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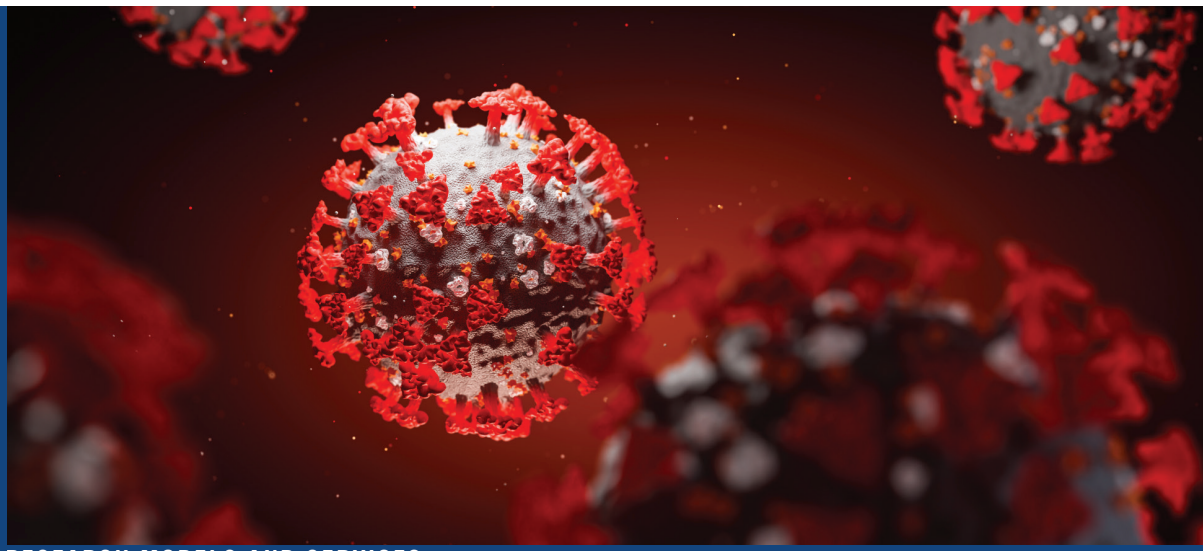
Summary

To support the laboratory animal research community in detecting all SARS-related viruses, a real-time PCR assay ,and a MFIA COVID-Plex assay, are now available through Charles River's Research Animal Diagnostic Services.



RESEARCH MODELS AND SERVICES

Sarbecoviruses

(SARS-CoV1, SARS-CoV2 aka COVID-19)

Classification

RNA virus, Enveloped

Family

Coronaviridae

Affected Species

Natural infection of research animals has not been reported. Zoonotic transfer from exotic Asian animals is the accepted mode of transmission to humans.

Frequency

There has been no report of natural infection of laboratory animals, but precautionary testing may be important for some models. Transmission from inoculated cats and ferrets to naïve cohorts has been reported[1].

The risk of NHP's and other lab animals, including mice and rats, in US colonies becoming infected with sarbecoviruses is low to none. Studies show rhesus might be naturally susceptible to the virus that causes COVID-19, but the prevalence of sarbecovirus, including COVID-19 in macaques and other NHP's, is currently unknown. Mice and rats do not share virus receptor similarity with humans and are highly unlikely to be come naturally infected. As bats are a natural reservoir for sarbecoviruses, screening of bats used in research could be important.

Transmission

Severe acute respiratory syndrome-related coronavirus (SARS-CoV) is a strain of coronavirus that naturally infects humans, bats, and several Asian mammals. It is an enveloped positive-sense, single-stranded RNA virus that enters its host cell by binding to the ACE2 receptor. It is a member of the genus Betacoronavirus and subgenus Sarbecoronavirus[2].

Two strains of the virus have caused outbreaks of SARS in humans. SARS-CoV1 caused an outbreak in 2002-2004, whereas SARS-CoV2 caused a coronavirus pandemic in 2019-2020, also referred to as coronavirus disease 2019 (COVID-19). There are hundreds of SARS-CoV strains known to infect different non-human species[3-4]. Coronaviruses are considered zoonotic and the subgenus of Sarbecoviruses specifically are gaining a notorious history of jumping from animals to humans. Exact evolutionary transmission has not been determined, but bats, pangolins, and civets are believed to play a role in transmission to humans[5-6]. SARS-CoV is thought to be most readily transmitted by respiratory

droplets (droplet spread) produced when an infected person coughs or sneezes. This infection can be spread easily from close person-to-person contact (such as living in the same household) via respiratory droplets that come in contact with mucous membranes (eyes, mouth, or nose).

Rodents and other small research animals are not likely to be infected through natural transmission, although infection through high titer inoculation of research animals, including mice, cats, ferrets, and NHP's, has been demonstrated[1, 7-9]. SARS viruses can be propagated in a variety of common mammalian cell lines[10]. Lastly, because our awareness of sarbecoviruses is a recent phenomenon, it is unclear if other sarbecoviruses may be present in other animal species. So far, a dog and a cat were found to be infected in homes of owners who tested positive for COVID-19[11-12].

Clinical Signs and Lesions

In humans, the most common symptoms of infected people are flu-like illness in the beginning, followed by a syndrome of "atypical" pneumonia, including dry cough, and progressively worsening shortness of breath with poor oxygenation[13]. Although laboratory animals have not been reported to be naturally infected, illness in some inoculated animals has been described[14].

Diagnosis

Possible clinical signs in naturally infected research species have not been described. Symptoms for SARS-CoV infection in humans include fever, cough, and shortness of breath. Most people may get mild illness and recover. In addition, gastrointestinal symptoms, including diarrhea, nausea, vomiting, and abdominal discomfort, have been reported[13]. Sarbecoviruses are respiratory viruses and can be detected by PCR on oral or nasal swabs, bronchial wash, lung tissue, or respiratory tract tissue. In humans, these viruses have been detected in fecal pellets and swabs, so these sample types may be useful in NHP's for screening. Serum or plasma from immunocompetent animals can be used for SARS-CoV1 and SARS-CoV2 antibody detection[15-16] using ELISA or multiplex MFIA® assays.

Interference with Research

In research animals, SARS viruses can infect and produce pneumonia in inoculated rhesus macaques[17]. Incidence of natural transmission of SARS-CoV viruses from humans to other research animals, including NHP's, is not yet known. SARS-CoV1 was shown to infect rhesus macaques, cynomolgus macaques, and African green monkeys (AGMs)[18-19]. Clinical signs, viral replication, and pathology depended upon the species[19].

Prevention and Treatment

The best way to prevent illness is to avoid being exposed to these viruses, which are mainly spread by person-to-person contact through respiratory droplets produced when an infected person coughs or sneezes[16]. Caretakers who are sick or have symptoms should avoid coming in contact with the research animals, especially NHP's, to protect them as not enough is known about transmission from humans to NHP's.

Non-propagative diagnostic laboratory work including sequencing and a nucleic acid amplification test (NAAT) on clinical specimens from patients or animals who are suspected or confirmed to be infected with SARS-CoV including COVID-19 should be handled under BSL-2 conditions[16]. Handling of material with high concentrations of live virus (such as when performing virus propagation, virus isolation, or neutralization assays) or large volumes of infectious materials should only be performed under BSL-3 conditions by trained personnel[16].

SARS-CoV viruses, including COVID-19, are susceptible to disinfectants with proven activity against enveloped viruses, including sodium hypochlorite (bleach) (e.g., 1,000 ppm [0.1%] for general surface disinfection and 10,000 ppm [1%] for disinfection of blood spills), 62-71% ethanol, 0.5% hydrogen peroxide, quaternary ammonium compounds, and phenolic compounds, if used according to manufacturer's recommendations. A contact time of 10 minutes is recommended[20].

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charles river

askcharlesriver@crl.com • www.criver.com