant, Cell Lysate, Plasma, Serum, Tissue Homogenate	Colorimetric (Pre-coated)	(31) (5)	ABIN6574165
IL1A ELISA Kit (Interleukin 1 alpha)	Sandwich ELISA	Cell Culture Supernatant, Cell Lysate, Plasma, Serum, Tissue Homogenate	Colorimetric (Pre-coated)	(4) (4)	ABIN6730878
Human TNF-a ELISpot Kit			Sterile plate		ABIN1447108
Human Interferon gamma ELISpot Kit			Sterile plate		ABIN1446656
HMGB1 ELISA Kit (High Mobility Group Box 1)	Sandwich ELISA	Plasma, Serum	Colorimetric (Pre-coated)	(49) (6)	ABIN6574155
HMGB1 ELISA Kit (High Mobility Group Box 1)	Sandwich ELISA	Plasma, Serum	Colorimetric (Pre-coated)	(25) (6)	ABIN6574156
Caspase 1 ELISA Kit (CASP1)	Sandwich ELISA	Cell Culture Supernatant, Cell Lysate, Tissue Homogenate	Colorimetric (Pre-coated)	(3) (5)	ABIN6574284

3. COVID-19 Diagnostics

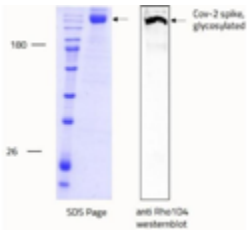
SARS-CoV-2 Proteins

Recombinant SARS-CoV-2 proteins are being used as antigens for antibody development, as capture antigens or as standards in assays. They can be used as a positive control in antigen-detecting ELISAs to accurately separate true positive results from potentially false results or as capture antigens for immunoglobin ELISAs. Our trimeric full-length SARS-CoV-2 S proteins for example are suitable for assay development and are highly useful for studying neutralizing antibodies.

Recommended SARS-CoV-2 Spike Protein Wildytpe

SARS-CoV-2 Spike Trimer Protein (rho-1D4 tag)

- Wild type, full length Cov-2 spike protein.
- For assay development.
- In Stock, Fast Delivery.



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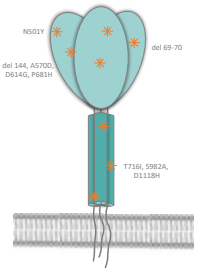
Recommended SARS-CoV-2 Spike Protein Variants

SARS-CoV-2 Spike (B.1.1.7) Protein (rho-1D4 tag)

- Incl. N501Y Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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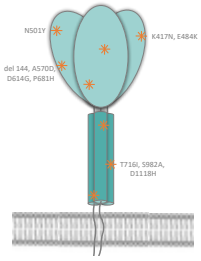
SARS-CoV-2 Spike B.1.351 Protein (rho-1D4 tag)

- Incl. N501Y, E484K.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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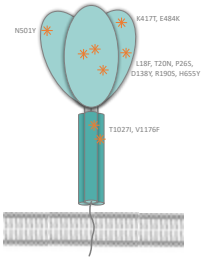
SARS-CoV-2 Spike (P.1 lineage) Protein (rho-1D4 tag)

- Incl. E484K, N501Y Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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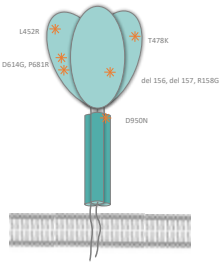
SARS-CoV-2 Spike (B.1.617.2 lineage) Protein

- Incl. D614G, P681R Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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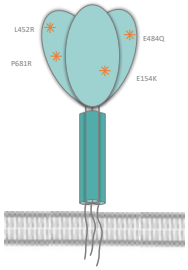
Recommended SARS-CoV-2 Spike Protein Variants

SARS-CoV-2 Spike (B.1.617.1 / Alpha Lineage) Protein (rho-1D4 tag)

- Incl. E484Q, P681R Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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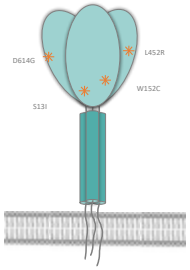
SARS-CoV-2 Spike B.1.429 / Epsilon Protein (rho-1D4 tag)

- Incl. W152C, L452R, D614G Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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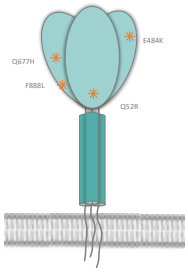
SARS-CoV-2 Spike (B.1.525 / Eta Lineage) Protein (rho-1D4 tag)

- Incl. E484K, F888L, Q677H Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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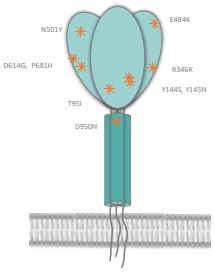
SARS-CoV-2 Spike (B.1.621 / Mu Lineage) Protein (rho-1D4 tag)

- Incl. E484K, N501Y , D614G, P681H Mutation.
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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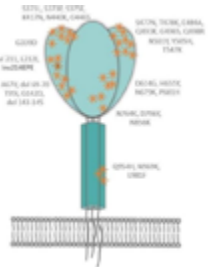
SARS-CoV-2 Spike (B.1.1.529 / Omicron Lineage) Protein (rho-1D4 tag)

- 39 Mutations between A67V and L981F
- Source: HEK-293 Cells.
- For ELISA, Ligand Binding Assay.
- In Stock, Fast Delivery.



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SARS-CoV-2 Antibodies

antibodies-online offers a broad collection against SARS-CoV targets. Antibodies against spike protein, membrane protein, envelope protein, nucleocapsid protein and non structural proteins are available. These antibodies can be used for detection of the virus in a variety of applications including IHC, ELISA, WB, IF staining.

SARS-CoV-2 Spike Antibodies (S1, S2, RBD)

The SARS-CoV-2 spike protein protrudes from the envelope of the virion and plays a pivotal role in the receptor host selectivity and cellular attachment. SARS-CoV-2 spike proteins interact with angiotensin-converting enzyme 2 (ACE2). The S1 subunit contains a receptor-binding domain (RBD) mediating this interaction. The region is an important target of neutralizing antibodies (nAbs) as it is crucial for receptor-binding and virion entry. nAbs targeting the RBD disrupt the functionality and can thus impede SARS-CoV-2 interaction.

The recombinant human neutralizing antibody ABIN6952546 and ABIN6952547 (clone CR3022) bind to epitope residues in the RBD. These antibodies can be utilized as a positive control in serological assays to detect antibodies in human serum that bind SARS-CoV-2 S-protein.

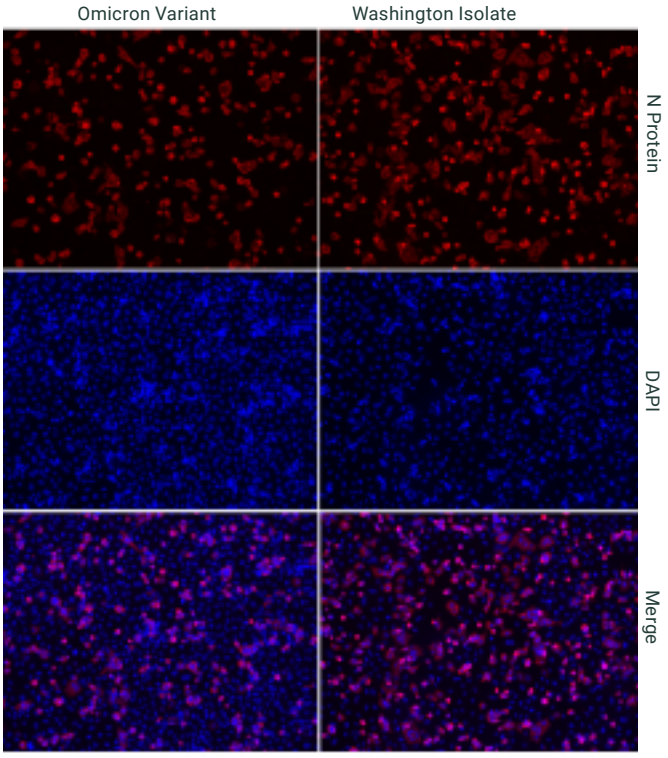
SARS-CoV-2 Nucleocapsid Antibodies

The nucleocapsid (N) protein is an important antigen for coronavirus, which participate in RNA package and virus particle release. After infection, the N protein enters the host cell together with the viral RNA to facilitate its replication and process the virus particle assembly and release. SARS-CoV-2 N protein contains two distinct RNA-binding domains (NTD and CTD) linked by a poorly structured linkage region containing a serine/arginine-rich (SR-rich) domain.

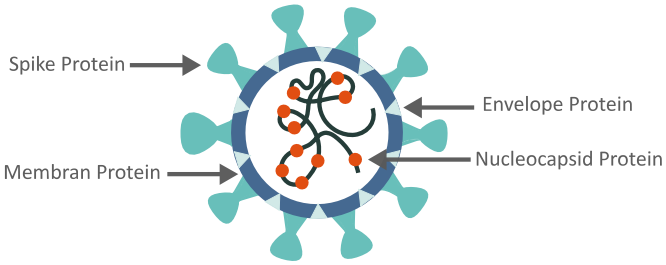
The diagnostic industry focuses on monoclonal antibodies for use as critical reagents in immunoassays. Their unique attributes allow for lot-to-lot consistency, rapid upscaling, and affordability. Rabbit monoclonals offer an improved immune response to small epitopes and a better response compared to mouse antibodies. They give a better reaction to antigens than those from rodents such as mice. Many COVID-19 rapid antigen tests are available in the marketplace as lateral flow immunoassay formats, requiring monoclonal antibodies as capture reagents, detection reagents, or both.

This can be problematic as SARS-CoV-2 lineages with new mutations rise. Polyclonal antibodies can be a powerful alternative to monoclonal antibodies for diagnostic purposes. Isolated from hyper-immunized host sera, polyclonal antibody reagents are essential antibody pools from many different B-cells and may recognize many different epitopes on the target protein or antigen. The 'poly' clonality of pAbs allows the binding of multiple antigenic determinants of the target. This allows pAbs to be more sensitive in certain assays against a variety of target proteins, cells, or organism. Furthermore, pAbs enable high-avidity binding, with the low likelihood of antigen 'escape variants' emerging.

The multiple epitopes on antigens available to polyclonal anti-Nucleocapsid antibody (ABIN6952544) enable the antibody to reliable detect both the canonical SARS-CoV-2 and the B.1.1.529 / omicron variant. The image below shows the detection of the omicron variant by immunofluorescence microscopy within infected A549 cells using ABIN6952544. The experiment was conducted by the National Emerging Infectious Diseases Laboratories (NEIDL) from Boston University.



IF assay using Rabbit Anti-SARS-CoV Nucleocapsid (N) (ABIN6952544) Antibody, showing viral protein detection. A549 cells over-expressing ACE2 were either infected with the SARS-CoV-2 Washington isolate or Omicron Variant at an MOI of 0.5 for 24 hours. The cells were then fixed in 10% Formalin and stained overnight at 4°C with primary antibodies directed against SARS-CoV Nucleocapsid (N)



SARS-CoV-2 Envelope Protein Antibodies

The envelope (E) protein is the smallest of the major structural proteins of SARS-CoV-2 and participates in viral assembly and budding. During the replication cycle, the E protein is abundantly expressed inside the infected cell, but only a small portion is incorporated into the virion envelope. The majority of the protein is localised at the site of intracellular trafficking. We currently offer two E-protein antibodies SARS-CoV-2 E-protein antibody ABIN1031551 and SARS-CoV-2 E-protein antibody ABIN6952904.

SARS-CoV-2 Membrane Protein Antibodies

The coronavirus membrane (M) protein is the key player in virion assembly. One of its functions is to mediate the incorporation of the spikes into the viral envelope. When expressed alone, it accumulates in the Golgi complex in homomultimeric complexes. However, in combination with the E protein, virus-like particles (VLPs) similar to authentic virions in size and shape are assembled, demonstrating that the M and E proteins are the minimal requirements for envelope formation.

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- Weihong Zeng *et al.*: „Biochemical characterization of SARS-CoV-2 nucleocapsid protein“, Biochem Biophys Res Commun. (2020)

SARS-CoV-2 Spike Antibodies (S1, S2, RBD)

Product	Clonality	Application	Cat. No.	Validations
anti-SARS-CoV-2 Spike S2 antibody (C-Term)	Polyclonal	ELISA, IF, IHC, WB	ABIN1030641	(7) (11)
anti-SARS-CoV-2 Spike S1 antibody (Biotin)	Monoclonal	ELISA	ABIN6953155	(1)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	GICA, ELISA, Neut	ABIN6953152	(4)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	ELISA, Neut	ABIN6952616	(3) (10)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Monoclonal	Crys, ELISA, Neut, SPR	ABIN6952546	(8) (5)
anti-SARS-CoV-2 Spike S1 antibody (RBD)	Chimeric	Crys, ELISA, Neut, SPR	ABIN6952547	(7) (3)
anti-SARS-CoV-2 Spike antibody	Monoclonal	ELISA	ABIN6964042	(1)
anti-SARS-CoV-2 Spike antibody (AA 319-541)	Monoclonal	ELISA, FACS	ABIN6964062	(2)

Monoclonal SARS-CoV-2 N-Protein Antibodies

Product	Clonality	Clone	Protein Type	Application	Cat. No.	Validations
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal	DM38	Rabbit	ELISA	ABIN6961070	(1)
SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal	85C1	Rabbit	ELISA, WB	ABIN6989977	(3)
SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal		Mouse	ELISA, WB, LF	ABIN6953169	
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Chimeric			ELISA, IF	ABIN6953059	(1) (1)
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Monoclonal			ELISA, IF, WB	ABIN6952432	(2) (2)

SARS-CoV-2 N-Protein Antibodies

Product	Clonality	Application	Cat. No.	Validations
anti-SARS-CoV-2 Nucleocapsid antibody (SARS-CoV-2 N)	Polyclonal	ELISA	ABIN6952440	(1)
anti-SARS-Coronavirus Nucleocapsid Protein (SARS-CoV N) antibody	Polyclonal	ELISA, FACS, IF, IHC, WB	ABIN6952544	(21) (10)

SARS-CoV-2 Envelope Protein Antibodies

Product	Clonality	Application	Cat. No.	Validations
anti-SARS-CoV-2 Envelope antibody (SARS-CoV-2 E)	Polyclonal	ELISA, WB	ABIN6952904	
anti-SARS-CoV-2 Envelope antibody (SARS-CoV-2 E) (N-Term)	Polyclonal	ELISA, IF, IHC	ABIN1031551	(8) (8)

SARS-CoV-2 Membrane Protein Antibodies

Product	Clonality	Application	Cat. No.	Validations
anti-SARS-CoV-2 Membrane Protein antibody (SARS-CoV-2 M)	Polyclonal	ELISA, WB	ABIN6952906	(1)
anti-SARS-Coronavirus Membrane Protein (SARS-CoV M) (N-Term) antibody	Polyclonal	ELISA	ABIN1031552	(1) (1)

SARS-CoV-2 ORF Antibodies

Product	Clonality	Application	Cat. No.	Validations
anti-SARS-CoV-2 ORF10 antibody	Polyclonal	ELISA, WB	ABIN6952939	
anti-SARS-CoV-2 ORF3a antibody	Polyclonal	ELISA, WB	ABIN6952940	
anti-SARS-CoV-2 ORF6 antibody	Polyclonal	ELISA, WB	ABIN6952945	
anti-SARS-CoV-2 ORF7a antibody	Polyclonal	ELISA, WB	ABIN6952946	
anti-SARS-CoV-2 ORF8 antibody	Polyclonal	ELISA, WB	ABIN6952948	

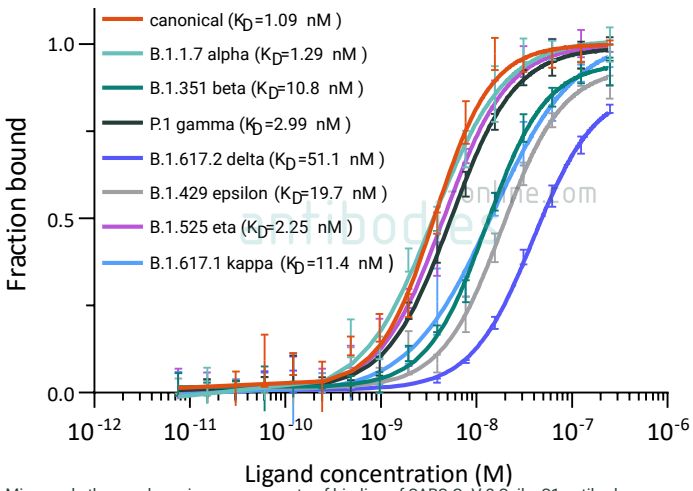
Neutralizing Antibodies in Assay Development

Neutralizing antibodies are of particular interest to scientists. They efficiently stop the infection by blocking the interaction between the SARS-CoV-2 virus and the host cells. Most neutralizing antibodies respond to the receptor binding domain (RBD) of the spike protein, which binds directly to the cell surface receptor ACE2. antibodies-online.com offers nAbs based on clone CR3022, MM43 as well as MM117.

Neutralizing Antibody CR3022

The antibody clone CR3022 (ABIN6952546) was originally isolated from a convalescent SARS patient from Singapore. The clone was demonstrated to be effective in neutralization assays for different SARS-CoV strains in synergy with other RBD-targeting antibodies. Its epitope does not overlap with the angiotensin-converting enzyme 2 (ACE2) binding site, thus leaving it accessible for other neutralizing antibodies. Since the outbreak of COVID-19, CR3022 has been demonstrated to bind the SARS-CoV-2 S protein RBD in a similar fashion. Crystallization assays of CR3022 bound to its SARS-CoV-2 target have provided important insights into possible attack points for therapeutics against this virus. Moreover, CR3022 has been used as a positive control in serological assays to detect antibodies in human serum that bind SARS-CoV-2 S-protein.

One of the looming questions regarding newly emerging variants of SARS-CoV-2 is, whether existing antibody based assays and pharmaceuticals remain useable. In collaboration with Nanotemper we measured the affinity of our S protein RBD antibody CR3022 to the canonical trimeric SARS-CoV-2 S protein and those of the variants of concern B.1.1.7 / alpha, B.1.351 / beta, B.1.617.2 / delta, B.1.617.1 / kappa and P.1 / gamma by microscale thermophoresis (MST). This version of the handbook acknowledges the dominant B.1.1.529 / omicron variant and extended the antibody selection with neutralizing antibodies MM43 (ABIN7036075) and MM117 (ABIN7042145).



Microscale thermophoresis measurements of binding of SARS-CoV-2 Spike S1 antibody (RBD) CR3022 (ABIN6952546) to SARS-CoV-2 Spike (Trimer) from Wuhan Strain SARS-CoV-2 and variants B.1.1.7 alpha, B.1.351 beta, P.1 gamma, B.1.6172 delta, B.1.429 epsilon, B.1.617.1 kappa and B.1.1.529 omicron.

MST Analysis of SARS-CoV-2 nAbs

The graphs shown in this section depict the change in fluorescence during MST – plotted on the y-axis – as a function of the S protein concentration. An antibody with a K_D in the low nM range is generally considered a high affinity antibody and the K_D for binding of the wt S protein to its host protein target, the ACE2 receptor, has been determined to be around 35 nM. A higher dissociation constant is indicative of a weaker binding, i.e. CR3022 binding of the B.1.617.2 / delta or B.1.1.529 / omicron S protein is significantly weaker than of other variants. However, a KD in the nanomolar range does indicate a high affinity of the antibody to all tested S proteins. Accordingly, the neutralizing antibody CR3022 remains an important tool for SARS-CoV-2 immunoassays. MST analysis of clone MM117 reveals even better binding capacities for the B.1.1.529 / omicron variant. Detailed MST curves for clone MM43 and MM117 are on the following page.

	Wuhan Strain	Delta B.1.617.2	Omicron B.1.1.529
CR3022 ABIN6952546	++	+	+
MM43 ABIN7036075	++	++	-
MM117 ABIN7042145	+	+	++

Binding preferences of the neutralizing antibodies CR3022, MM43,and MM117 for S proteins from the SARS-CoV-2 Wuhan strain and B.1.617.2/ delta and B.1.1.529/ omicron.

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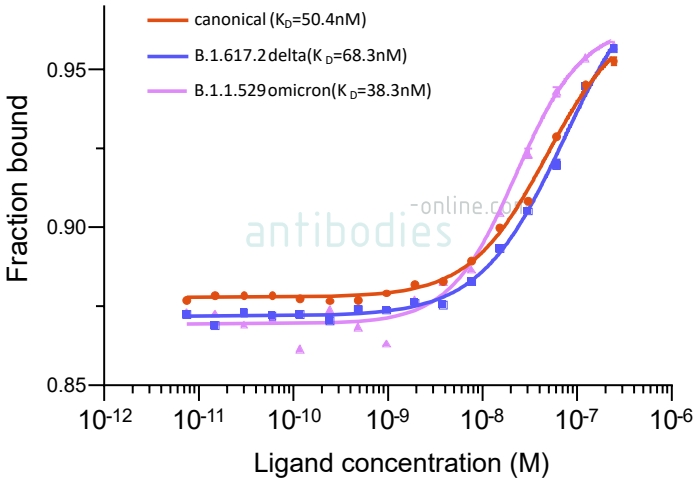
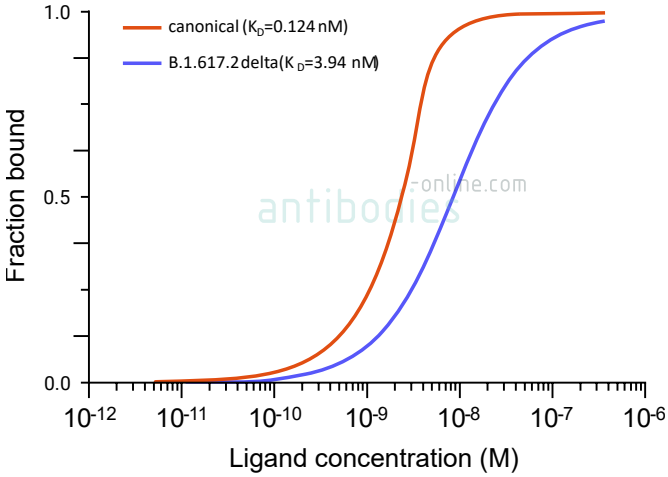
MST Analysis Clone M117

MM117 (ABIN7042145) is a monoclonal antibody raised in mice that binds the SARS-CoV-2 B.1.1.529 omicron S protein more tightly than that of other variants.



Microscale thermophoresis measurements of binding of SARS-CoV-2 Spike S1 antibody (RBD) MM117 (ABIN7042145) to SARS-CoV-2 Spike (Trimer) proteins of various lineages, including B.1.617.2 (delta) and B.1.1.529 (omicron). The determined dissociation constants KD are indicated.



Microscale thermophoresis measurements of binding of SARS-CoV-2 Spike S1 antibody (RBD) MM43 (ABIN7036075) to SARS-CoV-2 Spike (Trimer) of various lineages. Binds SARS-CoV-2 S proteins of various lineages, including B.1.617.2 (delta). Does NOT bind the S protein of SARS-CoV-2 B.1.1.529 (omicron).The determined dissociation constants KD are indicated.

MST Analysis Clone M43

The murine monoclonal antibody MM43 (ABIN7036075) on the other hand binds the canonical S protein more tightly than CR3022 and MM117. Binding to the SARS-CoV-2 B.1.617.2 delta S protein is also very good. However, binding of this antibody to the omicron variant's S protein is completely abolished due to the protein's mutations.

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Recommended

SARS-CoV-2 Spike S1 antibody (RBD)

- Recombinant SARS-CoV-2 Antibody. Clone CR3022
- Synergizes with other hNAbs: binds a highly conserved epitope, not interefering with the S-protein's ACE2 RBD.
- Reference in S-protein ELISAs and neutralization assays.
- In Stock, Fast Delivery.

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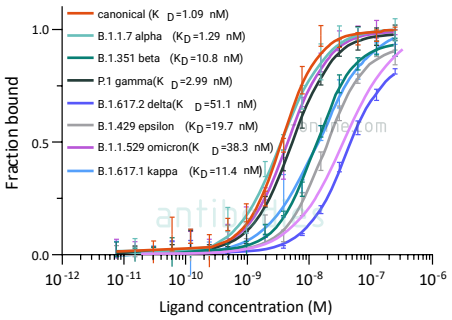

SARS-CoV-2 Spike S1 antibody (RBD)

- Chimeric Rabbit CR3022 Antibody.
- Epitope does not overlap with ACE2-Binding Site.
- Reference in S-protein ELISAs and neutralization assays.
- In Stock, Fast Delivery.

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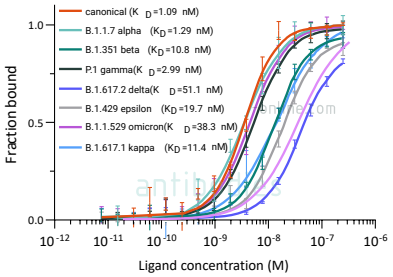

SARS-CoV-2 Spike S1 antibody (RBD)

- Clone MM43
- Synergizes with other hNAbs: binds a highly conserved epitope, not interefering with the S-protein's ACE2 RBD.
- Reference in S-protein ELISAs and neutralization assays.

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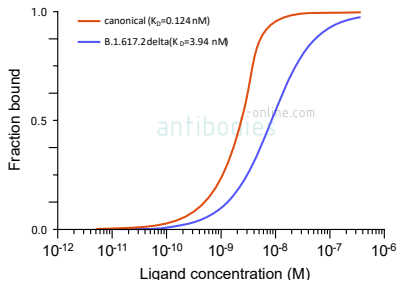

SARS-CoV-2 Spike S1 antibody (RBD)

- Clone MM117
- Epitope does not overlap with ACE2-Binding Site.
- Reference in S-protein ELISAs and neutralization assays.
- In Stock, Fast Delivery.

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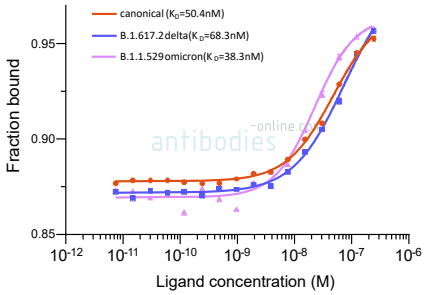

SARS-CoV-2 / COVID-19 ELISA Kits

We offer you a handpicked selection of proven quantitative SARS-CoV-2 ELISA Kits for the detection of COVID-19 immunoglobulins such as IgG and IgM in human serum or plasma. Quantitative measurement of immunoglobulins helps to understand kinectics of antibody response and the longevity of N, RBD and S1 antibodies. Furthermore it enables to draw conclusions about antibody level required for protection from reinfection and its duration. All kit advantages at one glance:

- Low Sample Volume (5µl)
- Short Incubation Time (100 min)
- Tested with NIBSC Panel Sera 20/B770

Our SARS-CoV-2 sandwich ELISA immunoglobulin kits have been extensively tested against anti-SARS-CoV-2 verification panel for serology assays 20/B770 from the National Institute for Biological Standards and Control (NIBSC). The panel contains 23 Anti-SARS-CoV-2 positive samples of varying reactivity and antibody composition & 14 Anti-SARS-CoV-2 negative samples provided by the WHO (see table). For more information please contact our customer service.

Sample	N-Protein IgG Antibody ELISA Kit (ABIN6999599)		
	OD_{450}	C [ng/mL]	Result
...	...	...	...
21	1.11	85.1	Positive
22	1.21	98.5	Positive
23	0.75	43.3	Positive
24	0.21	7.30	Negative
25	0.09	3.22	Negative
...	...	...	...

Extract from NIBSC 20/B770 Panel test for SARS-CoV-2 N-Protein IgG Antibody ELISA Kit (ABIN6999599)

Additionally we offer indirect anti SARS-CoV-2 IgG and IgM N Protein ELISA Kits extensively tested on patient sera by the Viral Diseases and Infections in Immunodeficiencies Research Group in the Institute of Biomedicine of Seville (IbiS).

Patient	ABIN6952773		ABIN6952772	
	OD_{450}	C [ng/mL]	OD_{450}	C [ng/mL]
Omicron 1	0.16	0.35	1.99	79.1
Omicron 2	0.33	0.89	2.93	188.8
Omicron 3	0.12	0.23	0.69	21.9
Delta 1	0.13	0.27	3.23	293.7
Delta 2	0.29	0.76	3.13	249.0
Delta 3	0.35	0.96	3.17	265.4

OD450 raw values and calculated SARS-CoV-2 N-Protein IgM Antibody concentrations of serum samples from SARS-CoV-2 delta or omicron positive patients.

Click here to see our full portfolio of SARS-CoV-2 / COVID-19 ELISA Kits

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SARS-CoV-2 Nucleocapsid Protein ELISA Kits

Product	Sample Type	Analytical Method	Cat. No.	Validations
SARS-CoV-2 N-Protein IgA Antibody ELISA Kit	Plasma, Serum	Quantitative Sandwich ELISA	ABIN6999593	(1)
SARS-CoV-2 N-Protein IgE Antibody ELISA Kit	Plasma, Serum	Quantitative Sandwich ELISA	ABIN6999596	(1)
SARS-CoV-2 N-Protein IgG Antibody ELISA Kit	Plasma, Serum	Quantitative Sandwich ELISA	ABIN6999599	(1)
SARS-CoV-2 N-Protein IgM Antibody ELISA Kit	Plasma, Serum	Quantitative Sandwich ELISA	ABIN6999602	(1)
SARS-CoV-2 N-Protein IgG Antibody ELISA Kit	Plasma, Serum	Indirect ELISA	ABIN6952772	(1)
SARS-CoV-2 N-Protein IgM Antibody ELISA Kit	Plasma, Serum	Indirect ELISA	ABIN6952773	(1)

SARS-CoV-2 Spike Protein ELISA Kits

Patient	Sample Type	Analytical Method	Cat. No.	Validations
SARS-CoV-2 S1 Subunit IgE Antibody ELISA Kit	Plasma, Serum	Quantitative Sandwich ELISA	ABIN6999597	(1)
SARS-CoV-2 S1 Subunit RBD IgM Antibody ELISA Kit	Plasma, Serum	Quantitative Sandwich ELISA	ABIN6698604	(1)

Anti-Human IgG & IgM Antibodies for in Vitro Diagnostics

The SARS-CoV-2 ongoing development of serological tests is massive. Various techniques are available, enzyme-linked immunosorbent assay (ELISA), chemiluminescence enzyme immunoassays, fluorescence immunoassays, lateral flow immunoassays to detect immunoglobulin G (IgG), immunoglobulin A (IgA), immunoglobulin M (IgM) (separately or in combination) as well as different antibody targets. Validation of anti-Human Ig Antibodies used in the assays is crucial before use in clinical routine practice.

IgM is the first immunoglobulin to be produced in response to an antigen and is primarily detected during the early onset of disease. Broad patient studies showed positive rates of SARS-CoV-2 IgM peaking within 15–21 days following by a slow decline. The positive rates of IgG were increased with the disease course and reached the peak between 22 and 39 days. IgG tests perform better compared with IgA or IgM ones and show better sensitivity when the samples were taken minimum 2 weeks after the RT-qPCR positive detection.

Separately, IgG detection assays perform better compared to IgA and IgM assays and show better sensitivity when the samples were taken minimum 2 weeks after the RT-qPCR positive detection. A combined IgG/IgA/IgM test seems to be a better choice in terms of sensitivity than measuring either antibody alone, additionally the period of reliable detection is extended. Another approach to increase sensitivity of the test is a combination of different antigens improves diagnostic performances.

antibodies-online offers anti-human IgG and IgM antibodies for the reliable detection in in vitro diagnostic. We can ensure supply chain stability for the selection of antibodies below.

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References

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- Zhao *et al.*: „Antibody responses to SARS-CoV-2 in patients of novel coronavirus disease" (2020).

Recommended Anti-Human IgG & IgM Antibodies

Product	Conjugate	Application	Cat. No.	Validations
Goat anti-Human IgA, IgG, IgM (Heavy & Light Chain) Antibody (Alkaline Phosphatase (AP)) - Preadsorbed	AP	ELISA, IHC, WB	ABIN100789	(1)
Goat anti-Human IgG (Heavy Chain) Antibody (Alkaline Phosphatase (AP)) - Preadsorbed	AP	ELISA, IHC, WB	ABIN101591	(1)
Goat anti-Human IgG (Fc Region) Antibody (Biotin) - Preadsorbed	Biotin	ELISA, IHC, WB	ABIN101660	(1)
Goat anti-Human IgG Antibody (DyLight 549) - Preadsorbed	DyLight 549	FLISA, FM, WB	ABIN6698923	(1)
Goat anti-Human IgG (Heavy & Light Chain) Antibody (HRP)	HRP	IA	ABIN101662	
Goat anti-Human IgG (Heavy & Light Chain) Antibody (HRP)	HRP	DB, IEM, IHC, ELISA, WB	ABIN1043965	(1) (1)
Goat anti-Human IgM (Chain mu) Antibody (HRP)	HRP	ELISA, WB	ABIN102628	(3)
Goat anti-Human IgG (F(ab')2 Region) Antibody - Preadsorbed		ELISA, IHC, WB	ABIN101607	
Goat anti-Human IgG (Heavy & Light Chain) Antibody - Preadsorbed		ELISA, IHC, WB	ABIN965345	(1)
Rabbit anti-Human IgG (Fc Region) Antibody - Preadsorbed		ELISA, IHC, WB	ABIN101666	(1)

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